IT's about more than speed. The impact of IT on the management of mass casualty incidents in Germany

Nils Ellebrecht*
nils.ellebrecht@soziologie.uni-freiburg.de

Konrad Feldmeier*
konradbox@gmx.de

Stefan Kaufmann*
stefan.kaufmann@soziologie.uni-freiburg.de

* Department of Sociology, University of Freiburg, Germany

ABSTRACT

In the new millennium new technologies (should) play an ever more prominent role in the management of mass casualty incidents (MCI). Drawing on empirical data from a four-year research project (SOGRO), the article reflects on the impact of information technologies (IT) on the organisation of emergency response and on rescue services against the backdrop of broader organisational shifts and contemporary demands. Because IT strengthens a particular way of MCI management, it is firstly described as expressing and reifying specific considerations of emergency response experts. Secondly, the benefits of an IT-based emergency response are critically reviewed. IT collects and makes available data about the rescue operation. Thus, it makes a formerly blurred rescue operation transparent. Although its operational benefit remains vague for on-scene executives, the visualisation reduces uncertainties among them. Thirdly, the article points out the inherent logics of IT. Its implementation not only satisfies newly evolved information needs, but also increases the control density.

Keywords

Triage, mass casualty incident, large-scale exercise, information technology, organisational change.

MCI MANAGEMENT: FROM PAPERWORK TO DIGITAL SYSTEMS

Triage (French: to sort, to select) can be understood as an administrative technique, which is applied in cases of *mass casualty incidents* (MCI). For example, after major accidents with a high number of casualties medical needs always overburden on-scene medical resources. For this reason, all casualties are initially categorized by the severity of their injuries and chance of survival. Thus, triage provides a rough guideline by separating the most seriously injured in need of immediate medical attention from wounded persons who, at the moment being ranked low on the medical priority list (be it that these casualties can survive the next hours without medical treatment, be it that they are so badly injured that medical aid is not justifiable at this stage). The triage process aims at rescuing as many lives as possible.[1]

The *triage tag* is the central artefact used in a MCI (Figure 1-5). It is a basic medical record that at the same time functions as a highly visible mark. Traditionally, the triage tag is a paper card with usually three, four or five coloured sections (Figure 2 and 3), each symbolising one possible triage status (red: immediate care; yellow: delayed care; green: waiting; blue: expectant; black: deceased). Depending on the kind of the tag, the respective triage status is indicated by folding (Figure 3) or by tearing off all other coloured parts (Figure 1 and 2).

[1] In military conflicts, the triage's medical purpose (to rescue as many lives as possible) can be overridden by military needs, that is: to make as many soldiers as possible fit for returning to the battle as fast as possible.

Figure 1. Military triage tag with three tear-off corners; Germany 1938.

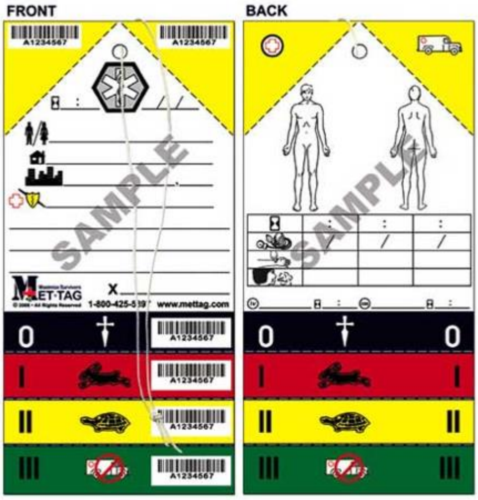

Figure 2. Since the 1970s the popular METTAG uses a three-tiered system. In the last decade a barcode was added to the tag.

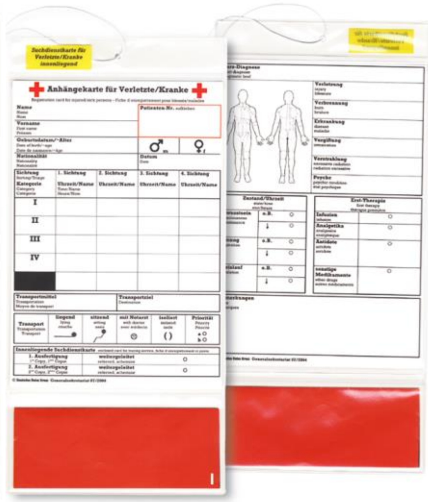

Figure 3. German Red Cross triage tag (2012) with a foldable multicoloured piece of paper.

Figure 4. Electronic triage tag with colour LED technology. Photo see Gao et al 2007: 207.

Figure 5. SOGRO 2012: digital triage system with PDA and colour-coded RFID tags. The PDA transmits the triage status to a data centre from where it can be accessed.

During the last decade different electronic interfaces have been developed for the management of MCIs: bar code readers (Figure 2) as well as electronic triage tags (Figure 4) and even technological systems that additionally interlink all involved actors and organisational levels (Figure 5 and 8). Recent developments of technological systems for MCI-management have focussed on the paper-based, 'analogue' triage tag and replaced it with digital counterparts which make possible a faster transmission of medical information, in particular of the patient's triage status.[2] Using PDAs (personal digital assistants) and coloured bracelets with RFID-Chips (Figure 5), SOGRO (Immediate rescue in a large-scale accident with mass casualties) is one research project among others which investigates this technological invention. SOGRO brings together hardware and software engineers, social scientists and end-users (emergency physicians, paramedics, fire-fighters) to develop an integrated system for MCI events, with the goal of interconnecting the different organisational levels and cross-linking involved organisations. The system's centrepiece is a database, which collects data from two different sources. The major part of the data is received from PDAs which paramedics

[2] In addition to SOGRO the CodeBlue research project at Harvard University (http://fiji.eecs.harvard.edu/CodeBlue), the medTRAX™ system (http://www.higgins3.com/product/detail.php?product_id=269), and the e-Triage research project (Adler, Krüssmann, Greiner-Mai, Donner, Mulero Chaves, Via Estrem, 2012) should be mentioned. Cf. as well: Nestler, Huber, Klinker, 2009; Nestler, Artinger, Coskun, Endres, Klinker, 2011: Fujisaki, S., Inoue, S., Oka, K., Sonoda, A., 2006.

use on-scene to conduct triage, to take a photo of the triaged person, to record medical data, and to choose transport destinations. Triage data is compiled in the database and thus available for on-scene executives and control centres that operate far away from the scene of the incident. The database also contains data about actual hospital capacities. On the basis of this information, on-scene transport coordinators can manage the allocation of casualties to hospitals. All in all the information system links on-scene and off-scene operations closer together.

The promise of IT: accelerating emergency response

Naturally, nearly every technology for emergency response purposes is measured against its benefit in the rescue efforts. In the end a good technological performance promises to save lives. Accordingly, the SOGRO system was exclusively designed as a tool for a more efficient MCI management. Above all, the information system (IS) was pitched as a technological acceleration of the emergency response. The project's first self-portrayal already expressed this:

"Researchers expect to optimise initial medical care of accident victims primarily through the use of IT to register casualties and record their medical care electronically and through the use of transportation systems with traceability right through to hospital admission.

The automated medical information chain from accident site right through to the admitting hospital with minimal need for interaction by rescue forces will ensure faster, more timely medical care and logistics." (SOGRO, 2010: 35)

The developed technology was deployed and experimentally implemented in large-scale exercises. The subsequent reviews depicted the system as a tool to speed up incident management, which thus made it a potential lifesaver. A press release stated: *"The development of the deployed PDA has been an important reason for the fast and qualified distribution of patients."*[3] In fact, the conducted exercises showed a fast rescue – and the increase in speed was to a large extent attributed to the use of the information system.

FRAMEWORK AND FIELDWORK

Although IT may have some impact on the speed of the rescue operation, it's important to remain critical of overly hasty proclamations of a successful invention. This applies especially to a new technology and its first implementation. Focusing too narrowly on the dominant expectations can obstruct one's view on further effects. As social scientists we set out to critically observe and evaluate the system's development, performance and implementation. While the project followed the technical objective of implementing the system, we looked at the stabilisation of the whole socio-technical network of emergency response from a theoretical perspective. (Latour, 1991) The network is composed of different organisations (fire and rescue services, hospitals, control centres, public authorities, etc.), technical artefacts (from emergency call systems to fire engines and medical equipment), and formal concepts (MCI concepts, incident command systems, contingency plans, etc.). The socio-technical network is tried to make stable – at least for the period of the operation. Because the entire structure is only established for the time of the rescue operation, organisational scientists speak of it as a *temporary system*. (Roberts and Bigley, 2001) Outside its ad hoc establishment, it subsists in scattered parts. Their systematic setup is described through formal concepts but also determined by technical artefacts and joint expectations. On the one hand, our research examined these more or less cemented patterns. On the other hand, we explored the impact of SOGRO IS on these structures. With the implementation of the SOGRO IS, a new agent realigns social relationships, tasks and functions, organisational structures and working routines. Our research highlights the process of technological adoption and the (re-)stabilisation of (new) structures. Particularly, we focussed on how the PDA affects paramedics' working routines and how one-scene executives utilise the new possibilities the IS supports. Special attention was drawn to emerging conflicts and unexpected effects.

We empirically investigated four large-scale exercises at which the SOGRO IS was implemented and tested. The MCI exercises re-enacted the scenarios of a) a bus accident, and b) the collapse of a gymnasium's roof, each with about 50 casualties, c) the collapse of a stand in a sports centre with 270 casualties, and d) a collision of two airplanes on a runway with 570 casualties. Three exercises were recorded with up to three fixed and up to five portable video cameras ('head cams'). In one drill, executive staff was equipped with small taped-on

[3] "Ein wichtiger Grund für diese schnelle und qualifizierte Zuweisung der Patienten lag in der Weiterentwicklung der eingesetzten PDAs [...]" (SOGRO, 2012).

microphones and mobile audio recorders. The data was extensively synchronised and analysed with help of the ELAN software[4]. After the exercises interviews with almost all executives were conducted. For reasons of comparison we additionally attended some traditional MCI drills, operating with paper-based triage tags.

In 'following the actors', we at the same time decided not to prove specific theoretical concepts. Instead, we chose a problem-driven approach. Emerging problems as well as unexpected phenomena were analysed within different theoretical frames. Hence, our research moved back and forth between empirical observations, data analyses, and theoretical grounding.

THE IMPACT OF IT ON EMERGENCY RESPONSE

Efficiency enhancement (increasing speed and improving coordination) is the main expectation and legitimating reason for the development of the SOGRO IS. On closer examination such a view proves to be little cogent. Although is still proclaim by protagonists, the insight is not new that development trajectories do not follow such simple paths of rationalisation. Nevertheless, the project is predominantly considered a success. Thus, the prevailing question is: which are the sources that promote the project's stability?

Technology as cultural reification

It is well known that the implementation of new technologies often promotes organisational change and necessitates the reconfiguration of roles and functions (cf. Windeler, Becker, Schulz, Ortmann, 1990). In the case of SOGRO, however, the developed IS encountered a MCI concept, that had been rearranged shortly before. Two organisational shifts could be identified which were adopted without the support of an IS. However, the developed system stabilises these organisational rearrangements. Firstly, the system fosters the switch from *physician triage* to *paramedic triage*, and secondly, it bolsters the strategy which underlies the MCI concept (switching from '*stay and play*' to '*scoop and run*'). Both organisational shifts are controversial. However, implementing SOGRO IS makes a return to previous organisational concepts unlikely. The system facilitates reification of recently emerged structures. Insofar, the technology can be understood as supporting a particular conviction in the field of MCI management. In this sense, technology is a reified expression of a specific opinion, which can be related to a specific safety culture.

First supported shift: from physician to paramedic triage

In Germany, triage ('Sichtung') is formally conducted by emergency physicians (Notarzt[5]). The emergency physician makes a quick and short diagnosis and then determines the casualty's triage status. S/he dictates the findings to a paramedic (Rettungsassistent[6]), who stands next to the physician and fills in the triage tag (Figure 6). This preclinical work-sharing structure can be compared to the clinical division of labour between nursing staff and doctors. Although the described procedure was the formal triage concept for a long time, it can be assumed that it was rarely practised that way.

Critical voices point to the fact that paramedics usually arrive at the scene of an accident first and should therefore immediately start triage. The usual workaround is to delegate triage (now defined as 'pre-triage') to the first responding paramedics via radio.

Several emergency medical service (EMS) systems outside Germany operate without emergency physicians. In these countries, pre-clinical emergency physicians play a less important role in triage concepts: *Physician triage* is replaced by simple *triage algorithms*, guiding the paramedic through a scheme of questions and well-defined instructions following the distinct answer. The following example of the most frequently applied triage algorithm *simple triage and rapid treatment* (START) demonstrates such a scheme:

---

[4] ELAN is a free software tool, which has been developed at the Max Planck Institute for Psycholinguistics. It supports the annotation of video and audio resources. An annotation document can be associated with up to four video resources. http://tla.mpi.nl/tools/tla-tools/elan/

[5] The German Notarzt (= emergency physician) is not the equivalent of the US-American emergency physician who regularly works in the accident and emergency department. The German Notarzt has a special education in emergency medicine and works together with the German Rettungsassistent in the pre-clinical rescue service.

[6] Due to different educational schedules, the German paramedic (*Rettungsassistent*) is not comparable to the US-American paramedic (Emergency Medical Technician - Paramedic). Furthermore, US-American paramedics are used to working without a physician on the incident scene (cf. preceding footnote).

Figure 6. Physician triage. An emergency physician (rightmost) examines a casualty. He is assisted by three paramedics: the first (f.r.t.l.) writes the physician's diagnosis and triage status down on a triage tag; the second checks the blood pressure; the third lists the triage status of each examined casualty for an overview.

Figure 7. Paramedic triage with PDA. Paramedics follow algorithms like START (Simple triage and rapid treatment) to conduct triage. On the picture, the triage status is typed in a yellow SOGRO PDA.

Question: "Is the breathing rate greater than 30/min?"

Instruction: "If no, answer the next question: 'Is the radial pulse palpable?', if yes, define the casualty as 'red' [= immediate treatment required]." (cf. Benson, Koenig, Schultz, 1996)

Although triage algorithms do not make paramedics think like a physician, they try to make them act like one.

In Germany, criticism against the triage performed by physicians has been strongly growing since the turn of the millennium. This and the worldwide trend towards algorithms have led to paramedic triage becoming more and more established in Germany, too (Ellebrecht, 2009). Very recently, the *Bundesärztekammer* (German Medical Association) paved the way for this (Bundesärztekammer, 2009). However, Germany's medical profession still hesitates to officially transfer certain medical competencies to paramedics.

Equipped with a special triage algorithm, the SOGRO PDA caters to the trend towards paramedic triage (Figure 7). In the SOGRO project, a chief emergency physician, who directed the EMS system in a German metropolis, defined the basic guidelines of the triage software. Thus, the PDA expresses his conviction (as well as a generally growing conviction) that paramedic triage represents the right way for future MCI concepts. From this point of view, the PDA pushes and reifies the reassignment of medical competencies in the pre-clinical field.

Second supported shift: from 'stay and play' to 'scoop and run'

After triaging nearly all casualties, the rescue operation continues with the spatial separation of all casualties. Those in the category 'red' are assembled in an area close to the dedicated transportation area, where ambulances have been ordered to wait. At the transportation area the PDA is used to select a transport destination. Its software shows nearby hospitals and their available capacities and, once a hospital is selected, informs the facility to expect a critically injured patient to arrive soon. When all 'red' casualties have been distributed, the process continues with 'yellow' casualties. Treatment centres for 'red' casualties, usually a 'trademark' of German MCI concepts, are no longer set up at the incident scene. The idea of 'stay and play', which means that patients receive intensive medical care already at the incident scene, was traded for rapid transport to a hospital. This process often goes by the name of 'scoop and run' strategy (cf. Sefrin, 1998).

The IS supports giving up treatment centres by changing two other processes. Firstly, the digital documentation of triage data frees operational executives from collecting such data manually. Secondly, the IS provides information about hospitals' capacities, which are available at the incident scene via the PDA. Thus, the transport coordination can be solely performed by transport coordinators on-scene. A consultation via radio with the control centre, previously the actor with the best overview about hospitals' capacities, as well as the supervision of the coordination process by executives is now made obsolete. Pointing at these two IT-supported facilitations, supporters of 'scoop and run' strategies argue for a broad acceleration of the rescue operation, which essentially includes the giving up of treatment centres. Although the gain in time through the technological support remains highly vague, the new MCI management strategy is introduced. Thus, medical treatment on-scene has been largely abandoned.

It is important to keep in mind that 'scoop and run' strategies have been executed for a long time without the help of IT. In the cases of the surveyed MCI exercises, the comparably fast rescue (which in this case means a rapid transfer of all casualties to hospitals) mainly needs to be viewed in the context of an organisational reassessment. Rapid transport is considered a better approach than any additional on-scene medical treatment that goes beyond making a patient fit for transport. From a social science perspective, technology in this case facilitates simultaneously, but independently emerging organisational strategies rather than functioning as a catalyst of new structures. However, it is likely that the implementation of the SOGRO IS would also trigger organisational adjustments in areas in which a 'first generation' MCI concept is still practised.[7]

Practical experiences: Using SOGRO

The PDA as 'materialised constraint'

A long tradition in technology studies – maybe particularly in Germany – refers to technical artefacts as a reification of social structures and observes the 'materialised constraints' ('Sachzwänge'), which pertain to their implementation and usage (Schulz-Schaeffer, 2000: 51-64 and 85-90). In this view a technical artefact *is* (within it) and *forces* (in the outside world) a certain kind of formalised action (Joerges, 1989). They do not only incorporate norms, but determine particular modes of behaviour. The PDA's triage software serves as a perfect example of this perspective.

At the beginning of the research project, paramedics were relatively free in how to use the triage software. By contrast, at the end of the project usage was strongly standardised. At this point, the user was forced to apply the triage algorithm before being able to type in any information about the patient. This restriction was added to the software after exercises had shown that many paramedics tended not to apply the triage algorithm and thus made false triage classifications. (Ellebrecht and Latasch, 2012) This 'malpractice' was unacceptable to emergency physicians and the software was reconfigured to force the right action. At least since this point the SOGRO PDA embodied the physicians' will to force paramedics to work precisely in a predefined way. While the technology empowers the paramedics at the meso-level of organisational change, it has the opposite effect at the micro-level of action.

Information and the reduction of uncertainty

SOGRO promises to provide invaluable information to incident commanders and executives for coordinating emergency response efforts. Information can be accessed via a graphical interface, which visualises exact casualty numbers by triage or transport status (Figure 5). Control centres, hospitals and on-scene executives can access the close to 'real-time'[8] data to adjust their actions with the help of compiled information and to give orders to the forces in the field accordingly. However, we discovered that the SOGRO technology *was never used that way*: on-scene executives preferred to observe the operations in person most of the time and let supporting staff monitor the computers. All in all only scarce operative use of the real-time data provided by the system could be observed. At MCI drills one of the most salient visualisations, the triage numbers, were only requested once or twice during the first hour of operations (Figure 8). Interestingly enough, accuracy and correctness of the data generated by the system were usually not scrutinised, as long as they met expectations (see below). Moreover, when used in radio communications, the numbers usually were rounded up. That may

[7] The new strategy in combination with the IS changes role and function of the chief emergency physician. As described above, the IT-supported facilitations mainly affect his/her tasks. In addition, 'scoop and run' relocates medical treatment from the incident scene to hospitals. In our investigations we observed recurring conflicts between the chief emergency physician and other operational executives, mainly from the fire service. These conflicts have a long tradition and are still waiting for their sociological exploration. It appears as if relieving the chief emergency physician's of certain tasks promotes her/his intervention in other domains. That, subsequently, intensifies the conflict.

[8] The 'real-time' quality of digital data transmissions leaves room for philosophical discussion. The system under discussion is perceived as 'real-time', meaning data transmission and access is very much faster than in a pen-and-paper environment; in reality, however, transmissions between PDAs and server can be delayed up to several minutes in cases of (probable) connection issues with the networks in use (ad-hoc WIFI, GSM/3G).

have been done to facilitate comprehension, but it also indicates some latitude regarding exact numbers when dealing with large scale emergencies. Another point is that the forces involved in the exercises were obviously used to coping with emergencies in the absence of exact data. The most crucial information for all further actions was the initial estimate by the fire-fighters responding first. This estimate laid the foundation for all resource management during the first hour. By contrast, the digital triage data was never used for operational decisions.

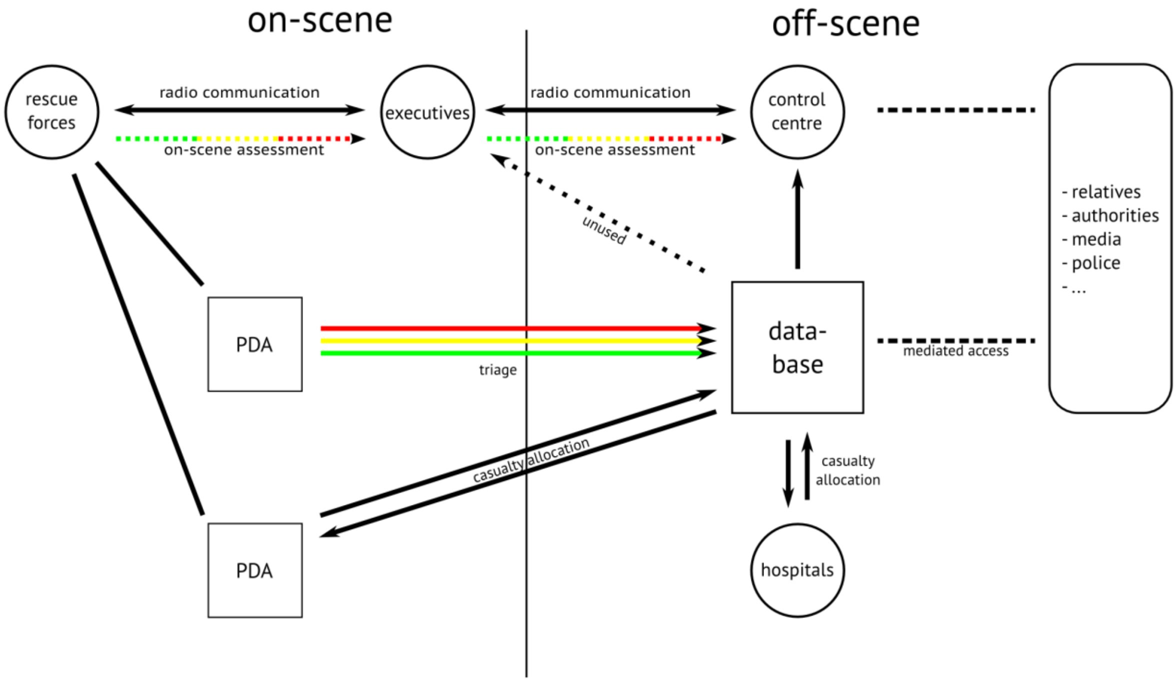

Figure 8. The integration of the SOGRO-IS in the MCI response network.

In spite of the rare use of the newly available information and some obvious discrepancies between digital triage data and the reality in the field, all of our interviewees responded highly positive towards the deployment and application of the SOGRO IS. Even though we could not find (and they did not mention) any 'practical' utility for their task (i.e. emergency response), they stated that SOGRO is of great help in managing MCIs. The motivation for this can be explained from a second-order perspective: our conclusion is that the merits of the real-time data for rescuers are of a psychological nature. Knowing that the numbers are available and possessing a graphical representation of how things advance, i.e. being able to visualise the progress on a screen, reduces uncertainty for those in charge. The SOGRO IS illustrates the largely opaque process of MCI management, which appears chaotic, particularly in the beginning. With SOGRO the rescue operation gets its graphical 'progress bar'.

New uncertainties

While the technology reduces uncertainties, it can also generate new ones. For example, in one instance executives started to re-allocate operational forces to 'get the numbers right'. They had perceived a deficit in the digital record of 'green' casualties, since the green progress bar did not grow for a while. As a reaction, they tried to find the 'greens' in order to boost their numbers. In an interview, the incident commander describes his confusion and reaction:

Interviewer: *Did you ever wish to have more information at one point during the exercise? Or any other information you would have liked to have?*

Incident commander: *Yes. I would have liked to have real numbers about the persons, that already had been triaged. Which we didn't have, as there were not enough bracelets [9], or as persons hadn't been triaged yet.*

[9] No bracelets means no data communication: each SOGRO bracelet contains an RFID-Chip (Figure 5). The triage data is only then transmitted to the data centre, when first the data is successfully stored on the RFID-Chip.

That is why… I'm not sure yet, what the reason was. All in all we have been triaging only 180 or 188 people, and this should be simply too FEW.

Interviewer: *Yes, indeed, as it have been more than 250.*

Incident commander: *For me this… I spent a lot of time with this: to check, man, what's happening over there with [organisation X], where in the world are the greens? Are there still 50 people sitting around, or not? Well, to me, that was a problem. In this situation, I would have liked to have MORE and (.) more UP-TO-date information, yes.*

The system's aim to produce unprecedented informational transparency leads to new uncertainties if that goal is not reached. The incident commander cannot understand *how* the (apparently false) information is generated. The system can only be perceived as a black-box. The underlying processes are too complex to be evaluated during an incidence and hence are unintelligible. The example shows that the unexpected perception of apparently false data (for 'technical' or 'human' reasons) leads to unintended consequences. Generally, black boxing not only reduces, it also enhances complexity, an outcome that has drawn criticism from rescue organizations (cf. Sturm, Aumayr, Brückner, Wanasek, 2013).

In critical environments digital technologies often fail to gain acceptance over their analogue counterparts (cf. Potthast, 2008). The reasons for that can be simple: a transport coordinator missing an overview screen, for example, claimed that with pen-and-paper it would have been easy to skim through pages; with the system on a PDA he was, however, lost. Digital interfaces are often perceived as less flexible than paper (Sellen and Harper, 2003).

The inherent logics of digital systems: SOGRO as technology of control

Daily rescue service is a mixture of formalized procedures, experience-based routines, and improvisation. Besides their core job of rescuing, paramedics also have to fill in a lot of paperwork. As they operate in an inherently dangerous context and are responsible for others' health and lives, there is a lot of effort put into measures of documentation and control. To some extent, this also holds true for MCI management. In Germany the on-scene operation is accompanied by an off-scene control centre ('*Leitstelle*'), which coordinates the alerting of all rescue units, records all radio messages, controls the allocation of patients to hospitals, etc. With the implementation of the SOGRO IS, this entity can now check the information it receives via radio against the most current digital data. The PDA tracks (or facilitates the tracking of) decisions and actions, such as triage, medication and GPS positions. This allows reconstruction and evaluation of the rescue operation in great detail. For instance, the new analytical possibilities were extensively used in our own field studies. At one MCI drill we used the PDA to collect information about the triage process and analysed the correctness of the triage status assigned by paramedics (Ellebrecht and Latasch, 2012). After each MCI drill, our research started with an analysis of the data that was collected and stored in the database during the rescue operation. The SOGRO IS makes it possible to obtain a fine-grained picture of the rescue operation. With the implementation of the IS, the chances of reconstructing a perhaps faulty decision increase. As often described, the density of surveillance increases with new technologies (cf. the corresponding articles in Lyon, 2006; Lyon, Haggerty, Ball, 2012). Enhancing control possibilities is part of the inherent logic of digital technologies.

Another aspect is the public's demand for information. In a media environment characterized by instant information flow, the SOGRO IS meets a growing demand for information. Before mobile communication became widespread, it took hours or even days and required a certain size for an incident to raise public awareness and get broad coverage. Decentralized news-feed mechanisms (e.g. twitter, mobile phones) make it a matter of only minutes for a greater audience to become aware of an accident or similar events. Thus, rescue organizations find themselves in a position that urges them to take up the role of information centres. They need to respond to questions from media, provide politicians with information about extent and progress of an incident and take care of concerned citizens and relatives of casualties. Being asked how the SOGRO IS supports his task, an executive of the fire-brigade expressed this new demand by embracing the new possibility to have digital photos of the casualties available immediately after their having been triaged:

Executive: *What I also find asTONISHING, that you have the [photos of the] faces available now. However, I'm not sure, whether this can be used in Germany. THIS, of course, would be a GREAT advantage. That you can say very fast, these and those people are affected, this one is doing well. IF you put [the photos of] the greens somewhere on TV, and everybody is saying: oh, great, my daddy is still ALIVE. This would be awesome. Well, considering that, I'm excited.*

After major accidents it used to take days to find out to which hospitals casualties had been transported. The digital documentation of several steps of the rescue process as along with the casualty's tracking makes it possible to determine their whereabouts. All of these information tasks are supported through the system, which may also account for the positive attitude executives and stakeholders have towards it. However, as our executive mentioned, new conflicts will appear: data protection and privacy concerns are at stake.

CONCLUSION

The SOGRO IS appears to be a logical step in the evolution of MCI management. It promises a more efficient rescue operation, particularly by reducing the time to allocate casualties to hospitals. The article argues that the main reasons for faster rescue operations are organisational changes, which the implemented technology stabilises and cements.

The IS was described as expressing a particular agenda behind how MCIs shall be managed. Although the IS brought no apparent operational benefit, operational executives embraced the technology. The graphical representation provides insight into the progress of the operation and offers seemingly exact numbers to draw on in cases of queries. Thus the IS reduces uncertainties. Besides, the IS satisfies new informational needs, which have emerged away from the incident scene during the last two decades. In the 'age of information' the news of major accidents or disasters spreads within minutes. Media, authorities and politicians, concerned citizens, and particularly relatives demand immediate information about the event and possible victims. The SOGRO IS collects and provides this information. In doing so, the system also offers new ways of surveilling and controlling overall rescue operation as well as single decisions.

The deployment of IS in MCI management is likely to bring about its own uncertainties. IS encounters a safety culture which is sceptical towards putting too much trust into digital technologies in the case of complex emergencies. In this regard, it is doubtful whether the 'analogue' paper tag will be replaced anytime soon. It will be still present – be it merely as a back-up solution.

REFERENCES

1. Adler, C., Krüssmann, M., Greiner-Mai, T., Donner, A., Mulero Chaves, J., and Via Estrem, À. (2012) IT-supported management of mass casualty incidents: The e-Triage project. In: *International Conference on Information Systems for Crisis Response and Management (ISCRAM)*, Lisbon, Portugal, May 2011.
2. Benson, M., Koenig, K.L. and Schultz, C.H. (1996) Disaster triage: START then SAVE - a new method of dynamic triage for victims of a catastrophic earthquake. Prehospital and disaster medicine, 11, 117–124.
3. Bundesärztekammer (2009) Stellungnahme der Bundesärztekammer zur ärztlichen Sichtung Verletzter/Erkrankter bei Großschadenslagen/Katastrophen, http://www.baek.de/downloads/baek-stellungnahme-_aerztliche_sichtung_-_240409.pdf (2/25/2013).
4. Ellebrecht, N. (2009) Triage. Charakteristika und Gegenwart eines ordnungsstiftenden Verfahrens. Sociologia Internationalis, 47, 229–257.
5. Ellebrecht, N. and Latasch, L. (2012) Vorsichtung durch Rettungsassistenten auf der Großübung SOGRO MANV 500. Notfall + Rettungsmedizin, 15, 58–64.
6. Fujisaki, S., Inoue, S., Oka, K., Sonoda, A. (2006) Triage with RFID Tags, http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=04205185 (2/20/2013).
7. Joerges, B. (1989) Soziologie und Maschinerie – Vorschläge zu einer „realistischen" Techniksoziologie. In: Weingart, P. (ed.) Technik als sozialer Prozeß, Suhrkamp, Frankfurt, 44–89.
8. Latour, B. (1991) Technology is society made durable. In: Law, J. (ed.) A Sociology of Monsters? Essays on Power, Technology and Domination, Routledge, London; New York, 103–131.
9. Lyon, D. (Ed.) (2006) *Theorizing surveillance*, Willan Publ., Cullompton.
10. Lyon, D., Haggerty, K.D. and Ball, K. (Eds.) (2012) *Routledge handbook of surveillance studies*. Routledge, Abingdon; Oxon; New York.
11. Nestler, S., Huber, M., Klinker, G. (2009) *Hybrid approach for management of patient-related information in mass casualty incidents.* http://ar.in.tum.de/pub/nestler2009hybrid/nestler2009hybrid.pdf (2/27/2013).
12. Nestler, S., Artinger, E., Coskun, T., Endres, T. and Klinker, G. (2011) RFID based patient registration in mass casualty incidents. *GMS Medizinische Informatik, Biometrie und Epidemiologie, 7,* 1–9.
13. Potthast, J. (2008) Ethnography of a Paper Strip: The Production of Air Safety. *Science, Technology & Innovation Studies, 4.* http://www.sti-studies.de/ojs/index.php/sti/article/view/83.
14. Roberts, K.H. and Bigley, G.A. (2001) The Incident Command System. High-Reliability Organizing for

Complex and Volatile Task Environments, *The Academy of Management Journal, 44,* 1281–1299.

15. Schulz-Schaeffer, I. (2000) *Sozialtheorie der Technik*, Campus, Frankfurt; New York.
16. Sefrin, P. (1998) "Scoop and Run" Or "Stay and Play", *The Internet Journal of Rescue and Disaster Medicine, 1*.
17. Sellen, A.J. and Harper, R. (2003) *The myth of the paperless office,* MIT, Cambridge, Mass; London.
18. SOGRO (2010) Immediate rescue in a large-scale accident with mass casualties. In: BMBF (Ed.), *Research for Civil Security: Rescue and Protection of People,* Bonn, Berlin, 34–35.
19. SOGRO (2012) *Erste Erkenntnisse zur Katastrophenschutzübung „SOGRO MANV 250" (press release).* http://www.sogro.de/new/fileadmin/Downloads/Abschluss_PM_SOGRO_MANV_250.pdf (11/25/2012).
20. Sturm, N., Aumayr, G., Brückner, K. and Wanasek, T. (2013) Technik im Einsatz – Bedenken und Lösungsansätze bei der Integration von Technik in Einsatzorganisationen. In: M. Jenki, N. Ellebrecht and S. Kaufmann (Eds.), *Organisationen und Experten des Notfalls. Technik und Kultur von Rettungswesen und Feuerwehr im Wandel.* Berlin: LIT.
21. Windeler, A., Becker, A., Schulz, H.-J. and Ortmann, G. (1990) *Computer und Macht in Organisationen. Mikropolitische Analysen,* Westdt. Verl., Opladen.