European Commission

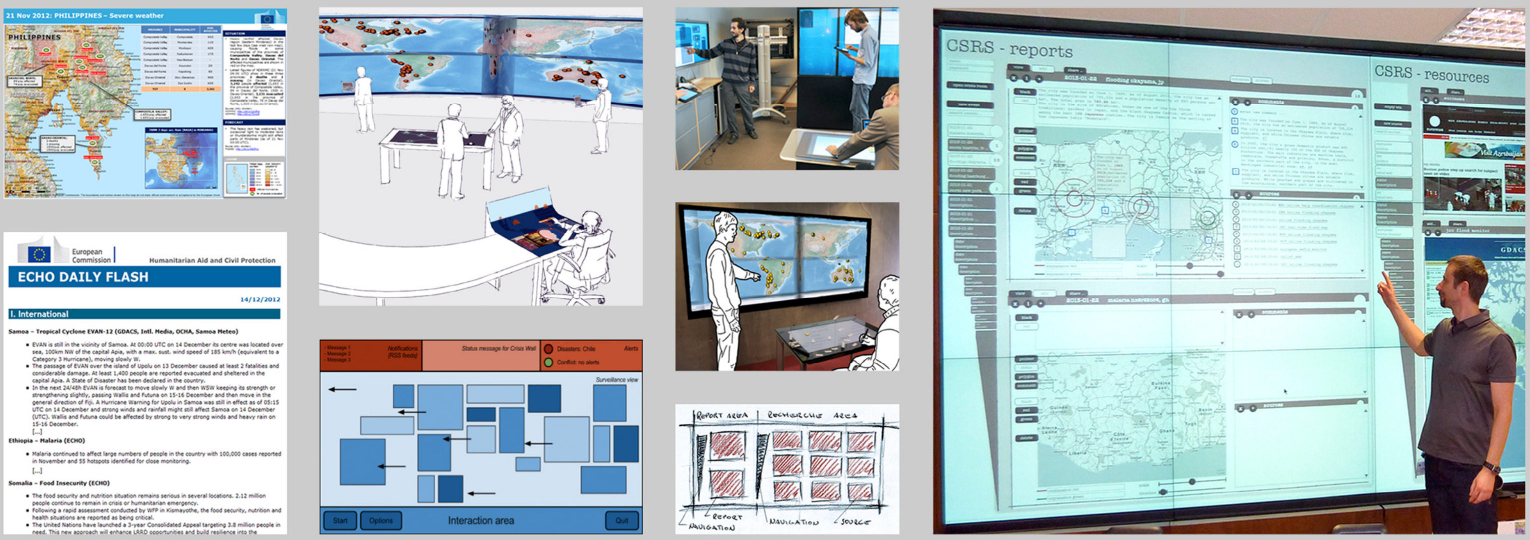
JRC SCIENTIFIC AND POLICY REPORTS

Collaborative Human-Computer Interaction with Big Wall Displays BigWallHCI 2013

3rd JRC ECML
Crisis Management
Technology Workshop

Editors:
Markus Rester,
Peter Judmaier,
Tom De Groeve,
Alessandro Annunziato

2013



Report EUR 26396 EN

Joint
Research
Centre

European Commission
Joint Research Centre
Institute for the Protection and Security of the Citizen

Contact information
Dr. Markus Rester
Address: Joint Research Centre, Via Enrico Fermi 2749, TP 680, 21027 Ispra (VA), Italy
E-mail: markus.rester@jrc.ec.europa.eu
Tel.: +(39) 0332 78-3805
Fax: +(39) 0332 78-5154
http://ipsc.jrc.ec.europa.eu/

JRC85533

EUR 26396 EN

ISBN 978-92-79-34935-5

ISSN 1831-9424

doi: 10.2788/50183

Luxembourg: Publications Office of the European Union, 2013

Printed in Italy

European Commission
Joint Research Centre
Institute for the Protection and Security of the Citizen
Global Security and Crisis Management Unit

University of Applied Sciences St. Pölten, Austria
IC\M/T – Institute of Creative\Media/Technologies

Collaborative Human-Computer Interaction with Big Wall Displays - BigWallHCI 2013

3rd JRC ECML Crisis Management Technology Workshop on Human-Computer Interaction with Big Wall Displays for Situation Monitoring and Reporting in Crisis Management Centres

18-19 April 2013
Ispra, Italy

Organised conjointly by:
European Commission Joint Research Centre &
University of Applied Sciences St. Pölten, Austria

Editors:

Markus Rester,

Peter Judmaier,

Tom De Groeve,

Alessandro Annunziato

1 Executive Summary

The 3rd JRC ECML Crisis Management Technology Workshop on Human-Computer Interaction with Big Wall Displays in Situation Rooms and Monitoring Centres was co-organised by the European Commission Joint Research Centre and the University of Applied Sciences St. Pölten, Austria. It took place in the European Crisis Management Laboratory (ECML) of the JRC in Ispra, Italy, from 18 to 19 April 2013. 40 participants from stakeholders in civil protection, academia, and industry attended the workshop (see Table 1).

Organisation / Company	State / European Commission
European Community Humanitarian Office (DG ECHO): Monitoring and Information Centre (MIC) / Emergency Response Centre (ERC)	EC
Federal Office of Civil Protection and Disaster Assistance (BBK): German Joint Information and Situation Centre (GMLZ)	DE
Swedish Civil Contingencies Agency (MSB)	SE
Frontex: Frontex Situation Centre (FSC)	EC
Danish Emergency Management Agency (DEMA): National Operation Centres	DK
Office of the State Government of Styria: Styria Regional Hazard Warning Centre	AT
Administration of the Republic of Slovenia for Civil Protection and Disaster Relief (ACPDR)	SI
Joint Research Centre, Global Security and Crisis Management Unit	EC
Crisis & Emergency Management Centre (CEMAC)	BE
Vienna University of Technology	AT
Université Paris-Sud	FR
INRIA - National Institute for Research in Computer Science and Control	FR
University College London	UK
Hasselt University	BE
Aarhus University	DK
Konstanz University	DE
University of Applied Sciences St. Pölten	AT
Chalmers University of Technology	SE
IT University of Copenhagen	DK
Barco	BE & IT
Eyevis	DE & IT
Planar	FR & US

Table 1: List of participants' affiliations.

The workshop's purpose was to present, demonstrate, and explore Human-Computer Interaction techniques, design considerations, and prototypes for supporting collaborative tasks at hand in high level situation monitoring and crisis management rooms equipped with a large display areas within the context of humanitarian aid and civil protection.

A scenario based design challenge for ICT solutions for crisis room operations was sent out to colleagues from academia (see invitation to academia in Annex A). Combined with a collaborative assessment discussion on presented ideas the workshop aimed at identification of promising directions for fostering the benefit of big wall displays to support collaboration in crisis rooms.

The following position statements, design considerations, and prototypes were presented at the workshop by the mentioned speakers:

- **Organising information on big walls - human perception and large displays.**
  *Prof. **Margit Pohl**, Vienna University of Technology, AT*
- **Perceptual affordances of wall-sized displays for visualization applications.**
  *Dr. **Anastasia Bezerianos**, LRI, Université Paris-Sud, FR &*
  *Dr. **Petra Isenberg**, INRIA, FR*
- **The interplay between personal and collaborative computing at big wall displays.**
  *Prof. **Kim Halskov**, Aarhus University, DK &*
  *Dr. **Clemens Klokmose**, Aarhus University, DK*
- **Situation reporting as co-creation of prospective interpretations with situated visualizations and crafted abstractions.**
  *Prof. **Jonas Landgren**, Chalmers University of Technology, SE*

- **Activity-based computing support for emergency crisis management.**
  Prof. ***Jakob E. Bardram****, IT University of Copenhagen, Denmark*
  [Substitute speaker: Dr. ***Clemens Klokmose****]*

- **The CrisisWall application.**
  Dr. ***Tom De Groeve****, European Commission Joint Research Centre, IT*

- **Multi-user twitter analysis for crisis room environments.**
  Simon Butscher*, M.Sc., Konstanz University, DE &*
  Prof. ***Harald Reiterer****, Konstanz University, DE*

- **Collaborative interactions in future crisis rooms.**
  Dr. ***Hans-Christian Jetter****, University College London, UK &*
  Prof. ***Johannes Schöning*** *, University College London, UK & Hasselt University, BE*

- **Collaborative situational report production on big wall displays.**
  Dr. ***Peter Judmaier****, University of Applied Sciences St. Pölten, AT &*
  Dr. ***Markus Rester****, European Commission Joint Research Centre, IT*

1.1 Outcomes

On day 1 participating federal and European civil protection institutions presented their organisations' mandates and most important the setup and organisational procedures of the crisis rooms and monitoring centres they operate. This was a perfect point to start from and allowed participants to get in contact and discuss their experiences throughout the whole workshop.

This was followed by presentations of industry participants on the state-of-the-art of available products supporting collaboration in crisis rooms on big wall displays. As participating crisis room operators in general are mostly familiar only with the hard- and software utilised in their centres this provided an overview of some features available in products of other providers.

Day 2 was dedicated to academia presentations. The talks addressed many aspects relevant in the operation of big wall displays, ranging from the foundations in human cognition and perception to near mature systems integrating different devices in crisis room settings.

1.2 Status-Quo and Further Development Needs

The hardware of large display areas is on the one hand mature since many years and on the other hand changing and improving constantly. This high pace developments promise amazing new setups with respect to e.g., pixel density or touch interaction.

On the software side there are two components that need improvement: 1. the software provided by the display manufacturers to operate their video walls (source selection, windowing system, layout control) and 2. dedicated ICT systems developed to the very needs of crisis management practitioners and monitoring centre operators.

While industry starts to focus more on the collaborative aspects of their operating software already, the customized and tailored ICT applications needed are still missing, unsatisfactory, or very expensive since they have to be developed from scratch many times.

Some of the biggest challenges identified in the workshop include making big wall display systems more interactive, applying participatory design and development principles, adopting InfoVis and Visual Analytics findings, and dealing with information overload.

Interaction: HCI technologies and techniques cannot easily be transferred from one scenario to another. A big wall display system requires new approaches for adequate interaction models. Here beside fundamental research a lot of applied research is needed.

Participatory design & development: There are several different approaches to user-centred design that are well investigated, explored, and established. Networking events and workshops are an appropriate approach to bring together industry, academia, and, most important, end-users.

InfoVis & Visual Analytics: The scientific disciplines of Information Visualisation and Visual Analytics are mature and offer enormous insights and solutions to wide-spread problems. Before Visual Analytics techniques can be applied successfully the above mentioned challenges in the HCI field need to be addressed first. There is need mostly for further applied research.

Information overload: Established solutions in areas such as pattern recognition or machine learning exist that can provide proper approaches for e.g., incident detection. HCI research makes procedures for attention management available. The increasing amount and also the diverse types of data demand new solutions to be developed in the fields of e.g., natural language processing. Again, mainly applied research is needed.

	Challenge	Recommendations	Next Steps / Actions in 2014+
1	**Interaction** Overcome static layouts and passive information consumption.	Develop dedicated software to add interaction and collaboration to big wall display systems enabling the exploitation of the full potential of big wall displays. This includes both the development of proper interaction models as well as accurate and suitable interaction technologies.	Applied research (e.g., Horizon 2020 Research & Innovation Action)
2	**Participatory Design & Development** Software needs to meet users' needs.	Allow for iterative and participatory software design & development in tender procedures. This approach not only has the power to make each and every single product better but applied on a larger scale bringing together industry & academia & users also can create new markets.	Networking activities and workshops (e.g., Horizon 2020 Coordination & Support Action: JRC work programme 2014-15 under Horizon 2020)
3	**Information Visualisation & Visual Analytics** Data ≠ Information ≠ Knowledge	Support knowledge generation and thus decision making by applying well known information visualisation principles based on cognitive psychology findings. Once big wall displays become highly interactive systems (see recommendation 1) visual analytics principles will then facilitate a new quality of dealing with the data at hand.	Applied research (e.g., Horizon 2020 Research & Innovation Action, Coordination & Support Action; JRC work programme 2014-15 under Horizon 2020)
4	**Information Overload** Support systems are needed	The sheer size of big wall displays and the ever growing amount of sensors and/or data to be analysed requires methods for attention management, automatic interpretation, incident detection, and alarm triggering.	Applied research (e.g., Research & Innovation Action; JRC work programme 2014-15 under Horizon 2020)

Table 2: Main challenges, recommendations, and suggested next steps/actions for 2014+.

Please see section 12 Summary of Discussions (p. 48 f) and section 13 Conclusions (p. 50 f) for details.

During the workshop a lot of networking took place. Future collaborations of academia and civil protection institutions on the development of bespoke ICT systems are planned. Also follow-up visits of industry to the JRC will provide input to future improvements and development of products.

The workshop obviously met the needs of European member states' civil protection bodies and European Commission institutions. It is envisioned to establish a platform for this discourse by repeating it annually with slightly different foci (e.g., situation awareness systems, communication systems, display hardware).

Figure 1: Group photograph on day 2 in front of the European Crisis Management Laboratory (ECML)

2 Organising Information on Big Walls – Human Perception and Large Displays

Margit Pohl

Institute of Design and Assessment of Technology, Vienna University of Technology, Austria

margit@igw.tuwien.ac.at

2.1 Introduction

Large displays raise challenging new questions concerning interface design. Some of these issues are known from interface design of desktop computers, but become more conspicuous in this context. One of the major problems is related to the fact that humans only perceive a small part of their environment (inattentional blindness, change blindness). This was already relevant for displays of desktop computers, but is an essential aspect for the design of large displays. Just because of the size of such displays, it is impossible to see everything on the screen and detect every change. An important feature of large displays is that they often support group activities. This implies that several different people might change the contents of the screen. Thereby, the problem of change blindness is increased because users also have to keep track of changes initiated by other persons.

Another issue is related to the usage of space as a metaphor. This issue was already discussed in the context of hypertext (see e.g. Pohl 2003). Space is a very powerful metaphor because human beings are used to navigation in space. People often organise their materials in the "real world" according to location in space (for a discussion of this issue see e.g. Dutke 1994). Students writing their master's or doctoral theses often put similar texts on one stack and put these stacks in specific locations on their desks. In a similar manner, users of virtual desktops organise their files on the screen according to their meaning. On small screens the usage of space as a metaphor is limited because of limited screen size. On large displays, there are more possibilities to organise materials according to their content.

In addition, this technology can offer new possibilities. Users can move in front of the display, which is probably a more natural form of perception than sitting in front of a screen. Groups can discuss while standing in front of the display and may adapt the screen collaboratively. Furthermore, some applications, like complex visualisations, need a large display to avoid extensive scrolling or panning.

Possible problems can only be overcome and advantages exploited when these displays are designed appropriately. So far, there are only few recommendations for the design of large displays, but some experience from cognitive psychology and HCI might be used.

To design big wall displays appropriately, knowledge about human perception is essential. The effects of change blindness and inattentional blindness, for example, are usually surprising for laypersons not acquainted with cognitive psychology. Therefore, it cannot be expected that programmers take such phenomena into account when designing interfaces of large displays. In this paper, I will address two issues in human perception which seem to be especially relevant for the design of large displays – change blindness/inattentional blindness and using space as a metaphor for the organisation of material on the screen. Based on cognitive psychology, guidelines and recommendations can be formulated which could help to overcome problems in the usage of large displays.

2.2 Change Blindness / Inattentional Blindness

Change blindness means that human beings are not able to perceive changes in their environment which they do not focus on. They only attend to aspects of their environment highly relevant to their current task or highly conspicuous. Everything else is quickly forgotten. Inattentional blindness is a similar phenomenon. It means that human beings sometimes even do not notice things happening in their field of vision if they are distracted by other stimuli.

Inattentional blindness (Mack 2003) and change blindness (Rensink 2002) can impede perception of important aspects of the screen. Rensink (2002) has formulated guidelines how to overcome problems resulting from this. He suggests that items on the screen should be easy to recognize and to find. Designers should minimise visual events. They should emphasise objects when they are necessary for the users' activities. These guidelines were formulated for small screens. To a certain extent, these guidelines are not valid anymore. Rensink has a very minimalistic approach. On a large screen, minimising objects and activities is often not possible. On the other hand, even on a large screen showing unnecessary objects or unnecessary animations should be avoided, and relevant items highlighted.

Mancero et al (2007) discuss empirical findings concerning monitoring tasks. In such tasks, change blindness can have highly detrimental effects. Their findings are also relevant for the design of large displays.

- **effect of the rate of change**

  When changes in visual displays only happen gradually they can be overlooked easily. To make them more visible they should happen suddenly.

- **effect of eccentricity**

  Eccentricity describes the distance of an object from the focus of attention of the user. Changes in the periphery are usually difficult to detect. They should be emphasised to make them more obvious. Motion is, for example, a good indicator of change in the periphery.

- **effect of conspicuity**

  Saliency is an important element of screen design. Salient features of the screen are perceived quickly and automatically. Movement, flashing light, orientation or colour are important features of interface design which draw people's attention. Nevertheless, it can be shown that such features are not always noticed when users are concentrating on fulfilling a task.

- **effect of significance**

  Meaning is very important for perception. Meaningless or random changes are seldom detected, whereas changes in meaningful or familiar stimuli are usually noticed.

- **effect of task relevance**

  Changes which are relevant for the task at hand are noticed more easily than irrelevant changes.

These five effects should be taken into account when designing large displays.

Mayer (2003) has proposed several principles for multimedia learning based on empirical research in educational psychology. Two of these principles are highly relevant for the design of large displays – the spatial contiguity principle and the temporal contiguity principle. Designing displays according to these principles can also help to overcome the effects of change blindness and inattentional blindness. The spatial contiguity principle implies that learning and understanding is improved when corresponding elements (text, pictures, videos,...) are placed near each other. This is especially important on large displays. The temporal contiguity principle says that related information elements should be presented at the same time.

These recommendations are a starting point for the design of large screens. More research to overcome change blindness and inattentional blindness when using large screens is necessary.

2.3 Space as a Metaphor

Space is a very powerful metaphor which we use continually to reason about complex processes in our environment. We use space, for example, to reason about time and draw conclusions about whether two or more events are concurrent or not (Johnson-Laird 1996). Position is often an indicator of meaning. In contrast to the small displays of the past, large displays allow to show a vast amount of information. When organised according to spatial position, information can be made more accessible, and clusters of similar information can be detected more easily by the users (Andrews et al 2011). Space can be used to support sensemaking processes (e.g. by different forms of spatial organisation) or to enable collaboration. Multiple views on the data or embedded visualisations (visualisations which are embedded into another visualisation) can be accomodated more easily. On the other hand, some forms of interaction are more difficult, e.g., brushing and linking of data in multiple views might be difficult to track across a large screen (Andrews et al 2011) because it is challenging to recognize that similar data elements are selected in various views scattered across the whole screen.

Andrews et al (2010) discuss several aspects of the sensemaking process which are specifically supported by large screens.

- **persistence**: Large screens support memory processes (especially by using information about position on the screen)
- **context**: Large screens enable the user to see data in their context. Users do not have to scroll or click to get another page. The whole context can be seen at once.
- **physical navigation**: There is empirical evidence that physical navigation is generally preferred by users to virtual navigation if given the choice.
- **presence of detail**: Large screens offer the user much more detail than small screens.
- **refresh**: The screen can be used as an external memory. If he or she forgot something they only have to look at the screen to remember.
- **awareness**: The user is aware of the information at all times.
- **spatial** semantics: Space is used as a metaphor for meaning.
- **incremental formalism**: Through spatial positioning and interaction with the system users are enabled to actively make sense of the material.

It should be mentioned, however, that despite the advantages large screens might have for sensemaking, the design of such systems is certainly challenging. Users might be overwhelmed by large amounts of information despite the possibility to organise it in clusters.

2.4 Conclusion

The interface design of large screens is a difficult issue and still not very well understood. Discussions of the design of smaller screens can help designers in their decisions. Some of the issues are already known from smaller screens, e.g., the issue of change blindness and inattentional blindness or the usage of space as a metaphor, but additional issues will probably arise when such screens become more common. Knowledge from cognitive psychology can help designers to cope with these problems. Extensive user testing will be necessary to solve them.

2.5 Acknowledgements

This work is conducted in the context of the CVAST - Centre of Visual Analytics Science and Technology project. It is funded by the Austrian Federal Ministry of Economy, Family and Youth in the exceptional Laura Bassi Centres of Excellence initiative.

2.6 References

Andrews, C., Endert, A., North, C. (2010) Space to Think: Large, High-Resolution Displays for Sensemaking. In: Proceedings of the SIGCHI 2010 Conference on Human Factors in Computing Systems, pp.55-64

Andrews, C., Endert, A., Yost, B., North, C. (2011) Information Visualization on Large, High-resolution Displays: Issues, Challenges and Opportunities. Information Visualization 10(4), pp. 341-355

Dutke, S. (1994) Mentale Modelle: Konstrukte des Wissens und Verstehens. Verlag für angewandte Psychologie: Göttingen.

Johnson-Laird, P.N. (1996) Space to Think. In: P. Bloom, M.A. Peterson, L. Nadel, M.F. Garrett (eds.) Language and Space. The MIT Press: Cambridge, Mass., London, UK, pp.437-462.

Mack, A. (2003) Inattentional Blindness: Looking Without Seeing. Current Directions in Psychological Science 12 (5), pp.180-184

Mancero, G., Wong, W., Amaldi, P. (2007) Looking but Not Seeing: Implications for HCI. In: Proceedings of the ECCE 2007 Conference, pp.28-31

Mayer, R.E. (2003) Multimedia Learning. Cambridge University Press: Cambridge

Pohl, M. (2003) Hypertext und analoge Wissensrepräsentation. Peter Lang Verlag: Frankfurt am Main, Berlin, Bern.

Rensink, R.A. (2002) Internal vs. External Information in Visual Perception. In: Proceedings of the Symposium on Smart Graphics, pp. 63-70

Ware, C. (2008) Visual Thinking for Design. Morgan Kaufmann: Amsterdam, Boston, Heidelberg

3 Perceptual Affordances of Wall-Sized Displays for Visualization Applications

Anastasia Bezerianos[1,2] **Petra Isenberg**[2]

[1]Université Paris-Sud / CNRS, France

[2]INRIA - National Institute for Research in Computer Science and Control, France

anastasia.bezerianos@lri.fr petra.isenberg@inria.fr

3.1 Motivation

Wall-sized displays engulf viewers in large high-resolution information spaces and form intriguing environments for data visualization and monitoring due to several inherent benefits: (i) physical rather than virtual navigation affords a natural pan-and-zoom in the information space to see overview from afar and details up-close; (ii) an enlarged physical space in front of the display enables collaborative viewing; (iii) and millions of pixels support viewing large amounts of data.

Nevertheless, when used outside research settings in a work context, wall displays are largely treated as big desktop monitors, both in the type of information we view on them and in how we interact with them. For example they often act only as summary and information sharing tools seen from afar (e. g. to enhance situation awareness), with interaction being inexistent or limited to mice and keyboard. Thus the full potential of interactive large wall technology, such as high resolution or direct-touch interaction are not fully leveraged, despite re- search work on interaction and visualization guidelines.

This lack of adoption can be due to the fact that we still need to learn more about (i) **what** information should be placed on wall displays (replicated information from personal screens, different information, or summaries); and **where** (how to lay- out the information); (ii) **who** interacts and updates this information (real-time feeds, a group leader, everyone); (iii) **how** to share and more generally interact with them (from a distance using mouse/keyboards or up-close using touch).

3.2 The Where

Our current work focuses on **where** to lay out visual information. To answer this question we need to consider the tasks users perform and identify the important information to place in optimal locations. But beyond that we can provide initial guidelines to data visualization designers to help determine this optimal location by examining the perception of visual representations on wall displays. This is challenging as viewers' perception is affected by their position around the wall.

Elementary graphical items such as points, lines, and areas are the building blocks of information visualizations. They possess properties such as position, color, orientation, or size which are the visual variables defining them [2]. Information visualizations consist of an assembly of these items and their variables. Thus, work studying how visual variables are perceived, quantitatively measured, and compared, has built a basis for how these "assembled" visualization are perceived. Nevertheless, the unique viewing environment of wall-sized displays requires a re-assessment of these studies [1].

Recently, we conducted a set of comparison tasks of three visual variables (length, area, angle) across different locations of the wall, to assess their visual perception from different viewing positions [1]. Understanding perception discrepancies and where and when they occur is important as fundamental data analysis tasks involve the correct assessment and comparison of elementary visual variables. To read a bubble chart, for example, one has to compare the sizes of circles to one another and to a legend, as well as relate their positions in a 2D coordinate space. The question arises whether comparisons such as these are affected by the oblique viewing angles which occur when viewing data from different positions in front of a wall-sized display. We found that an increase of the horizontal displacement of items on a wall display can lead in some cases to estimation errors up to 60% when viewers are close to the wall. Our participants consistently overestimated items, even in the case of the traditionally robust or underestimated visual variables. Finally we found that some parts of the wall are perceived differently than others.

Our work, and that of others on how changes in viewers' distance and viewing angle affect visual perception (e.g. visual aggregation of information [3] or text readability and color perception [4]), can help suggest which locations on the wall are optimal for given visualizations, ensuring effective information monitoring and a shared understanding between collaborators working at different positions around the wall.

3.3 Some concrete recommendations

We present here some concrete recommendations based on ours and previous studies:

- If visual information is spread across the width of a wall display it is likely to be distorted (perceived differently) based on where different viewers are seated, especially if they are seated fairly close to the display.
- Viewing a wall display close to its center and from a distance of 2-3m reduces distortion across the entire display. Of course it may not be a good position for other tasks (e.g. looking at details). In this case periodically walking around the display is encouraged.
- Some visual variables are known to be visually harder to perceive and compare, such as angles, even in traditional monitors. Angles are also greatly affected by visual distortion in wall displays, more so than lengths, positions and areas. If viewers need to compare visualizations placed at different locations across the display, avoid ones that are based on angle comparison (e.g. pie charts). Bar-charts, for example, are more robust.
- If visual items need to be compared across distances on the wall display, e.g. two pie- or bar-charts, try to either (i) bring them close to the viewer with interaction, (ii) place them as close as possible even if they are not close to the viewers, (iii) or encourage viewers to move to see both items.
- There is evidence that screens below and above the visual field are perceive differently. It is thus advisable to place items to compare (e.g. legends and visualizations) close together not only in width but also in height.

We hope these recommendations will help create more robust visualizations for wall displays.

3.4 References

[1] Bezerianos, A., and Isenberg, P. Perception of Visual Variables on Tiled Wall-Sized Displays for Information Visualization Applications. IEEE TVCG 18, 12 (2012), 2516–2525.

[2] Cleveland, W. S. The Elements of Graphing Data. Wadsworth Advanced Book Program, 1985.

[3] Endert, A., Andrews, C., Lee, Y.H., and North, C. Visual Encodings that Support Physical Navigation on Large Displays. In Proc. GI, CHCCS (2011), 103–110.

[4] L. Douglas, D. Aleva, P.H. Shared Displays: an Overview of Perceptual and Cognitive Issues. 12th Annual Command and Control Research and Technology Symposium: Adapting C2 to the 21st Century (2007).

4 The interplay between personal and collaborative computing at big wall displays

Peter Dalsgaard[1] **Kim Halskov**[1,2] **Clemens N. Klokmose**[1]

[1]Centre for Participatory IT, Aarhus University, Denmark

[2]CAVI, Aarhus University, Denmark

dalsgaard@cavi.au.dk *halskov@cavi.au.dk* *clemens@cs.au.dk*

4.1 Abstract

In this position paper we argue that collaborative interactive surfaces such as big wall displays are not yet used to their full potential, due to how our interactive systems are stuck in a personal computing paradigm. Hence, they have little support for fluid transitions between individual and collaborative work. Through an example, we discuss how different types of devices can have different roles in an interactive space, some used individually and some collaboratively. We furthermore discuss the challenge of bringing content to and from a shared surface. Finally we argue for an integration of the physical and the digital in interactive spaces.

4.2 Introduction

Interactive surfaces such as multi-touch tables and big wall displays have in recent years gained a lot of attention in research and are beginning to be accessible and used outside of research labs as well. These technologies have a number of qualities that regular desktop computers do not. Wall displays can provide enormous detail, some above 100 mega pixels compared to a regular high-definition monitor of around two mega pixels [1]. Multi-touch tables and surfaces provide novel means of interaction and affords co-located collaboration. However, neither of these technologies are general purpose technologies in the same manner as desktop computers. Nor are they personal computers; they are intended to be collaboratively used, e.g. in a crisis room with perhaps a dozen of users. This challenge 30 to 40 years tradition of designing and building interactive systems rooted in personal computing.

Work constantly shifts between the individual and collaborative activities; as a programmer, a scientist, an architect, or a designer work shifts between focused individual work, to discussion at a whiteboard, to meetings where work is reviewed. Wall and table surfaces have the potential to support co-located cooperative work but from technological perspective the transitions between individual and collaborative work are poorly supported. Even if an office were equipped with large wall mounted touch-screens, bringing architectural drawings, 3D models of molecules or snippets of source-code to the shared surface require effort. It would involve copying files to the machine running the surface, connecting a laptop to the wall mounted screen, or installing software to display the particular 3D model. Hence, large displays and electronic whiteboards often end up being used simply as an external display to a personal computer.

We strongly believe that in order to support real world professional praxis we need to enable interaction spaces where interaction with personal and shared devices can happen both sequentially and in concert, and where content and work can move fluently between devices. In the following we describe three areas of research into interaction with large displays and shared surfaces that we currently are engaged in.

4.3 Personal and collaborative devices in concert

We are exploring what role different devices can play in a concert of devices. E.g., in a setup of a large display, an interactive table, and a number of personal devices; what kind of interaction and what content should meaningfully be available on the different devices, and at different points in time?

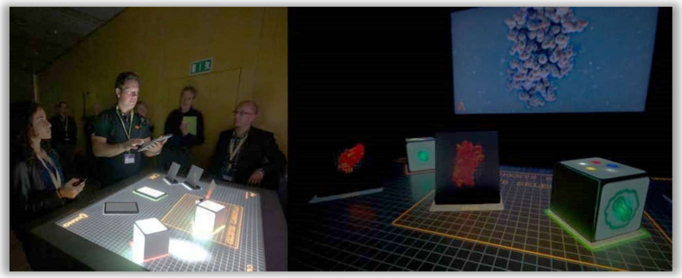


Figure 2: Multi-surface molecular visualization

In an ongoing project we are exploring how molecular biologists can collaborate on molecular visualizations in a multi-surface environment[1].

In Figure 2 a large display shows the actual molecule, an interactive table is used to coordinate which molecule is visualized and what set of visualization properties is applied to the visualization with the use of tangibles with real-time 3D projection [2]. On the table the user can move a tangible representing a molecule to a zone in the middle of the table. This results in the molecule being displayed on the large display. Cubes on the table represent different visualization properties that can be applied to the molecular visualization by moving them to zone. The visualization properties can be manipulated through a personal tablet interface. A tablet is connected to the room by navigating its browser to a given URL on the local network. Tablets connected to the room get represented on the table with a tangible object. This tangible object can be used to pick up visualization properties by moving it to one of the cubes, or it can be used to pick notes associated to a molecule by moving it to the tangible object representing the molecule. The notes of the currently displayed molecule are displayed on an auxiliary display next to the large display, and can be edited collaboratively by multiple users. Hence, in this setup personal tablets are used for individual interaction with the system. One user can manipulate visualization properties of a molecule, while another edits the notes of the given molecule. Two users can manipulate the same visualization properties collaboratively. Or the two users can edit each of their visualization properties and apply them to the molecule on the large display in turns.

In the above described tech-demo, personal devices are used as a means for individual interaction in a collaborative environment. They can either be used during a collaborative session or as individual control panels or remote controls for the system. But they can also be used to interweave individual work in a collaborative activity, e.g. by picking up notes of a given molecule on a personal tablet to edit them alone in a quiet spot. An interactive table is used as the coordinating device for managing what is shown where and how in the interactive space. From this tech-demo three classes of devices emerged: Information displays with no or limited direct interaction, personal devices for detailed individual editing or control, and a collaboratively used interactive table for more coarse-grained coordination. We believe that there is an uncharted design space of the roles devices can play when used together in an interactive space, and we intend to explore this space in our future work.

4.4 To and From

Getting digital content to and from a shared surface such as a big wall display is another challenge we are exploring in our research. We are currently working on conceptualizing the different ways to bring content to and from a shared surface. Sharing an image or a document to large display is fairly simple and can be achieved e.g. by letting the wall display have an e-mail or web interface (as described in [1]) where the user can post content to. A user may also want to share what is on the screen of her laptop, or just what is shown in a given application window on her laptop. Commercial solutions such as Barco's ClickShare[2] allow easy streaming and display of multiple users' screens on a large display. Research prototypes such as Scotty [3] demonstrate how a user can beam individual windows from a personal computer to a wall-sized display. However, in both cases what is dis-played on the external display is only available as long as the source computer is connected, and still only the person at the source computer can interact with the displayed content. Furthermore, moving the application window onwards to another user's laptop for either collaborative use, or to pass over work is impossible. We have explored software architectures that do allow for the above types of interactions (e.g., in [5]), however, this requires a fundamental rethinking of how we build interactive systems.

---

[1] Initial tech-demo presented at "You Need To See This", Symposium on Scientific Visualization, The Royal Danish Academy of Sciences and Letters, Copenhagen, 25-26 September 2012.

[2] http://www.barco.com

4.5 Beyond the digital

Work spaces, whether a crisis room, a software house, or a design office does not only consist of computers. People use physical whiteboards, notebooks, post-it notes and tangible objects as part of their everyday work. These physical objects have qualities that are difficult, if not impossible, to replace with computing. Interactive spaces that mix the physical and the digital in a seamless manner have recently been conceptualized as blended interaction-spaces [4]. One challenge is to bridge interaction between personal and collaborative computing devices, another challenge that we address in our research is how to bridge the use of physical objects and material with computing in an interactive space. This ranges from means for quickly capturing an image of a post-it to display it on a shared surface, to using physical objects and 3D-projections as a means for augmented the physical with the digital and vice-versa.

4.6 Acknowledgements

The molecular visualization tech-demo was developed in collaboration with the Computer Graphics Group at the Alexandra Institute. The work was partly funded by the Carlsberg Foundation.

4.7 References

[1] M. Beaudouin-Lafon, S. Huot, M. Nancel, W. Mackay, E. Pietriga, R. Primet, J. Wagner, O. Chapuis, C. Pillias, J. Eagan, T. Gjerlufsen, and C. Klokmose. Multisurface interaction in the wild room. Computer, 45(4):48 –56, april 2012.

[2] P. Dalsgaard and K. Halskov. Tangible 3d tabletops: combining tangible tabletop interaction and 3d projection. In Proceedings of NordiCHI 2012, pages 109–118, New York, NY, USA, 2012. ACM.

[3] J. R. Eagan, M. Beaudouin-Lafon, and W. E. Mackay. Cracking the cocoa nut: user interface programming at runtime. In Proceedings of ACM UIST 2011, pages 225–234, New York, NY, USA, 2011. ACM.

[4] H.-C. Jetter, R. Dachselt, H. Reiterer, A. Quigley, D. Benyon, and M. Haller. Blended interaction: envisioning future collaborative interactive spaces. In CHI '13 Extended Abstracts, CHI EA '13, pages 3271–3274, New York, NY, USA, 2013. ACM.

[5] C. N. Klokmose and M. Beaudouin-Lafon. Vigo: instrumental interaction in multi-surface environments. In Proceedings of ACM CHI 2009, pages 869–878, New York, NY, USA, 2009. ACM.

5 Situation reporting as co-creation of prospective interpretations with situated visualizations and crafted abstractions

Jonas Landgren[1] **Fredrik Bergstrand**[2]

[1]Chalmers University of Technology, Sweden

[2]University of Gothenburg, Sweden

jonas.landgren@chalmers.se fredrik.bergstrand@ait.gu.se

5.1 Introduction

International and national authorities face increasing complexity when monitoring, making sense of and crafting actions as a response to disruptive events characterized by an interconnected web of natural, technical, organizational and social dynamics (Topper & Lagadec, 2013). In order to address such complexities, monitoring and coordination centers with situation rooms have been established on regional, national and international levels to ensure up-to-date information access, synthesized analysis, and delivery of situation reports to decision makers. Information technology has a critical and visible role in these situation rooms, manifested by impressive wall-size projections, video-conferencing systems, digital whiteboards, map-technologies (MacEachren, 2013), event-logging (Landgren, 2011) and social media monitoring tools (Abel et al, 2012).

With an increased interest from government authorities in establishing situation room settings and in implementing situation-reporting procedures, there is a need for improved understanding of these technologized settings. This paper suggest that practitioners and researchers need to shift attention partly away from the exciting possibilities of emerging technology and instead, if only just for a moment, look at the activities taking place in such settings. Such shift of attention would improve the possibilities to gain better understanding of the design challenges in situation room settings.

The need for the shift of attention is based on insights from a series of ethnographic field-studies (Hughes, Randall & Shapiro, 1992) focusing on situation room work at the fire and rescue services as well as municipality crisis response in Sweden. These studies have taken place during ongoing real emergencies, including events such as large-scale fires, polluted drinking water, extreme weather and social unrest in suburbs. The material from these field studies indicates that situation room work and the activities of situation reporting are sociotechnical accomplishments oriented at multi-actor sensemaking (Weick, 1995) activities.

Situation room work could in broad and general terms be characterized as the retrieval and transformation of fragmented, conflicting, and equivocal information into synthesized, aggregated and condensed situation reports that cover key aspects of emerging or ongoing crisis situations. In order to further advance such work with improved organizational routines and re-designed technology support, a set of design dimensions have been tentatively outlined for this purpose. Two of the design dimensions are labeled as a shift of perspective while the last two are labeled as a need of balancing different types of information material. As will be noted in the subsequent presentation, each dimension addresses a set of interrelated aspects, where each component have significant complexity. The descriptions should therefore not be understood as complete nor detailed enough. The purpose of the descriptions is instead to provide triggers for discussions and departure points for vivid and constructive discussions regarding the sociomateriality (Orlikowski, 2007) of situation reporting as a practice that is intertwined with an advanced technological material.

5.2 Dimensions

5.2.1 Shift from consumption to production to co-creation

Information technology in situation room settings are too often focused on displaying information based on a pre-planned understanding of which information is important to have continuous access to. This have resulted in a situation with an evident risk that situation room personnel focus on information consumption rather than focus their efforts on producing accounts of an emerging interpretation of the ongoing situation. In addition, the production of information should also shift from being an organization specific internal activity to be opened up and include collaborating partners and become a co-creation multi-actor activity.

5.2.2 Shift from retrospective accounts to real-time reporting to prospective interpretations

Situation reports as a product and situation reporting as an activity is too often characterized by retrospective accounts of a situation. This means that there is a gap between the real and ongoing situation and the situation that decision makers believe they are addressing. Real-time reporting technology has to some degree reduced this problem, but in order to move from reactive to proactive actions in disruptive events, situation reporting should shift to a model of prospective interpretations rather than detailed accounts of aspects that soon or already have changed. Prospective interpretations are focused on the near future in the form of imaginable alternative trajectories of the evolving situation.

5.2.3 Balance between textual reports, annotated maps, and situated representations

The dominance of structured textual descriptions of an evolving situation has partly been reduced by the increased use of annotated interactive maps. There is however also a need to provide technology-mediated support for what could be called situated representations that address aspects of the situation that is too complex to formulate in text or have little or no meaning to assign to geographical positions. These representations include temporal trajectories, mind maps of key aspects, visualization of actor-networks, boundary-spanning consequences, and expected response patterns.

5.2.4 Balance between details and abstractions

The increased access to visual and detailed information from affected areas and people via news agencies and social media provide an important and useful flow of insights in large-scale events. Still, there seems to be a lack of technical and methodological support to craft important details into more powerful abstractions. Such abstractions serve the role of synthesizing the underlying meaning from a range of detailed accounts. Even if details are important as triggers for sensemaking when formulating actions in a crisis design space, these details provide little meaning due to their specificity. Instead these details must be transformed into crafted abstractions to form a viable design material for interpretation and action. Despite the power of crafted abstractions, they must be continuously challenged by new detailed updates in order not to crystalize into representations without meaning.

Organizations with situation room settings will over the next few years continue to invest heavily in advanced wall-size technologies that will strive to support the creation and provision of efficient situation reports and situation reporting processes.

The tentative and high-level design recommendations outlined above has been formulated in order improve the design of situation room technology use. We believe that such improvements will minimize the temporal latency in situation reporting as well as improving the descriptive power of the material in the reports. We argue that future interaction technologies in this domain should view situation reporting as co-creation of prospective interpretations with situated visualizations and crafted abstractions in order to further advance the capabilities of time-critical multi-actor situation reporting.

5.3 References

Abel, F., Hauff, C., Houben, G. J., Stronkman, R., & Tao, K. (2012). Semantics+ filtering+ search= twitcident. exploring information in social web streams. In Proceedings of the 23rd ACM conference on Hypertext and social media (pp. 285-294). ACM.

Hughes, J. A., Randall, D., & Shapiro, D. (1992). Faltering from ethnography to design. In Proceedings of the 1992 ACM conference on Computer-supported cooperative work (pp. 115-122). ACM.

MacEachren, A. M., Cai, G., Brewer, I., & Chen, J. (2013). Supporting map-based geocollaboration through natural interfaces to large-screen displays. Cartographic Perspectives, (54), 16-34.

Landgren, J. (2011). Critical Aspects of Early-Phase Response Work and its Consequences for Digital Event-Log Systems. In 8th International ISCRAM Conference, Lisbon, Portugal.

Orlikowski, W. J. (2007). Sociomaterial practices: Exploring technology at work. Organization studies, 28(9), 1435-1448.

Topper, B., & Lagadec, P. (2013). Fractal Crises–A New Path for Crisis Theory and Management. Journal of Contingencies and Crisis Management, 21(1), 4-16.

Weick, K. E. (1995). Sensemaking in organizations (Vol. 3). SAGE Publications, Incorporated.

6 Activity-Based Computing Support for Emergency Crisis Management

Jakob E. Bardram

IT University of Copenhagen, Denmark

bardram@itu.dk

6.1 Introduction

Emergency crisis management is highly task-based and involves time- and life-critical multitasking and decision-making. Handling several concurrent tasks and activities in a crisis situation is absolutely crucial. For example, it is essential to be able to track the development of several emerging crisis situations in a disaster area, while at the same time being able to monitoring the status of emergency and accidents (E&A) departments in a city.

Enabling support for task-based or activity-based computing in a crisis management room is therefore essential. This provides crisis personnel to manage many concurrent activities in a collaborative way. Yet, many technologies for smart space and/or crisis management in "war rooms" provide little or no support for activity management.

This paper presents our work on providing activity-based computing support to smart space technology. This work takes it outset in detailed studies and technology design for hospital work, including at E&A departments. The paper presents the basic notion of activity-based computing (ABC) and discusses the 6 main ABC principles of activity-based resource aggregation, activity suspend/resume, activity roaming, activity-based collaboration, and activity awareness. The paper presents *ReticularSpaces*, which is an activity-based computing environment for smart spaces. *ReticularSpaces* supports a fluid and integrated interaction across mobile and fixed displays inside and outside a smart space, including large interactive wall displays. We discuss how the principles of activity-based computing and the design of *ReticularSpaces* may help the design of smart space environments for crisis management.

6.2 Activity-Based Computing

Our approach to activity-based computing (ABC) is rooted in a year-long engagement in the study of, and design for, hospital work with focus on the challenges of handling parallel activities, interruptions, mobility, sharing, collaboration, coordination, and easy access to large amount of physical and digital information [4]. In the analysis of the use of contemporary computer technology in hospital work we have seen a range of critical shortcomings, which pose fundamental challenges to the design of future computer technology, including lack of support for mobility, collaboration, and multi-device integration [1].

Activity-based computing (ABC) is a novel approach to computing, which focuses on computational support for mobile, collaborative, and distributed activities which are adapted to their usage context. We are arguing that support for whole activities, rather than individual tasks, are important in ubiquitous multi-device environments. We have defined activity-based computing around the following essential principles:

Activity-Centered – A 'Computational Activity' collects in a coherent set a range of services and data needed to support a user carrying out a work activity. This principle helps users manage large amount of task-related digital resources.

Activity Suspend and Resume – A user participates in several activities and he or she can alternate between these by suspending one activity and resuming another. Resuming an activity will bring forth all the services and data that are part of the user's activity. This principle helps users manage multi-tasking and interruptions.

Activity Roaming – An activity is stored in an infrastructure (e.g. a server) and can be distributed across a network. Hence, an activity can be suspended on one device in one work setting and resumed on another in a different place. This principle supports mobility without necessarily relying on mobile technology.

Activity Sharing – An activity is shared among collaborating users. It has a list of participants who can access and manipulate the activity. Consequently, all participants of an activity can resume it and continue the work of another user. Furthermore, if two or more users resume the same activity at the same time on different devices, they will be notified and if their devices support it, they will engage in an on-line, real-time desktop conference. This principle helps users collaborate.

Context-awareness – An activity is context-aware, i.e. it is able to adapt and adjust itself according to its usage context. Context-awareness can be used for adapting the user interface according to the user's current work situation or it can be used in a more technical sense, where the execution of an activity, and its discovery of services, is adjusted to the resources available. This principle helps users to adapt to changing context.

In short, ABC supports complex information and task management and has been successfully applied to several areas, including desktop computing [3] and pervasive computing in hospitals [1, 2]. Recently, the *Clinical Surfaces* system [2] used the ABC approach to allow clinicians to manage, access, and move patient data across a distributed multi-display environment covering a whole hospital.

6.3 ReticularSpaces

Compared to previous research on smart space technology, *ReticularSpaces* presents an integrated approach to a unified UI design, information and task management, collaboration, and nomadic computing that builds on the activity-based computing approach and principles [5, 6]. *ReticularSpaces* extends the research on distributed multi-display environments for hospitals to a generic approach for general-purpose smart space technology. Reticular-Spaces supports:

- A unified interaction paradigm for handling activities, applications, resources, documents, and services across a distributed displays environment.
- A peer-to-peer and event-based architecture to manage the complex flow of distributed activities and documents between users, displays and devices.
- Support for mobile and nomadic users moving in and out of the smart space environment.
- Support for communication, collaboration and awareness among local and remote users

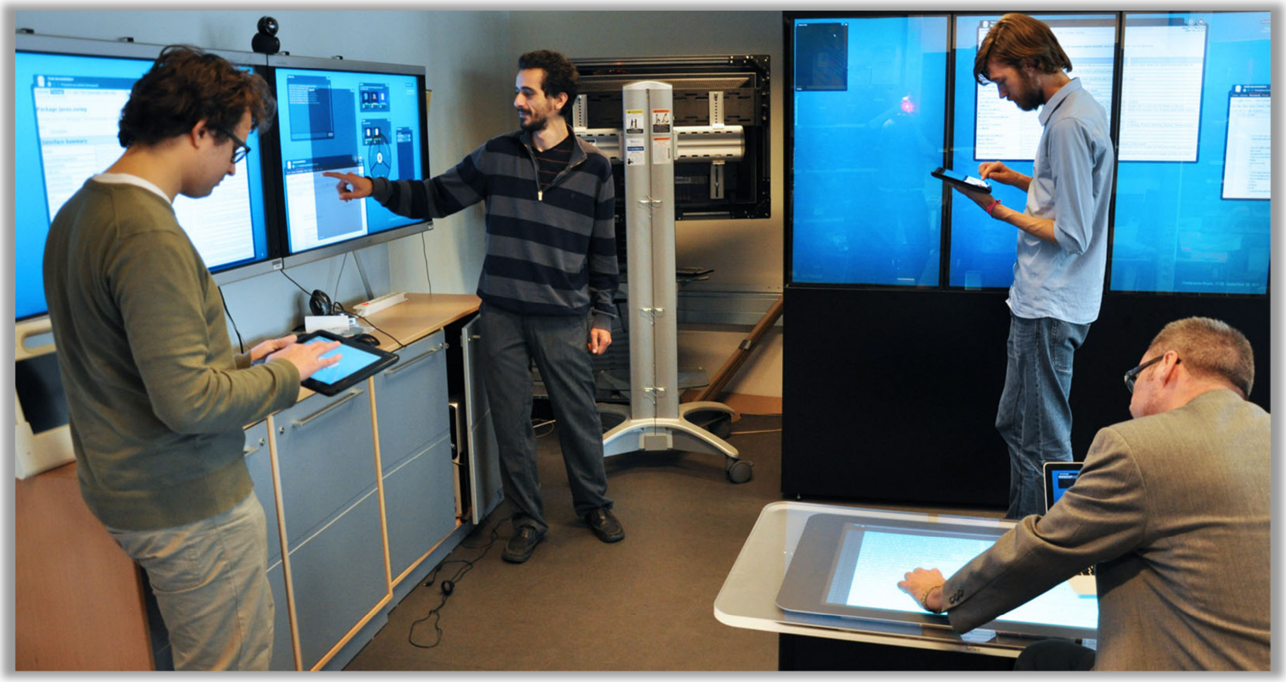


Figure 3: *ReticularSpaces* in use. Support for large interactive displays, multi-touch displays, tabletop displays, mobile computers, and tablet computers.

Figure 3 shows *ReticularSpaces* in use in a smart space setup including a number of different displays, indoor location tracking, and collaboration via video conferencing. The system focuses on 4 main things:

1. **User Interface** – *ReticularSpaces* implements a completely novel UI metaphor for smart space. As such, *ReticularSpaces* does not rely or expand on existing desktop UIs, but implement a new design based on an 'Activity' metaphor. The goal is to align the UI metaphor to the activities of the users, rather than their desktop.
2. **Information Management** – according to the 'Activity' metaphor, *ReticularSpaces* implements an activity-based computing approach to information and data management. Thus, in contrast to the desktop metaphor where information management is modeled according to an office (files, folders, trashcans), the goal of *ReticularSpaces* is to align information management to the activities of the users.
3. **Mobility** – *ReticularSpaces* has inherent support for mobility of users as well as devices. In addition to supporting devices entering and leaving a smart room, *ReticularSpaces* supports mobility within a larger smart space, which typically spans large geographical areas like a hospital, large factory, or a campus.
4. **Collaboration** – *ReticularSpaces* has inherent support for collaboration amongst users and devices. In addition to supporting collocated collaboration by display sharing inside a room, remote collaboration across a larger site is supported.

6.4 Activity-Based Computing in Emergency Crisis Management

In general, Accidents & Emergency (A&E) departments in hospitals handle acute patients with severe medical problems and victims from accidents. In an emergency crisis situation, a significant load is put on the A&E departments in the vicinity of the emergency situation. For example, in a large bus accident on the highway, the A&E department of the local hospital would receive considerably more patients with significantly more injuries than normally. In such a situation, it is important that paramedics from ambulances can efficiently hand over patients to the staff of the A&E department, which again can prioritize patients (know as “triage” in medical terminology), cooperate and communicate internally as well as with other nearby A&E departments, and get a complete overview of the crisis situation.

If we look at A&E departments in a hospital setting, modern hospitals are already starting to deploy and use large interactive screens for overview, indoor location tracking, mobile computers like smartphones and tablets, and use video and sensors for facility and patient monitoring. In other words; smart space technology is being adapted and deployed in crisis management in A&E departments in hospitals. A picture from a Danish A&E department is shown in Figure 4.

Figure 4: Interactive displays used in Accidents & Emergency departments for crisis management by paramedics (left) and clinicians (right). Used with permission from Cetrea.

Since activity-based computing originated from in-depth studies of hospital settings, we view *ReticularSpaces* as a promising platform to support crisis management in A&E departments.

From a clinical usage point of view, *ReticularSpaces* will help clinicians and paramedics with:

- **Information Management** – *ReticularSpaces* provides easy access to relevant patient information and helps integrate different information sources. The support for large interactive displays helps clinicians to get an overview of data and to navigate large data sets. The system helps identify and present relevant “activities” for the clinicians, thereby providing easy and fast access to relevant data, services, and resource that are tailored to the specific work context. For example, when a doctor approach a large display like the one in Figure 4, the list of relevant patient case (i.e. “activities”) are listed on the display, and when clicking one of them, relevant data for this patient is displayed and laid out on the displays, thereby enable the doctor get fast and easy access to the patient case. Relevance are determined based on the “type” of activity, which in the A&E department typically will be an “Emergency” activity holding information on basic patient life parameters, radiology images, and triage information.

- **Task and Patient Flow Management** – *ReticularSpaces* inherently presents users with the most relevant tasks (“activities”) in the current situation and thereby guides clinicians through a set of tasks for managing the flow of patients. Checklists can be incorporated that makes sure that clinicians goes through a set of step in an otherwise hectic crisis situation.

- **Overview** – *ReticularSpaces* is inherently designed to provide a task-based overview of relevant resources and data. In particular, *ReticularSpaces* makes use of many interactive displays and helps users to e.g. move data from a tablet to a large interactive wall-display for easy overview and sharing in a medical staff meeting (as shown in Figure 4)

- **Communication** – *ReticularSpaces* supports text- and voice-based communication through the so-called "Activity Log", which logs all communication events in an activity. As such, all communication in *ReticularSpaces* is tied to a specific activity and thereby filtered for easy and fast communication. For example, when resuming the activity related to a specific patient, the Activity Log will displays all historic communication related to this patient, which may include text, pictures, and video.
- **Mobility** – *ReticularSpaces* supports all kind of mobile devices ranging from smartphones, tablets, and portable laptops. Moreover, *ReticularSpaces* has in-built support for indoor location tracking in a hospital. This is extremely important in an emergency crisis situation where efficient location of staff and patients can mean the difference between life and death. For example, having a complete overview of the location of staff in a hectic A&E department with many injured patients helps locate a doctor that is required in a life-saving treatment of a patient.
- **Collaboration** – *ReticularSpaces* is inherently design to support "activity sharing", which means that several collaborating clinicians can share e.g. a patient case, work on it separately or concurrently. *ReticularSpaces* helps bridge distance in collaboration, and if two or more clinicians resume and work on the same patient case simultaneously, then *ReticularSpaces* automatically establish a video conferencing session. Moreover, *ReticularSpaces* supports task hand-over from one device to another (more specifically from one activity system to another). This is for example used in the hand-over from paramedic to clinicians when arriving at the A&E department. In this case the paramedics can simply drag a patient from the ambulance's tablet computer to the large displays in the A&E department.

In summary, the idea of activity-based computing originated in the design of ubiquitous computing technologies for hospital work. *ReticularSpaces* is the most recent activity-based computing technology platform and should be suitable for the use in hospitals, including supporting emergency crisis situation in A&E departments. *ReticularSpaces* have, however, not yet been tailored specifically for a hospital scenario, but this is something that we plan to pursue in our future research.

6.5 References

[1] JE Bardram. Activity-based computing for medical work in hospitals. ACM Transactions on Computer-Human Interaction, 16(2):1–36, 2009.

[2] JE Bardram, J Bunde-Pedersen, A Doryab, and S Sørensen. Clinical Surfaces — activity-based computing for distributed multi-display environments in hospitals. In Proceedings of INTERACT 2009, p. 704–717, Berlin, Heidelberg, 2009. Springer-Verlag.

[3] JE Bardram, J Bunde-Pedersen, and M Søgaard. Support for activity-based computing in a personal computing operating system. In Proceedings of the 2006 ACM conference on Human Factors in Computing Systems (CHI 2006), New York, NY, USA, 2006.

[4] JE Bardram and C Bossen. Mobility Work – The Spatial Dimension of Collaboration at a Hospital. Computer Supported Cooperative Work, 14(2):131–160, 2005.

[5] JE Bardram, S Gueddana, S Houben, and S Nielsen, "*ReticularSpaces*: activity-based computing support for physically distributed and collaborative smart spaces", in Proceedings of the 2012 ACM conference on Human Factors in Computing Systems (CHI 2012), New York, NY, USA, 2012.

[6] JE Bardram, S Houben, S Nielsen, and S Gueddana, "The design and architecture of *ReticularSpaces*: an activity-based computing framework for distributed and collaborative smartspaces", in Proceedings of the 4th ACM SIGCHI symposium on Engineering interactive computing systems (EICS 2012), New York, NY, USA, 2012.

7 "CrisisWall" - A Multi-Device, Multi-System Crisis Management Software

Tom De Groeve[1] **Markus Rester**[1] **Martin Atkinson**[1] **Yaniv Steiner**[2]

Brian Doherty[1] **Alessandro Annunziato**[1] **Daniele Galliano**[1]

European Commission - Joint Research Centre, Institute for the Protection and Security of the Citizen (IPSC), Italy

[1] *{firstname.lastname}@jrc.ec.europa.eu* [2] *{firstname.lastname}@ext.jrc.ec.europa.eu*

7.1 Introduction

After two years of extensive experience with operating a big wall display it can be concluded that many large display installations are functioning from a hardware point of view. However, the software available to operate and utilize such video walls has much room for improvement in functionality, in particular for a situation room environment.

With experience gained in human computer interaction (HCI) in several projects (including ECML experiments and developments for multitouch phones and tablets), the Crisis Monitoring and Response Technologies (CRITECH) action, in collaboration with the Open Source Text Information Mining and Analysis (OPTIMA) action, have developed a concept of dedicated software exploiting the benefits of a large video wall and supporting a clear set of situation room tasks: analysis, collaboration, and presentation.

The concept combines novel layouts for the big wall display, support for multiple interaction modes (touch-screen, surface table, iPad, space mouse, etc.) and OLAP (on-line analytical processing) techniques. The software is in essence a presentation layer exploiting to the maximum the existing information systems of the Global Security and Crisis Management Unit (GlobeSec) unit but in a harmonized and integrated way: Global Disaster Alert and Coordination System (GDACS) [1] by the Crisis Monitoring and Response Technologies (CRITECH) action, Europe Media Monitor (EMM) [2] by the Open Source Text Information Mining and Analysis (OPTIMA) action, Global Human Settlement Layer (GHSL) by the Geo-Spatial Information Analysis for Security and Stability (ISFEREA) action, Theseus by the Statistics and Information Technologies for Anti-Fraud and Security (SITAFS) action, Spatial Data Infrastructure (SDI) by the Geospatial EMergency Management (GEMMA) action, etc.

7.2 Concept for "CrisisWall"

The CrisisWall will follow classical service oriented architecture. All GlobeSec systems have well-defined, standardized Application Programming Interfaces (APIs), providing access to their data and functionality. Future systems to be integrated will need to have similar APIs.

7.2.1 Architecture

The CrisisWall software uses the APIs to get data from the systems dynamically and display it on the wall as text, lists, maps, graphs, time series, images, networks or other formats. The CrisisWall could also interact with the systems for editing, manipulating, processing, and storing data by back channel communication.

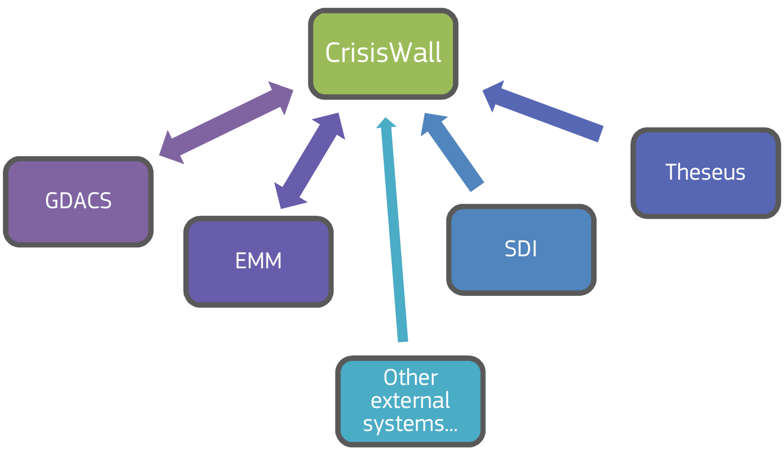


Figure 5: Systems feeding information to CrisisWall and possible back channel communication

Central to the concept is a well-defined data structure (see Figure 6). All systems expose their content in a similar way, using json. The data object consists of two levels:

- *item*: a single data item with common metadata and system-specific metadata.
- *event*: a group of items, with additional metadata (e.g. statistics, aggregate data)

The common metadata elements must be such that all items can be mapped (geographic information), displayed as a time series (time or period) or as a table (attribute, value). Specific metadata elements are used by system-specific visualization methods.

The data elements are not static. The Crisis Wall software allows users to add or change metadata elements. The key analytical tasks usually consist of validating, interpreting and judging data, and then recording the context-specific data. (For instance, one article may report on death tolls in different provinces; these numbers must be recorded by province in a table-like format.)

The Crisis Wall stores information in an *activation* object. This is the core object supporting visualization of event-related information, but also triggering processes (e.g. "calculate population in affected area", "get GHSL statistics in this area"), composing situation maps and reports. An *activation* object contains one or more events (themselves containing items), one or more analyses, *view-settings* and a link to a *sitrep* and a *sitmap*.

The results of analyses, a selection of items, or new *analysis* text are posted in a *sitrep*. A *sitrep* object stores a list of data objects, their visualization settings (text, table, map, graph) and editing information. It works similar to Google Docs, with immediate storage and multiple simultaneous authors. It is similar to Critech's and Optima's newsletter solutions in its use of structured lists of data (RSS feeds or - in this case - json feeds). A *sitmap* object is similar, but defines a map.

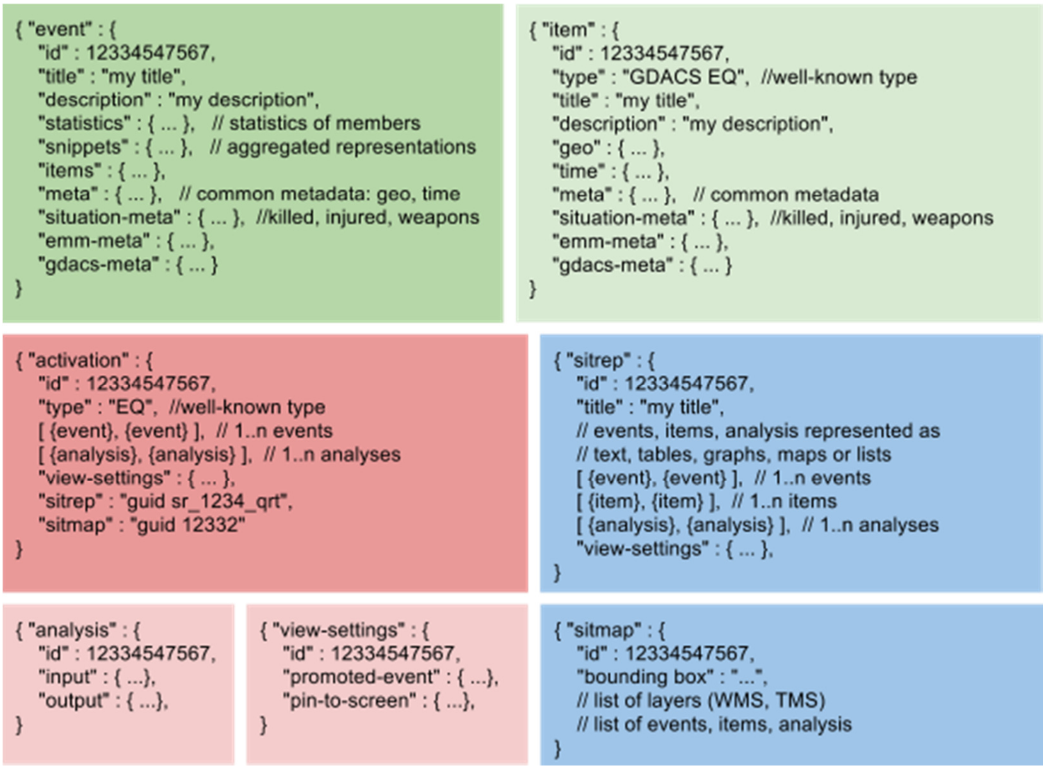


Figure 6: Unified data structure for items, events, activations, sitreps, sitmaps, analysis, and view-settings..

7.2.2 Emergency Management Tasks

The Crisis Wall software is targeted to the principle emergency management tasks in a national or international crisis room, such like the European Emergency Response Centre. Driven by the outcomes of previous research and ECML experiments, the following tasks were identified as having the most potential to benefit from the Crisis Wall.

- Surveillance
    - Overview of events in the world, with automatic notifications and attention management
- Activation: analytical tasks for an emergency
    - Operational coordination: tools for information management for the operations chief, with integrated, single access.
    - Collaborative analysis: tools for managing simultaneous interaction with the video wall to support collaborative, distributed and/or parallel tasks.
- Presentation
    - Handover among analysts: tools for showing tactical information
    - Situation overview for decision makers: tools for showing strategic information
    - Press room: tools for showing public, strategic information

7.2.3 Support for Multiple Devices

The main scope for the Crisis Wall software is to exploit the large display and interaction surface of the large video wall. However, a principal design element of the software is collaboration, be it with several analysts in front of the video wall, or distributed analysts using different devices. Therefore, the Crisis Wall software - or elements of it - should work on normal PCs, tablets, and smart phones, but also on surface tables and alternative devices.

An example of this is the joint writing of SitReps. Different analysts should be able to contribute to a single SitRep in an activation, each focusing on a particular task. They work each on their device of choice, best supporting their work. When their analysis is ready, they can post their contribution to the SitRep. The chief analyst, in charge of validating, editing and publishing the SitRep, has workflow control over the report (changing sections to read-only).

7.3 Design of "Crisis Wall"

7.3.1 Generic design of Crisis Wall layout

The space of the large video wall will be optimized for use by several interfaces, including touch enabled. This requires the screen to be laid out in a way that a person can reach the areas for interaction: the top parts of the screen cannot be reached. Besides touch, the screen can be interacted with using a surface table, iPads, regular mouse and keyboard and a space mouse.

The general components of the Crisis Wall are (see Figure 7):

- Interaction area: area for menus, buttons, etc.
- Notification, status and alert area: area that is always present in all layouts
- Main area: designed according to task

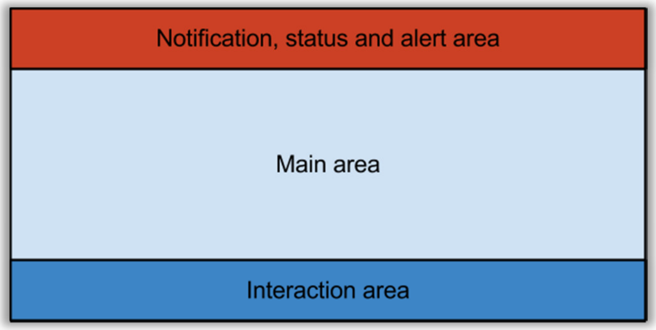


Figure 7: General three components of CrisisWall layout.

The top area is meant to show constant, important, summary information items, similar to the stock market ticker. It may contain:

- Alerts: alert status of a well-defined list of items that are monitored. For instance: natural disasters, conflicts, epidemics, etc. It shows the overall status of GDACS, EMM, etc.
- Notifications: a ticker like in LiveMon or the EMM ticker, consisting of the current GDACS alerts, top 3 EMM stories, etc.
- CrisisWall status: messages related to the software

The interaction area is near the bottom, but must be easily accessible by a person standing in front of the screen. Its position may be changeable according to the interaction device used.

7.3.2 Surveillance view

The surveillance view is shown during "peacetime". It is meant to provide a dynamic overview of all ongoing events, small and large. Dynamic content from composing systems is shown in a moving timeline (see Figure 8). Content is ranked according to relevance; relevant content is shown in larger windows, with more detail (e.g., a map).

Each content box can be clicked / touched. This stops the timeline and makes the box bigger, showing more content (e.g. a map) and options for interaction. One possibility is to "activate" the event, i.e. show this event on full screen. More than one box can be handled simultaneously by different users.

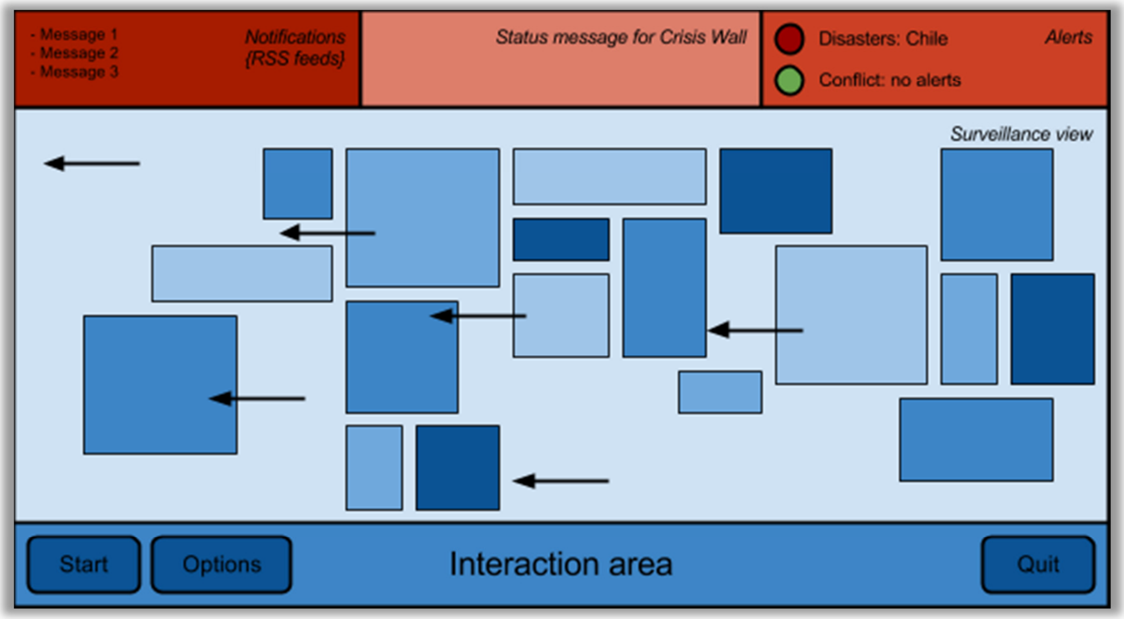


Figure 8: Surveillance view.

7.3.3 Activation view

The activation view shows relevant information for a particular event (see Figure 9). It is a view optimized for visual analytics.

An activation is started from an EMM story or a GDACS alert (usually through the surveillance view). Other events (EMM stories, EMM clusters or GDACS alerts) can be added to the activation (e.g. the EMM story associated to a GDACS alert, or an aftershock).

Depending on the event type, the view combines content from GDACS, EMM, external web sites and offers ways to visualize data in maps and graphs. The view supports actions such as:

- add layers to map: EMM stories, shakemap areas, storm surge areas, etc.
- translate text
- combine text, images, maps in situation report
- request GIS analysis (population in affected area, GHSL results in an area)

The surveillance bar remains visible on the right hand side (scrolling upwards). Associated events can be dragged from the surveillance bar into the activation view.

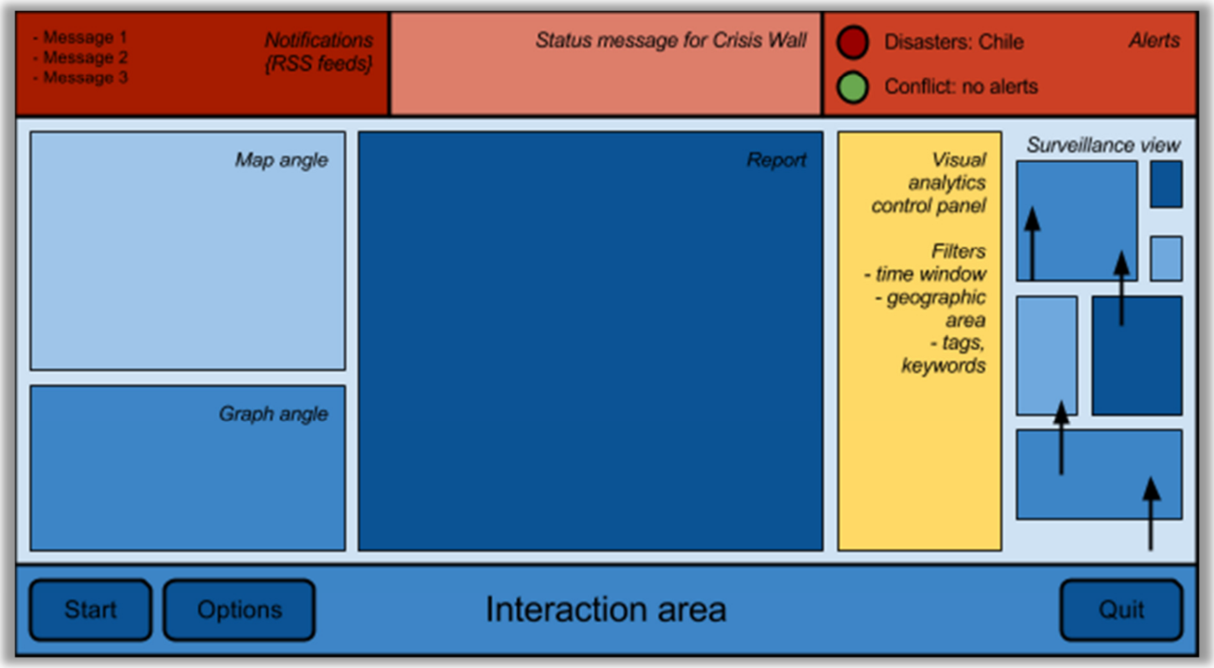


Figure 9: Activation view.

7.3.4 Presentation view

The presentation view is similar to the activation view, but replaces analytical tools by presentation tools. Maps e.g., are displayed in Google Earth instead of in 2D maps to allow for immersion effects. Most interactions buttons and options are hidden.

7.4 Conclusion

Combining the experience with building software for supporting emergency management tasks and the experience with building software for multiple devices is ideal to take up the challenge to design and develop innovative software for supporting emergency management on large video walls.

The presented design of the CrisisWall application is based on a unified data structure capable of handling input from different relevant existing and possible future systems. It is based on tasks at hand at crisis management and situation monitoring centres. It supports three main usage scenarios: situation surveillance, activation during a crisis situation, presentation mode for e.g., briefing high level decision makers.

7.5 References

[1] De Groeve, T., Vernaccini, L., Annunziato, A.: Modelling disaster impact for the global disaster alert and coordination system. In: Proceedings of the 3rd International ISCRAM Conference, Newark, NJ. 2006.

[2] Atkinson, M. and Van der Goot, E.: Near Real Time Information Mining in Multilingual News. In: Proceedings of WWW 2009.

8 Multi-user Twitter Analysis for Crisis Room Environments

Simon Butscher[1] **Jens Müller**[1] **Andreas Weiler**[2] **Roman Rädle**[1] **Harald Reiterer**[1] **Marc Scholl**[2]

[1]HCI Group, University of Konstanz, Germany

[2]DBIS Group, University of Konstanz, Germany

{firstname.lastname}@uni-konstanz.de

8.1 Abstract

In this paper we suggest novel interaction and visualization techniques for a prospective ECML crisis room environment focusing on the analysis of social media data. For this purpose we describe both, concepts providing a Daily Newsflash and concepts for the preparation of Daily Reports referring to a selected incident or crisis situation. The Daily Newsflash is an overview of global incidents regarding humanitarian crises, natural disasters, disease outbreaks, conflicts, etc. Such a bulletin typical contains 1-5 international items with brief facts and 1-5 European items. For selected incidents or crisis situations a Daily Report is prepared. A typical Daily Report consists of one page usually providing a map, key facts, and a brief summary of the situation.

8.2 Introduction

Social media services can be a very important data source if it comes to identify and analyze crisis situations. In recent years there has been a continuous development of such social media services on the web. Unprecedented success and active usage of these services result in a vast amount of user-generated data containing a large diversity of information. A popular example is the microblogging platform Twitter. Initially introduced in 2006 as a simple platform for exchanging short messages ("tweets") on the internet, Twitter rapidly gained worldwide popularity (over 140 million active users as of 2012 generating over 340 million of tweets daily) and has evolved into an extremely influential channel for reporting and commenting about ongoing incidents.

Efficient monitoring of incidents within such data is a very challenging task. Therefor the usage of novel visualization techniques and automatic knowledge extraction is of vital importance to the analyst to obtain a correct and significant report about ongoing incidents of interest. Our proposal combines different visualization and interaction techniques to display the evolution of different dimensions of an incident using the social media service Twitter as data source.

8.3 Physical Environment

Control rooms are multi-display and multi-user environments. To make use of new interaction and visualization technologies it is important to consider the physical environment of a control room. While physical environments comprise various aspects in general, HCI typically focuses on only core aspects in this domain such as size, position, mobility, and orientation of interactive displays with respect to technological, ergonomic, and social constraints. Nonetheless, these contributions are very important to avoid situations in which the physical configuration of digital devices conflicts with natural collaboration styles.

A suitable environment is of vital importance for the design of future control rooms. Based on our visualization and interaction concepts we make use of different types of displays and input modalities (see Figure 10). The central device is an interactive tabletop ("Incident Selector") used for collaboratively selecting and filtering incidents and distributing information all over the control room. To get an overview and at the same time facilitate the nonverbal coordination of the operators we make use of a large wall-sized display. The large wall display ("Incident Overview") shows the single tweets referring to incidents that are potentially of interest. Additionally, two different device types are used for a more detailed data analysis: tablets and curved displays. Whereas tablets have the advantage of mobility and provide the possibility to freely move within the control room the curved display provides new perspectives to investigate an information space. The tablets ("Mobile Incident Inspectors") show detailed information on a particular section of the information space and offer tools for analyzing the information in a collaborative analysis situation. The curved display ("Stationary Incident Inspector") is designed as a single user workplace to analyze data in more detail.

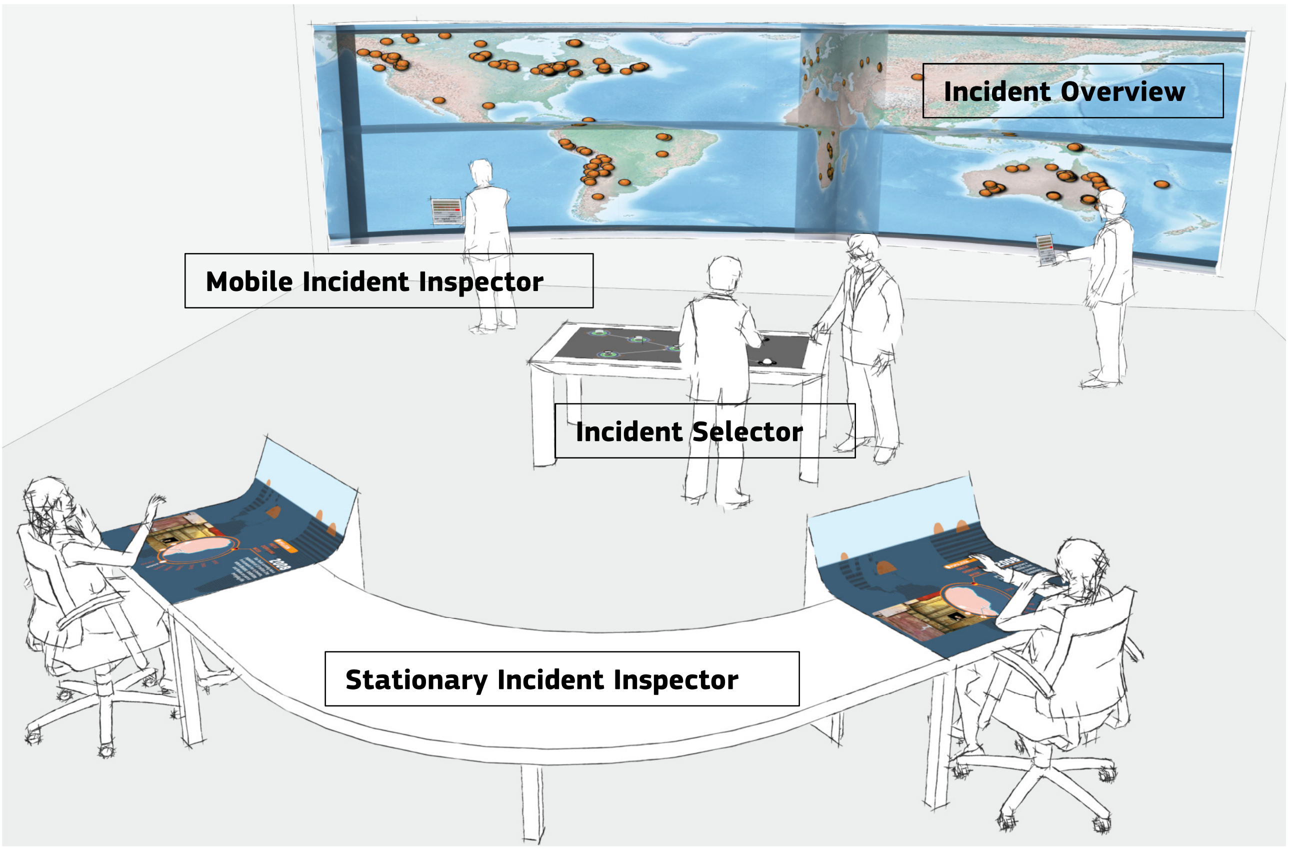


Figure 10: Future crisis control room environment

8.4 Visualization and Interaction Concepts

For the production of a Daily Newsflash the first thing is to identify possible topics using the Incident Selector on the interactive tabletop. Incidents can be detected with the help of an event identification approach using twitter data. To pre-filter this data regarding for example sentiment, geo-information or time period an interface for collaborative search is used. An overview over the geo-tagged Twitter Feeds is provided with the help of the Incident Overview. Such an overview helps to find hotspots, which are supposed to be investigated in more detail. At the same time the Mobile and the Stationary Incident Inspector enable a more detailed analysis e.g. in terms of sentiment analysis. The production of a Daily Report requires to first collaboratively filtering the Twitter Feeds regarding a special incident with the help of the interactive tabletop. Also for the production of the Daily Report the Incident Overview can be used to get an overview of the data related to the selected incident. For a more detailed analysis of this data the analysts again switch to the Mobile and Stationary Incident Inspector.

8.4.1 Incident Selector

For the production of a Daily Newsflash an automatic event identification approach can be used on the interactive tabletop. The method supports the analyst in keeping the overview about currently ongoing events. Weiler et al. [10] use a log-likelihood ratio approach to identify significant terms in the geographic and time dimension of live Twitter Streaming data (see Figure 11). The presented scenarios illustrate the opportunity to identify actual and ongoing events, which belong to a certain region and are outstanding over time, by using the log-likelihood ratio approach. Furthermore, it is possible to effectively eliminate random noise out of the data and suppress those repeating terms that are not of interest for the analyst. Later on, the Incident Overview and Incident Inspector can be used to track the identified events. For example, the occurrence of the storm incident in the Northeast of the USA on 7/8 February 2013 (see Figure 11) is identified by the approach. This is the most significant event that emerges in the first hour. The co-occurrence terms of the event indicate that the storm is a blizzard and the terms nemo and #nemo describe the given name of the snowstorm. During the next hours co-occurrence terms like warning, food, lines, and bread describe the situation around the storm. These terms indicate that the people on-site should be well prepared for the upcoming storm. Hereby it is possible to have a closer insight into the event and the analyst can see how the situation around an event evolves over time. Later on the Incident Inspector can be used to track the identified events.

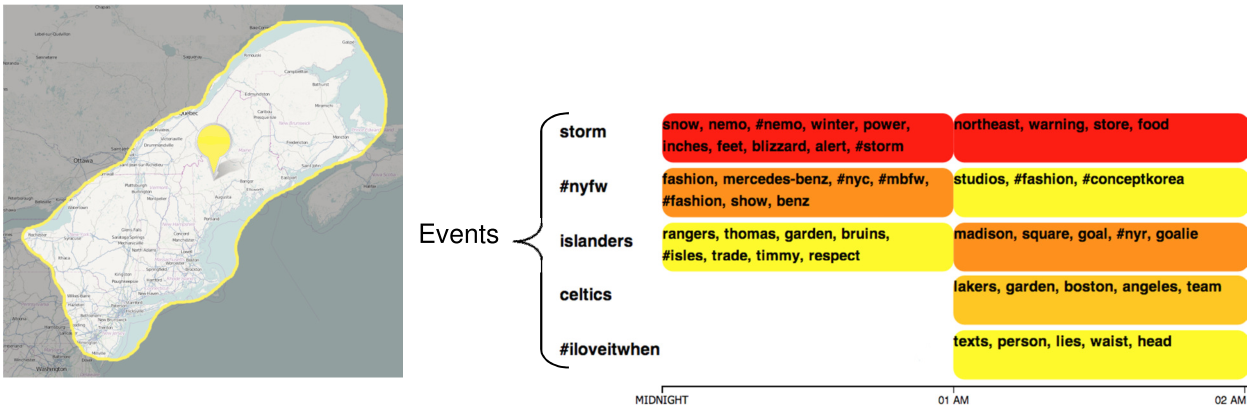


Figure 11: Log-likelihood event detection: (left) selection of region, (right) detected events

A faceted pre-filtering of the data used for the event detection can be done with the help of a Tangible User Interface using facets and keywords as described by Jetter et al. [2]. In this approach, Jetter et al. use an interactive tabletop to collaboratively search Twitter data to obtain information relating to specific situation criteria like geo-location or time (see Figure 12). This kind of information filtering is of vital importance if incidents for further investigation within the Daily Report have to be selected. Furthermore, the filter results are used to determine which information is shown on which of the other devices[3].

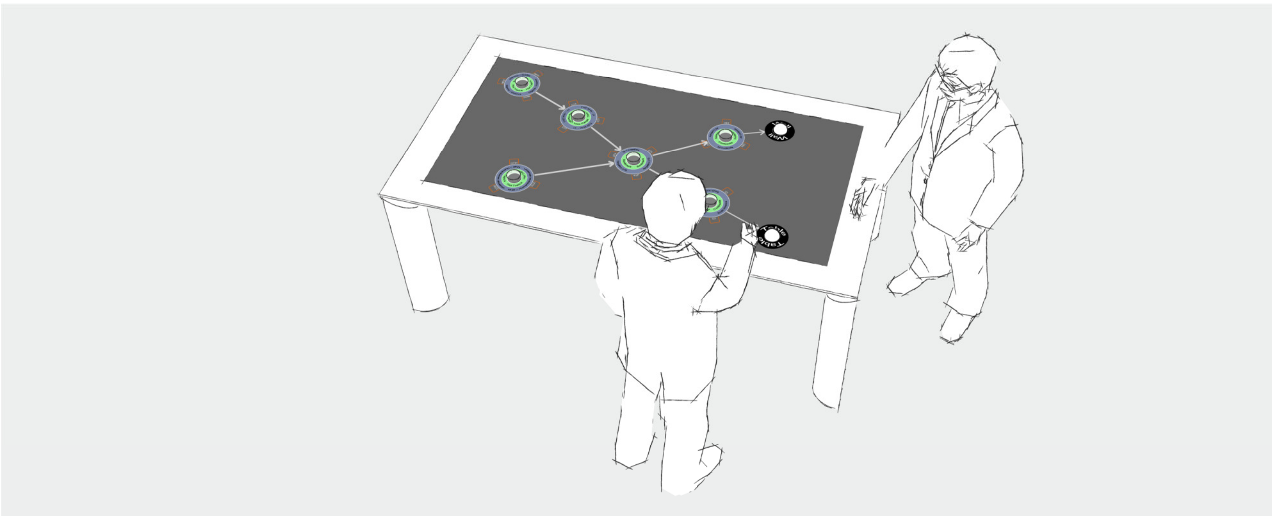


Figure 12: Tangible User Interface using facets and keywords to filter Twitter data and distribute information to other devices

8.4.2 Incident Overview

The Incident Overview can be used to obtain an overview over the data filter with help of the event detection algorithm. The use of a large wall-sized display facilitates nonverbal coordination between the analysts. Therefore we suggest a novel technique for visualizing the single tweets corresponding to relevant incidents within a multi-user setting. To provide an overview on the entire information space and at the same time display local details, we propose the so-called Folding View [8] which bases on the visualization technique by Elmqvist et al. [1]. It represents a dynamic distortion-based technique which folds the information space depending on the location of several focus points (see Figure 13). The concept guarantees the visibility of multiple focus regions while the folds themselves

[3] To clarify the interplay between the work at hand and the work done by Jetter et al., we sketched a unified video that highlights the workflow of a tangible and collaborative exploration of crisis data on a tabletop and a subsequent and profound analysis of previously filtered data with the help of tools described in this article: http://hci.uni-konstanz.de/researchprojects/crisis-room

show contextual information. Unlike other distortion techniques the Folding View provides a visual cue of the focus point distances by means of the depths of the individual folds. While a focus point is moved, the folding is adjusted in real-time and therefore features smooth transitions. There are various ways to move a focus point on a remote display. One of them is the proxemic navigation [6] where the user's location relative to the wall-sized display is used to manipulate the position of a focus point. The focus point is panned horizontally according to the user's lateral movement in front of the display. Forward and backward movements relative to the display are translated into vertical movements of the focus point. Another way to control a focus point is to use the tablet as a pointing device in the tradition of a laser pointer. Additionally, Adaptive Pointing [4][3] may be applied to foster precise interaction on remote displays. The technique improves pointing performance for absolute input devices by implicitly adapting the Control-Display gain to the current user needs. With the help of this technique it is additionally possible to select small clusters of tweets or a single tweet in a fast and precise manner. The third alternative refers to the utilization of the tablets as simple touchpads in which the focus points are controlled via vector scrolling.

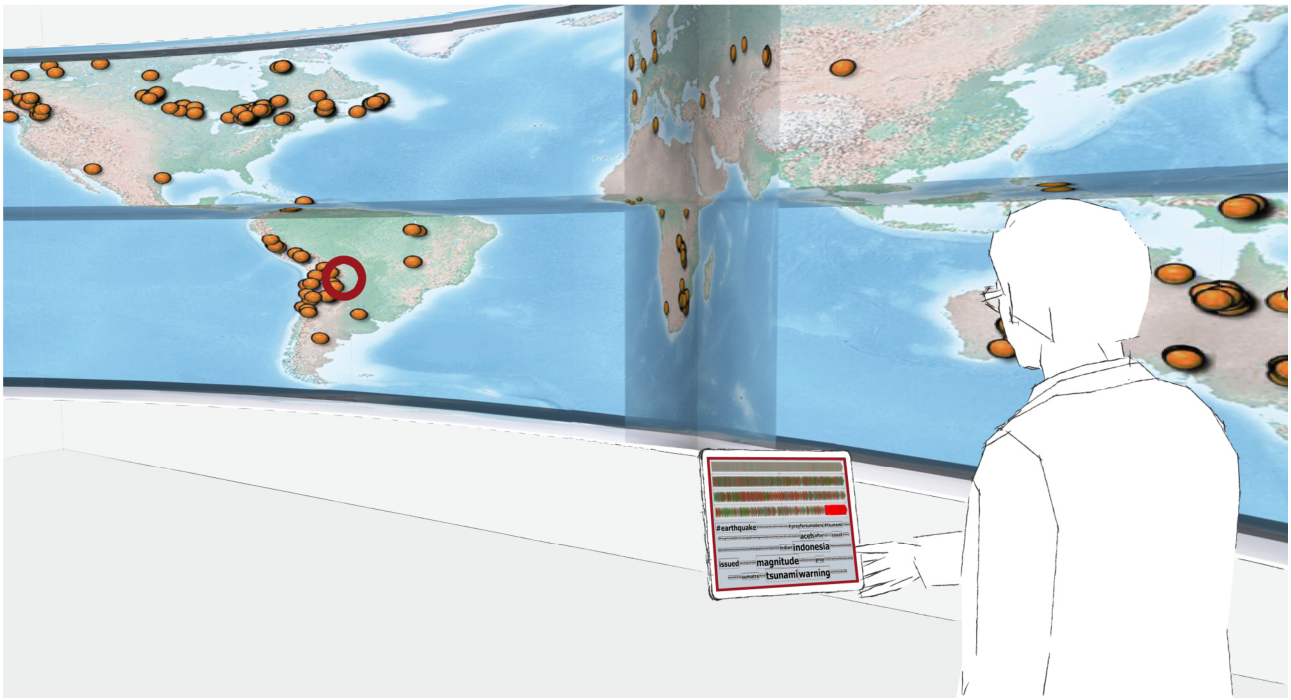


Figure 13: Folding View in combination with mobile devices for a more detailed data analysis

8.4.3 Mobile Incident Inspector

The Mobile Incident Inspector runs on the tablet device. It synchronizes with the corresponding focus region on the Incident Overview and serves as a tool for a more detailed analysis of the Twitter Feeds. Our current concept envisions the following panels (see Figure 14):

- *Situation Monitor*: This panel delivers a real-time visualization of the current tweet frequency about the monitored incident. Each line represents one hour of data. The filling color of a shape signifies the sentiment (red = negative, green = positive, grey = neutral) of the tweet and the opacity of the shape expresses the value (-5 = extremely negative to + 5 = extremely positive) of the sentiment.
- *Location Monitor*: This panel shows all single tweets corresponding to an incident with attached geographic information in the selected time frame from the Situation Monitor.
- *Information Monitor*: This panel summarizes the reported content of all tweets belonging to an incident in the selected time frame from the Situation Monitor.

Figure 14: Twitter data analysis: (left) Situation Monitor; (middle) Location Monitor; (right) Information Monitor

8.4.4 Stationary Incident Inspector

The Stationary Incident Inspector is a tool for a more detailed analysis of large information spaces and can be thought of as geo-tagged tweets visualized on a large map. To preserve the orientation within the information space and at the same time show detailed information, Schwarz et al. [9] propose a novel visualization technique based on a curved display. Large information spaces require special visualization patterns to allow easy and efficient interaction. Perspective + Detail is a visualization technique addressing this problem. The visualization technique is inspired by the bird's eye perspective used by Lorenz et al. [5]. The bird's eye perspective provides a simple top-down overview as well as a perspective view of the data combined on one single display. Thereby it enables the user to simultaneously explore information presentations with two different viewing angles (e.g. two-dimensional map information and three-dimensional height information). The drawback of the bird's eye perspective is that it leads to an unnatural change of the viewing perspective. The change of the perspective on a planar display might lead to difficulties and errors while interpreting the visualized data.

Perspective + Detail is based on a vertically curved interactive display [12] [11] to overcome the described problems (see Figure 15, left). Such a curved display combines a horizontal and a vertical screen into one smooth surface, minimizing the haptic, visual and mental gap between the differently oriented display areas. Perspective + Detail is based on three different interface elements: (a) an overview on the horizontal display segment of the curved display, (b) a detail view area on the vertical display segment and (c) a head-up display (HUD) in the connecting curved segment (see Figure 15, right). To enlarge the overview it is extended using a three-dimensional perspective view located within the curved display segment. The differently oriented segments of such a non-planar display allow for a natural view by a perspectively corrected visualization. Thus, three-dimensional extension extends naturally into the space behind the display surface (see Figure 16, left).

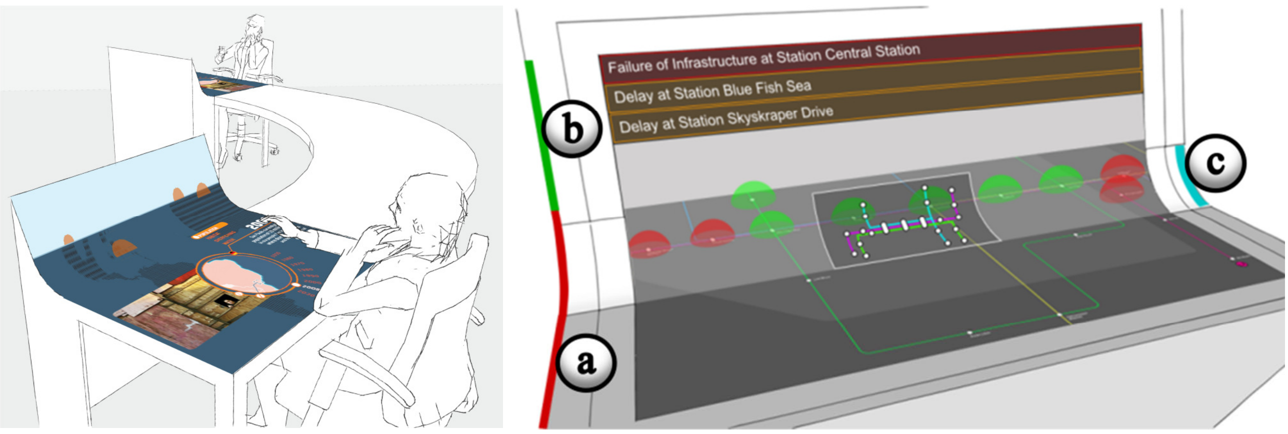


Figure 15: Perspective + Detail: (left) curved display in a crisis control room, (right) interface elements

- *Overview (a):* The horizontal segment offers an overview similar to a large map in the real world. It combines a top-down view on the information in front of the user with a natural perspective view on information far away from the user. This segment additionally supports conventional interaction options such as panning and zooming, which affect the overview visualization including the perspective extension.

- *Detail View (b):* The vertical display area is used to visualize detailed information about specific objects in the information space, as it offers a convenient viewing angle for reading tasks.
- *Head-up Display (c):* The semitransparent head-up display located in the arc of the curved display is superimposed on the three-dimensional extension of the overview, similarly to an HUD in a car or airplane.

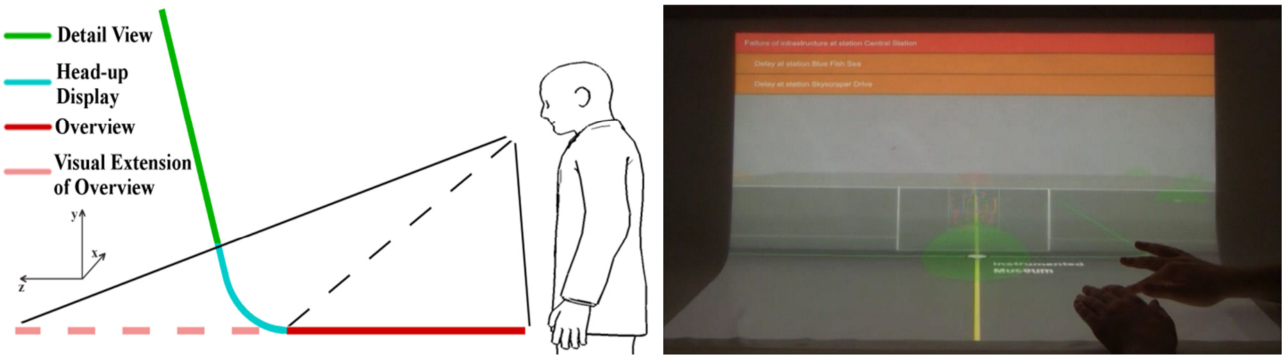


Figure 16: Display segments and visual extension

8.5 Outlook

The presented concepts offer a variety of features (techniques, features, and interplays of tools) to detect incidents and analyze social media data provided by Twitter. A combination of a pre-filtered data source in combination with automatic event detection can help establishing robust event detection. The use of a multi-focus technique enables multi-user interaction on a common information space. Furthermore, it allows multiple analysis scenarios such as the comparison of synchronous and asynchronous reactions of one incident at different geo-locations (e.g. on a national level). The combination of the Incident Overview and the Incident Inspectors enables a shared understanding regarding global incident data as well as ongoing tasks within the crisis room. Additional features may address the exclusive visualization of newly added information and the extraction of further information (e.g. credibility and social impact score) to rank the tweets and the detected incidents, respectively.

8.6 About the Authors

Harald Reiterer is head of the HCI Group at the University of Konstanz [7]. His research focus is on the development of new interaction techniques and visualizations for Distributed User Interface Environments like control rooms.

Simon Butscher is PhD student at the HCI Group of the University of Konstanz. He has been working on the design, implementation and evaluation of holistic workspaces for control rooms. His current research focuses on information visualization for collaborative interactive spaces.

Jens Müller is also PhD student and member of the HCI Group. Together with Simon Butscher he has been working on concepts for future control room settings whereat he focuses on tangible computing and interactive tabletops.

The HCI Group of the University of Konstanz is also home of Roman Rädle who is working on proxemics interaction techniques to support spatial navigation in large information spaces.

Marc H. Scholl is head of the DBIS Group at the University of Konstanz. His research in the area of databases and information systems focuses on theoretical and practical aspects of data intensive processing systems for many years.

Andreas Weiler is PhD student at the DBIS Group of the University of Konstanz. His current research focuses on social media stream analysis for event identification and tracking.

8.7 References

[1] Elmqvist, N., Henry, N., Y. Riche Y. and Fekete, J. D. (2008). Mélange: Space Folding for Multi-Focus Interaction. In Proc. of CHI 2008, ACM Press, 1333–1342.

[2] Jetter H-C., Schöning J., Rädle R., Reiterer H. and Rogers Y. (2013). Collaborative Interactions in Future Crisis Rooms. Submisson to ECML Workshop 2013.

[3] König W. A., Gerken J. and Reiterer H. (2013). Adaptive Pointing - Implicit Gain Adaptation for Absolute Pointing Devices. Patent number EP 2 226 707 B1.

[4] König, W. A., Gerken, J., Dierdorf, S. and Reiterer, H. (2009). Adaptive Pointing – Design and Evaluation of a Precision Enhancing Technique for Absolute Pointing Devices. In Proc. of INTERACT 2009, Springer, 658–671.

[5] Lorenz, H., Trapp, M., Jobst, M., and Döllner, J. (2008). Interactive multi–perspective views of virtual 3d landscape and city models. In Proc. of AGILE '08, Springer, 301–321.

[6] Rädle, R., Butscher, S., Huber, S. and Reiterer, H. (2012). Navigation Concepts for ZUIs Using Proxemic Interactions. In Proc. of Proxemics 2012 a Workshop in conjunction with NordiCHI 2012.

[7] Reiterer, Harald: Human-Computer Interaction Group, University of Konstanz, Germany. In Interactions, Nov+Dec 2011 (pp.82-85). ACM.

[8] Schwarz, T., Butscher, S., Mueller, J., and Reiterer, H. (2012). Content-aware navigation for large displays in context of traffic control rooms. In Proc. of AVI 2012, ACM Press, 249–252.

[9] Schwarz, T., Hennecke, F., Lauber, F., Reiterer, H. (2012). Perspective+Detail - a visualization technique for vertically curved displays. In Proc. of AVI 2012, ACM Press, 485–488.

[10] Weiler, A., Wanner, F., Rohrdantz C. and Scholl, M.H. (2013) Event Identification for Local Areas using Social Media Streaming Data. In Proc. of the SIGMOD Workshop on Databases and Social Networks, ACM Press.

[11] Weiss, M. Voelker, S., Sutter, C., and Borchers, J. (2010). BendDesk: dragging across the curve. In Proc. of ITS 2010, ACM Press, 1–10.

[12] Wimmer, R., Hennecke F., Schulz, F., Boring, S., Butz, A., and Hussmann, H. (2010). Curve: revisiting the digital desk. In Proc. of NordicCHI 2010, ACM Press, 561–570. Text Text Text Text Text Text Text Text

9 Collaborative Interactions in Future Crisis Rooms

Hans-Christian Jetter[1] **Johannes Schöning**[1,2] **Roman Rädle**[3] **Harald Reiterer**[3] **Yvonne Rogers**[1]

[1] Intel ICRI Cities, University College London, United Kingdom, United Kingdom

[2] Hasselt University, Belgium

[3] University of Konstanz, Germany

h.jetter@ucl.ac.uk johannes.schoening@uhasselt.be roman.raedle@uni-konstanz.de

harald.reiterer@uni-konstanz.de y.rogers@ucl.ak.uk

9.1 Abstract

In this paper, we tie together different streams of research from our institutions to present a joint vision of collaborative computer-supported interactions in future crisis rooms. We envision novel interaction and visualisation techniques for the next generation of crisis rooms that will better support collaborative search, analysis, and comparison of data during sensemaking activities. Such a sensemaking activity for example could be the production of daily situation reports. We focus on how users can benefit from device ecologies consisting of big wall displays, interactive tabletop surfaces and tangible user interfaces during such activities.

9.2 Introduction

Since we are researchers in the field of Human-Computer Interaction (HCI) and Information Visualisation (InfoVis), we combine technological aspects and human aspects in our research. For us, novel devices, sensors and visualisations are enabling technologies that, if they are designed and combined in an appropriate user-centred manner [7], can support collaborative activities to a much greater extent than desktop personal computers with traditional WIMP (Windows Icons Menu Pointer) applications. Therefore, rather than focusing on individual technologies or single WIMP applications, our research emphasis here is on how to support collaborative activities of multiple people in an interactive physical space through multiple devices, displays and post-WIMP interaction and visualisation techniques.

We believe that future crisis room should be designed holistically as collaborative interactive spaces with careful consideration of the users' individual interactions, their social interactions, their workflows and their physical environment [8]. For example, we need to facilitate the switching between different topics, representations and phases of the workflow. We must also consider how to design lures, salient information, and grabbers for our attention [6] and how to employ seams, bridges and niches to let users benefit from device ecologies [9]. To approach this goal, we here propose different designs and technologies that are based on our previous research and are combined to illustrate how collaboration in future crisis rooms could look like.

9.3 Components of a Future Crisis Room

Before we describe the individual components and their interplay, we introduce a simple scenario of use as a starting point. In this scenario, two or more users are searching Twitter feeds to find tweets that contain relevant information about a specific situation, e.g., a humanitarian crisis in a city struck by a natural or man-made catastrophe. They want to use keywords (e.g., hashtags) or different facets (e.g., time, geo location, number of retweets) to narrow down the flood of incoming tweets to a manageable amount. In the following, we describe a setup that enables this collaborative search for selected facets and keywords in large amounts of tweets by integrating a tabletop system with tangible user interface elements into a setup with a large video wall. This setup can be regarded as complementary to the setup that is described in a further submission to this workshop by the University of Konstanz [3]. To illustrate the interplay between the different components, we created a video sketch[4] that shows the workflow of a tangible and collaborative exploration of crisis data on a tabletop and a subsequent analysis of the filtered data in a multi-focus visualization on a large wall-sized display.

[4] http://hci.uni-konstanz.de/researchprojects/crisis-room

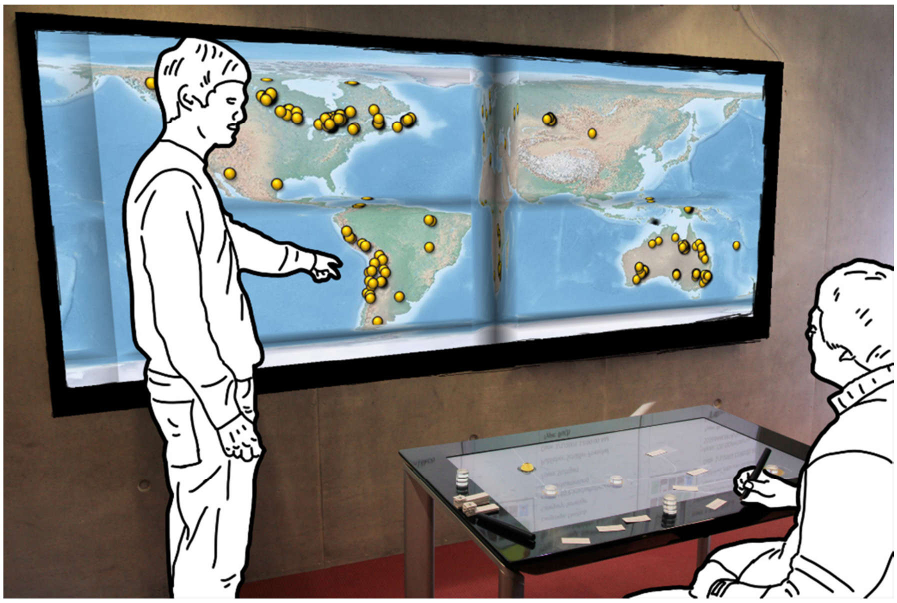


Figure 17: Combination of a video wall showing a geographic visualisation and a tabletop for searching and filtering tweets.

9.3.1 Tabletop for Collaborative Search and Filtering

The tabletop system for collaborative search and filtering is based on “Facet-Streams” a hybrid visual-tangible user interface that was designed, implemented and evaluated by the University of Konstanz [1]. It enables co-located collaborative search by combining techniques of information visualisation with tangible and multi-touch interaction[5] (see Figure 18). It harnesses the expressive power of facets and Boolean logic without exposing users to complex formal notations. User studies revealed how the system unifies visual and tangible expressivity with simplicity in interaction, supports different search strategies and collaboration styles, and turns search into a fun and social experience [1]. More recently this system was extended with keyword and faceted search in large amounts of tweets and visualising and manipulating them on external devices such as video walls (see Figure 17).

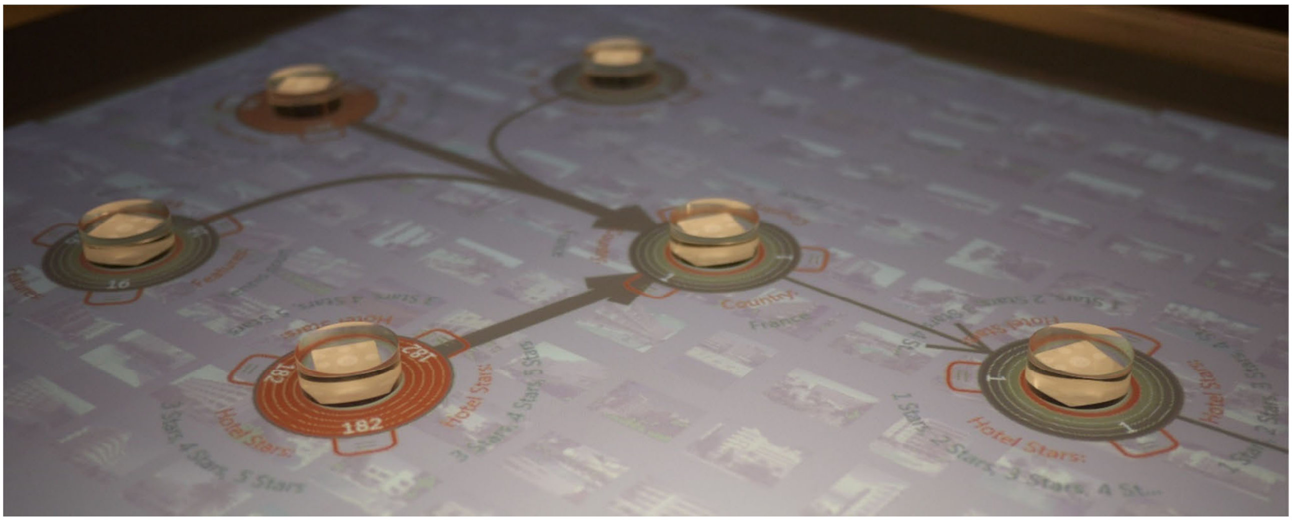


Figure 18: Facet-Streams combines a filter/flow metaphor with tangible user interface elements.

[5] Video: http://www.youtube.com/watch?v=giDF9lKhCLc

9.3.2 Optical User Identification

To enable a truly collaborative search activity, it is important to track the users' identity throughout this task to later use this information to create the daily report. Recent work on "Carpus" by the University of Hasselt[6] shows how multi-user collaboration on interactive surfaces can be enriched significantly if touch points can be associated with a particular user [2]. Carpus is a non-intrusive, high-accuracy technique for mapping touches to their corresponding users in a collaborative environment. By mounting a high-resolution camera above any interactive surface, it is able to identify touches reliably without any extra instrumentation, and users are able to move around the crisis room (see Figure 19). The technique, which leverages the back of users' hands as identifiers, supports walk-up-and-use situations in which multiple people interact on a shared surface. Using such an identification technique to extend the search will greatly enhance the possible design space and will enable better support of individual users and their needs during collaboration. The technique could also be used to identify users, when interacting via touch with stereoscopic data as proposed in [12].

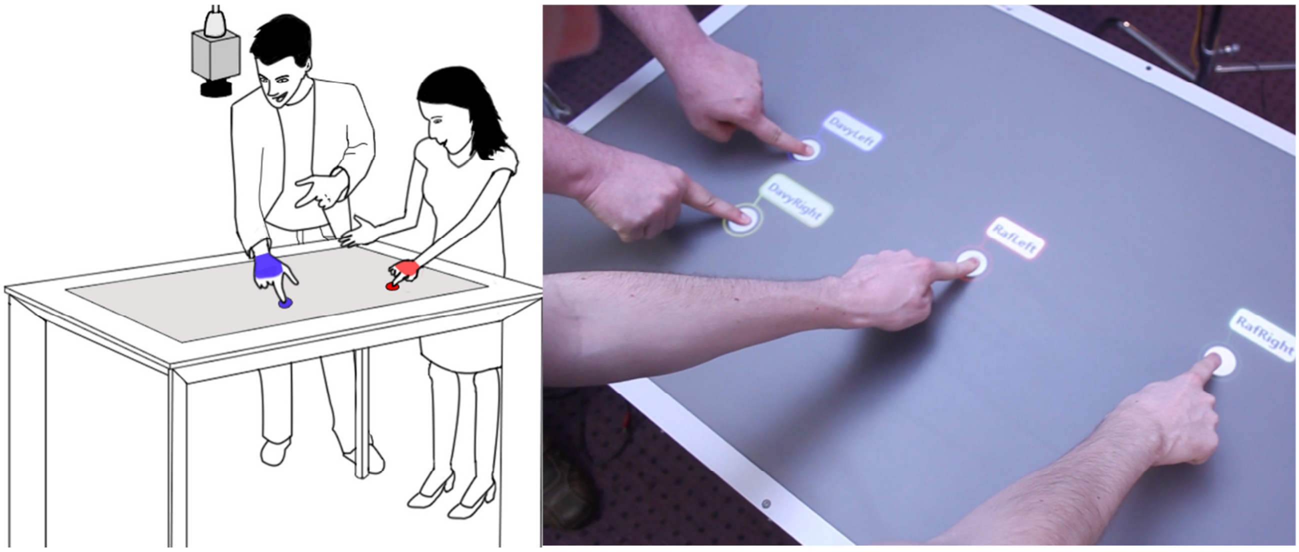


Figure 19: Carpus enables multi-user identification on interactive surfaces by analyzing the back of users' hands. (left) Illustration of the technical setup. (right) Carpus identifies two users and distinguishes between their left and right hand.

9.3.3 Space-folding Techniques for Geographical Visualisation

When specific information is found, it is also important to provide different (often geographic) visualisation techniques to present this information (in our case geo-tagged Twitter feeds) in the daily report. Please refer to [3] for detailed information. As an example, Schwarz et al. used a space-folding technique (see Figure 17Figure 16) that enables multiple users to collaboratively explore map data and to focus on different geographic regions while sustaining their spatial context and creating spatial awareness among group members [4].

9.3.4 Lenses for Multi-user Interaction with Geographic Data

In [5], a lens concept is used to allow synchronous multi-user interaction with geographic visualisations. These lenses are GUI widgets that can be used like scalable as well as zoomable magnifying lenses. GeoLenses are fully multi-user capable while still being intuitive to use. Bier et al. first introduced the notion of the "magic lens" in an UI in 1993 [10]. Bier et al.'s original lenses are transparent or semi-transparent user interface elements, which can be placed over objects to change their appearance and/or facilitate interaction. Since then, the concept has been applied frequently to geographic visualisation [11] to overcome the problems of multi-user interaction with spatial information.

[6] Video: http://www.youtube.com/watch?v=HNQfjnw4Aw4

Figure 20: A GeoLens visualizes location-dependent geographic data similar to a "magic lens".

9.4 Conclusion

In the previous section we highlighted four different components and their interplay to show how to better support collaborative search, analysis, and comparison of data during sensemaking activities in future crisis response rooms. We still see a lot of potential of ICT technology to better support the heterogeneous teams in crisis control rooms and their various, often highly complex, tasks and activities. This clearly involves designing user-centred tools, interactive visualisations and novel user interfaces for crisis response rooms, alongside with the teams working in theses rooms, to provide them with information that they can readily understand and act upon to save lives.

9.5 About the authors

The newly founded Intel Collaborative Research Institute (ICRI) on Sustainable Connected Cities [6] is led by Yvonne Rogers (UCL), who has been researching interactive tabletops and shareable user interfaces "in the wild" for many years [7], Julie McCann (Imperial College London, UK) and Duncan Wilson (Intel).

ICRI Cities is also the home of Johannes Schöning who is working on tabletop and mobile interaction technologies and Hans-Christian Jetter who has joined ICRI Cities in April 2013 from the University of Konstanz, where he has been working with Roman Rädle and Harald Reiterer on the design, implementation, and evaluation of collaborative interactive spaces and user interfaces for knowledge work.

Harald Reiterer heads the Human-Computer Interaction Group at the University of Konstanz [13]. His research focuses on the development of new interaction techniques and visualisations for distributed user interface environments like control rooms.

Roman Rädle is PhD student at the Human-Computer Interaction Group of the University of Konstanz. His current research focuses on proxemic interaction techniques to support spatial navigation in large information spaces.

9.6 References

[1] Jetter, Hans-Christian, Gerken, Jens, Zöllner, Michael, Reiterer, Harald, and Milic-Frayling, Natasa (2011), 'Materializing the query with facet-streams: a hybrid surface for collaborative search on tabletops', Proc. CHI '11 (ACM), 3013-22.

[2] Ramakers, Raf, Vanacken, Davy, Luyten, Kris, Schöning, Johannes, and Coninx, & Karin (2012), 'Carpus: A Non-Intrusive User Identification Technique for Interactive Surfaces', Proc. UIST '12 (ACM), 35-44.

[3] Butscher, Simon, Müller, Jens, Weiler, Andreas, Rädle, Roman, Reiterer, Harald, Scholl, Marc H. (2013, Jan). Multi-user Twitter Analysis for Crisis Room Environments. (submitted to this workshop)

[4] Schwarz, Tobias, Butscher, Simon, Müller, Jens, & Reiterer, Harald (2012, May). Content-aware navigation for large displays in context of traffic control rooms. In Proceedings of the International Working Conference on Advanced Visual Interfaces (pp. 249-252). ACM.

[5] von Zadow, Ulrich, Daiber, Florian, Schöning, Johannes, & Krüger, Antonio. GlobalData: multi-user interaction with geographic information systems on interactive surfaces. In ACM International Conference on Interactive Tabletops and Surfaces 2010 (pp. 318-318). ACM.

[6] Schöning, Johannes, Rogers, Yvonne, Bird, Jon, Capra, Licia McCann, Julie A., Prendergast, David, & Sheridan, Charles. Intel Collaborative Research Institute-Sustainable Connected Cities. In Proc. of AmI 2012.

[7] Rogers, Yvonne, Sharp, Helen, & Preece, Jenny (2011). Interaction Design: Beyond Human Computer Interaction. 3rd Edition.

[8] Jetter, Hans-Christian, Geyer, Florian, Schwarz, Tobias, Reiterer, Harald (2012), Blended Interaction – Toward a Framework for the Design of Interactive Spaces, Workshop "Designing Collaborative Interactive Spaces" (DCIS 2012) at AVI 2012, HCI Group, Univ. of Konstanz, May 2012.

[9] Tim Coughlan, Trevor D. Collins, Anne Adams, Yvonne Rogers, Pablo A. Haya, Estefanía Martín (2012) The conceptual framing, design and evaluation of device ecologies for collaborative activities. International Journal of Human-Computer Studies, Volume 70, Issue 10, October 2012, Pages 765–779

[10] Bier, Eric A., et al. "Toolglass and magic lenses: the see-through interface." Proceedings of the 20th annual conference on Computer graphics and interactive techniques. ACM, 1993.

[11] Carpendale, Sheelagh, John Ligh, and Eric Pattison. "Achieving higher magnification in context." Proceedings of the 17th annual ACM symposium on User interface software and technology. ACM, 2004.

[12] Schöning, Johannes, Steinicke, Frank, Krüger, Antonio, Hinrichs, Klaus. "Bimanual interaction with interscopic multi-touch surfaces." Human-Computer Interaction–INTERACT 2009. Springer Berlin Heidelberg, 2009. 40-53.

[13] Reiterer, Harald: Human-Computer Interaction Group, University of Konstanz, Germany. In interactions, Nov+Dec 2011 (pp.82-85). ACM.

10 Collaborative Situation Report Production on Big Wall Displays: the CoSitRepSys

Peter Judmaier[1] **Markus Rester**[2]

[1] Institut of Creative\Media/Technologies, University of Applied Sciences St.Pölten, Austria

[2] Institute for the Protection and Security of the Citizen, European Commission Joint Research Centre, Italy

peter.judmaier@fhstp.ac.at *markus.rester@jrc.ec.europa.eu*

10.1 Abstract

This paper presents the concept for a collaborative situation report production system (hereinafter referred to as CoSitRepSys) being used in situation monitoring centres and crisis management headquarters (hereinafter crisis rooms) equipped with large display areas.

We present a concept of a collaborative system that aims at supporting the production of daily bulletin and situation report production or similar workflows.

The central feature of the CoSitRepSys is the collaborative editing of reports and a broad applicability on big wall displays of varying size. The whole system uses just a few simple interaction patterns. There are two separate areas: one for creating and editing situation reports and another for sifting and review of information sources.

The key artefact is the big wall display and the information shown thereon. Besides the present operators also remote team members can control what is displayed by using their personal mobile devices, such as laptops, tablets or smart phones. Web technology and html-based deployment ensures a substantial independence of operating systems.

10.2 Introduction

In the daily business of information analysts producing situation reports (SitReps) on evolving and ongoing crises a huge amount of information sources has to be screened. Detected incidents have to be recorded and prioritised and depending on the severance immediate or later research has to be scheduled. The incident detection, the search for detailed information on relevant cases, and the SitRep production are perfectly suited for division of labour. This asks for adequate support by computer supported cooperative work (CSCW) ICT systems.

In the context of civil protection bodies and humanitarian aid organisations situation monitoring centres equipped with large display areas (video walls) and several operators and analysts present are becoming more and more common. In the same time remote team members and experts have to be included in the work processes as well. These settings need specialised solutions to exploit the available large displays and support both remote and co-located contributors.

Such a solution should address some of the following issues and provide respective functionalities to support: interactive collaboration of co-located and remote co-workers, discovery of relevant incidents, sharing of information, attention management of newly available information and knowledge, prioritisation, attention handling and processing of information, dynamic and adaptive display and alignment of relevant information on all connected devices (e.g., big wall display, desktop computers, multi-touch tables, tablet computers, and smartphones).

10.3 Crisis Rooms and Big Wall Displays

The work setting in crisis rooms for situation monitoring and reporting are very specific and can be characterised by a high degree of collaboration and cooperation. Especially the optimal flow of information between and amongst operators, coordinators, and co-located experts needs special attention (Azadehdel, et al. 2009; Gryszkiewicz, et al. 2010). Particular design challenges arise from the collaborative work processes that have to be supported (Yuill et al 2012):

- awareness of actions of co-workers
- high control over the interface
- availability of background information

Here video-walls can provide significant support to the teams of users but at the same time require additional design efforts (Gouin, et al. 2011):

- Information content: what is presented when and how?
- Content and display: how to dynamically arrange and manage the displayed content?

- Integration: how is the video-wall integrated with other devices (e.g., tablets, touch-tables, and smartphones) into a smart and well-connected ICT system?
- Interaction: which interaction modes are most appropriate in crisis rooms?

Novel interaction mode opportunities result from touch and motion sensors (Jota 2009). But these are also of limited use or require sophisticated enhancement because of the display size and the multi-user setting. A direct interaction (e.g., via touch) with the video-wall is difficult because of the lack of accessibility and the required constant movement in the room (Bausisch 2006). As with every other interaction design concept, the interaction design for video-walls has to be simple, intuitive, and largely known to the users in order to reduce the cognitive load in using the system to a minimum.

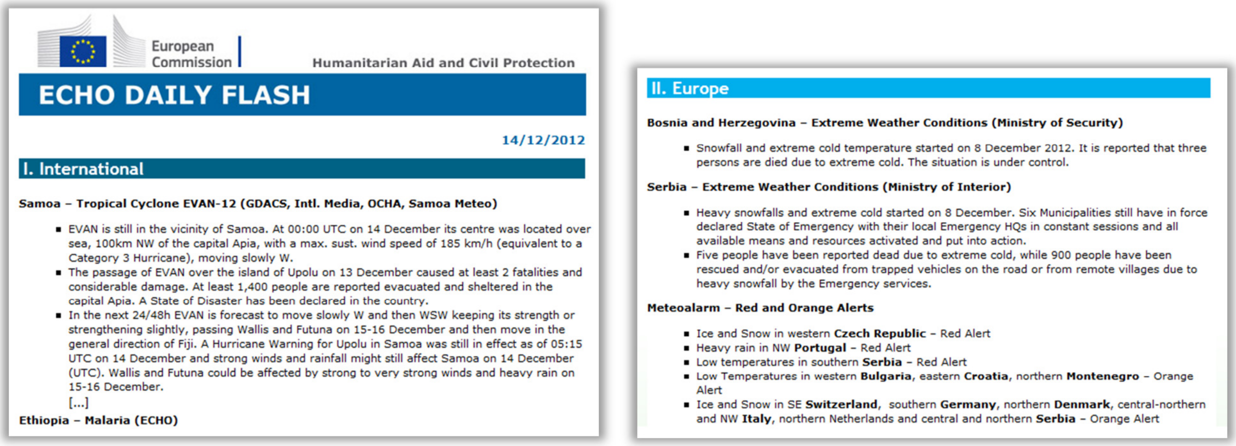
Beside the mentioned challenges with respect to the appropriate design of a collaborative situation report system (CSRS), video-walls also offer big advantages when utilised in crisis rooms: reducing the cognitive load by offering more room to display relevant visual information in parallel (Andrews, et al. 2010), or an increased spatial perception and more accurate interpretation of geographic maps (Desney et al 2003). Currently there is little experience with video-walls in crisis rooms supporting a CSRS, so it is of particular importance to select a user centered design approach which takes account of the users, the context, and the tasks (Rogers et al 2008).

10.4 Crisis Monitoring and Situational Reporting at CriTech

The Crisis Monitoring and Response Technologies (CriTech) action of the Global Security and Crisis Management (GlobeSec) unit in Ispra produces every day two reports on evolving and ongoing crisis situations worldwide for the European Commission Monitoring and Information Centre (MIC) of the European Community Humanitarian Office (DG ECHO) in Brussels. Interviews with information analysts who produce these daily reports give the following picture of a typical workflow.

There are three tasks scenarios for the analysts:

- Scenario 1: Daily Newsflash. First thing in the morning is providing an overview of what is going on worldwide with respect to humanitarian crises, natural disasters, disease outbreaks, conflicts, etc. A typical bulletin contains 1-5 international items with brief facts and/or analysis and 1-5 European items (see Figure 21).


European Commission

Humanitarian Aid and Civil Protection

ECHO DAILY FLASH

14/12/2012

I. International

Samoa – Tropical Cyclone EVAN-12 (GDACS, Intl. Media, OCHA, Samoa Meteo)

- EVAN is still in the vicinity of Samoa. At 00:00 UTC on 14 December its centre was located over sea, 100km NW of the capital Apia, with a max. sust. wind speed of 185 km/h (equivalent to a Category 3 Hurricane), moving slowly W.
- The passage of EVAN over the island of Upolu on 13 December caused at least 2 fatalities and considerable damage. At least 1,400 people are reported evacuated and sheltered in the capital Apia. A State of Disaster has been declared in the country.
- In the next 24/48h EVAN is forecast to move slowly W and then WSW keeping its strength or strengthening slightly, passing Wallis and Futuna on 15-16 December and then move in the general direction of Fiji. A Hurricane Warning for Upolu in Samoa was still in effect as of 05:15 UTC on 14 December and strong winds and rainfall might still affect Samoa on 14 December (UTC). Wallis and Futuna could be affected by strong to very strong winds and heavy rain on 15-16 December.

[...]

Ethiopia – Malaria (ECHO)

II. Europe

Bosnia and Herzegovina – Extreme Weather Conditions (Ministry of Security)

- Snowfall and extreme cold temperature started on 8 December 2012. It is reported that three persons are died due to extreme cold. The situation is under control.

Serbia – Extreme Weather Conditions (Ministry of Interior)

- Heavy snowfalls and extreme cold started on 8 December. Six Municipalities still have in force declared State of Emergency with their local Emergency HQs in constant sessions and all available means and resources activated and put into action.
- Five people have been reported dead due to extreme cold, while 900 people have been rescued and/or evacuated from trapped vehicles on the road or from remote villages due to heavy snowfall by the Emergency services.

Meteoalarm – Red and Orange Alerts

- Ice and Snow in western **Czech Republic** – Red Alert
- Heavy rain in NW **Portugal** – Red Alert
- Low temperatures in southern **Serbia** – Red Alert
- Low Temperatures in western **Bulgaria**, eastern **Croatia**, northern **Montenegro** – Orange Alert
- Ice and Snow in SE **Switzerland**, southern **Germany**, northern **Denmark**, central-northern and NW **Italy**, northern Netherlands and central and northern **Serbia** – Orange Alert

Figure 21: ECHO Daily Flash, cf. http://ec.europa.eu/echo/news/echo-flash/index_en.htm

- Scenario 2: Daily Report. For selected incidents or crisis situations daily reports are prepared. A typical daily report consists of one page usually giving a map, key facts, and a brief summary of the situation. Preparation time is about 1-3 hours per report. Additional to the two analysts typically one domain expert (hurricane, tsunami, earthquake, etc.) and one GIS expert is involved (see Figure 22).

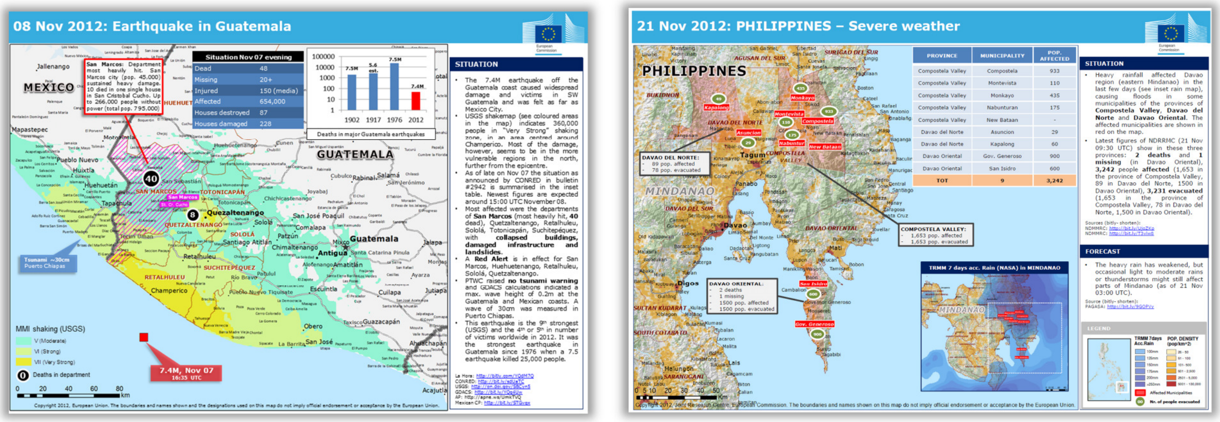


Figure 22: JRC Daily Report on selected incidents.

- Scenario 3: Detailed Report. For severe situations a detailed report may be requested. This in depth analysis takes 1-4 day to prepare and is usually between 5 and 20 pages long containing maps, timelines, InfoVis. Depending on the situation it includes components like sophisticated GIS analysis, forecasts based on prediction models, risk assessments, vulnerability estimations, and impact assessments. Beside the analysts, usually two domain experts, a team leader, and sometimes the head of unit are involved in the production of these reports.

The workflow of the information analyst team starts typically around midnight. One analyst screens at home media web sites for crisis events. He/she drafts a first information compilation document. At breakfast the analysts watch breaking news on TV and add new information to the document.

The first analyst in office scans selected tweets (official, trusted private). He/she opens a new report file and starts directed searches for relevant information. The second analyst joins about an hour later, reviews the report file(s) and takes over the search tasks while analyst one concentrates on summarisation and report production from there on. Collocated team members will be involved if necessary.

At 09:00 the bulletin is sent to Brussels via email. Responsibilities and tasks for the following work on daily report(s) (information search, compilation, and map production) are assigned then. At 15:30 am the final daily report(s) are sent to Brussels.

10.5 Concept for Cooperative Reporting

The presented concept of a collaborative system aims at supporting the described daily bulletin and report production or similar workflows. Time-critical decision making on tactical level (e.g., command & control of first responders; military domain) is not addressed and not in the focus of interest.

The basics of the workflow are twofold: 1. search for crisis information, and 2. cooperative (collocated, remote) crisis report production. The first artefacts in this workflow are compiled during the night in remote locations.

Only in the morning starts the analysts' work in the crisis room. Here additional collocated experts join the team if needed. This results in four key design requirements:

- A situation report is a cooperative document to which the entire team has access to anytime and from anywhere. The SitRep and changes to it is displayed crisis room on the video-wall in real time.
- Information and data sources can be shared via the video-wall in the crisis room or directly between the operators' devices.
- The video-wall in the crisis room sets the focus of the resources search tasks for the team.
- A searchable database with previous reports and data sources supports operators.

The big wall display in the crisis room is split into two areas (see Figure 23): a SitRep area and a resources area each with its own navigational aid. In the SitRep area up to two reports can be opened simultaneously. A SitRep contains a description, a map with markers and explanations, comments, and sources. The sources area includes a grid for up to

9 web-based sources. The navigation is based on a fish eye view which is ranked according to age of source and frequency of use. For fast lookup of sources or reports filter can be applied.

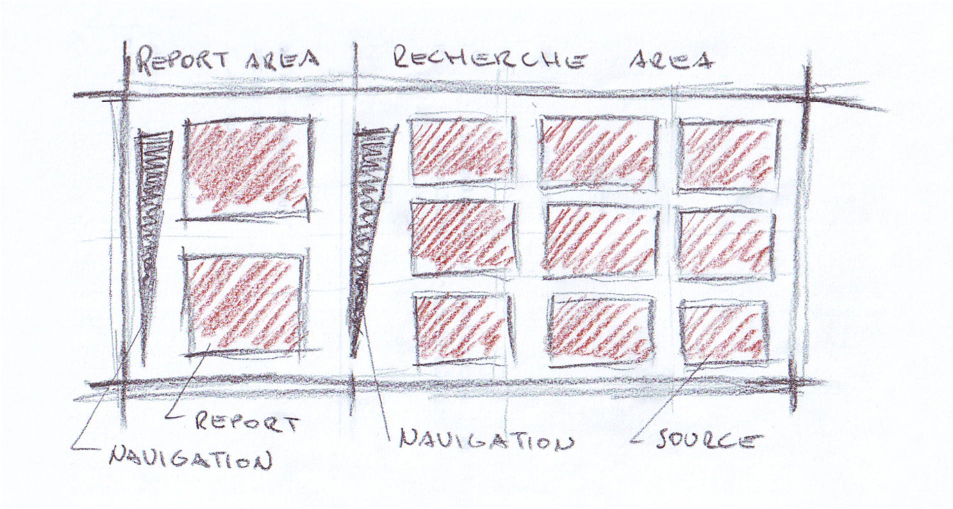


Figure 23: Basic layout of CoSitRepSys. Report area on the left information sources on the right.

The operators work with a variant of the CoSitRepSys, which basically has the same layout as the big wall display, but is adapted to the respective device used (desktop computer, tabletop computer, laptop, tablet, smartphone). Changes in any report are immediately displayed on all connected devices if the respective report is currently viewed on a given device.

10.6 Technical Framework

An html-framework that allows browser-based access via the internet is a suitable technical basis for the proposedd system. By means of responsive web design (cf. Marcotte 2011), a device independent access as well as device tailored interaction design is ensured. The core of the system is the databases on a central server to which all operators and experts have access, regardless of their location (see Figure 24).

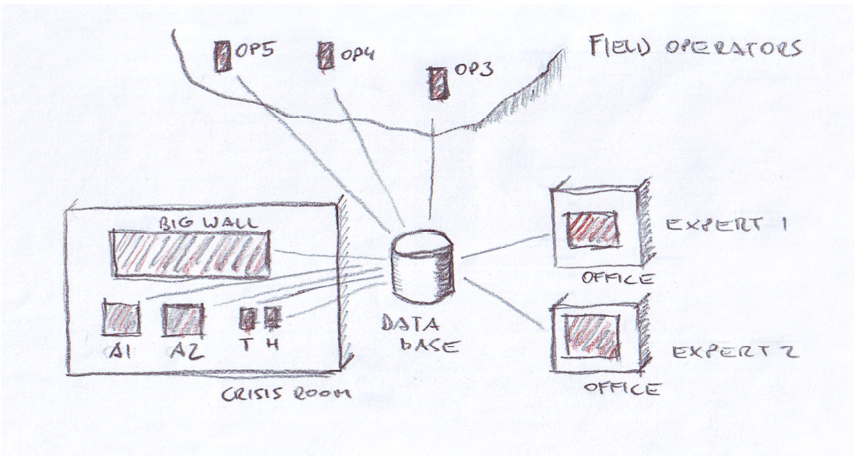


Figure 24: System design of CoSitRepSys. Central database serving all users with their respective devices.

This solution allows the integration of further crisis rooms with their respective big wall displays and other display devices (e.g., tables, interactive whiteboards). For smooth cooperation both reports and operators could be associated with one crisis room. A given team in one crisis room is then in charge of final editing and distributing a given report. For more detailed and precise map production with GIS applications the CoSitRepSys provides e.g., a KML export function.

10.7 Concept Demonstration

The central features of the CoSitRepSys is the collaborative editing of reports and a broad applicability on big wall displays of varying size. The whole system uses just a few simple interaction patterns. There are two separate areas: one for creating and editing situation reports and another for sifting and review of sources.

10.7.1 Reports Area

Each report is displayed in its own window with the crisis map as the central element (see Figure 25). The map element of the report window is automatically selected on creation of a new report and can be panned and zoomed. For annotating and editing the crisis map standard tools allow to add pointers, circles, and polygons. Polygons and circles are used to highlight areas and all have a description field. All markers in the map and the related text can be coloured. A legend can be added. To support the analysis and editing processes, it is possible to put comments on the crisis map. They are continuously numbered and are shown as blue squares. Thus they differ in shape and colour from the other marker elements on the map.

On top of the map element there is the crisis description. Two colours are available to highlight important data or information. On the right in the report window there are two inspectors for comments and sources. The comment inspector shows the comments added on the map (blue square icons). It is also possible to enter text comments in the inspector without being related to a position on the map. The latter are numbered independently and get a circular icon for being distinguishable.

All information sources of a report originate from the system's sources area. They are numbered and dated. If a used source is currently displayed within the sources area its number gets a square icon indicating a displayed window. Otherwise a circle is displayed. Clicking the latter opens the respective source in the sources area.

Closing one of the inspectors (comments, sources) enlarges the other inspector. For easy editing each inspector can also temporarily populate the whole report window area. If both inspectors are closed, the report window is reduced to the map and description elements.

A report window is either in edit mode or view mode. After completion and closing of a report becomes locked and can only be viewed and no longer edited. Using the timeline below the map element the genesis of a report can be traced and examined.

On the left side of the report area a navigation bar shows all existing reports in the CoSitRepSys. These are visualised in a time-ordered fish-eye-view and can be filtered by the search mask on top. Open reports are shown with inverted coloured icons. The number next to the icon in the navigation bar and the header of the report window shows a given user the number of newly added sources or comments.

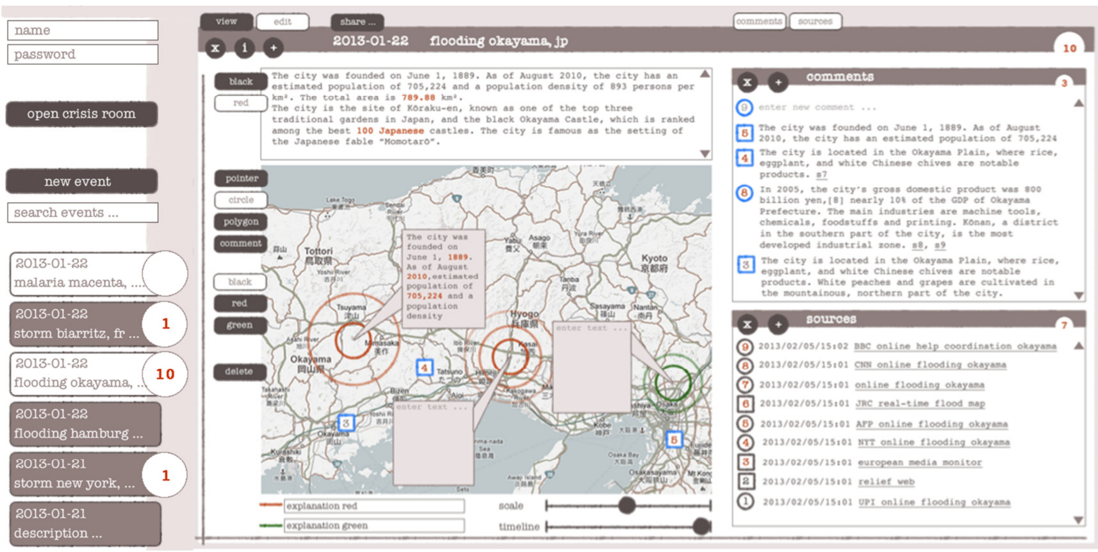


Figure 25: Report including description, comments, maps, and references.

10.7.2 Resources Area

In the sources area any web-based information source can be displayed as fully functional browser windows (see Figure 26). A system-wide database stores all sources which have been accessed by the operators. To harvest this sources database again a fish-eye-view is provided which can be filtered. To quickly view sources temporarily it is possible to open a browser window and enter a URL without having it stored in the database of sources. So cluttering is avoided. Sources windows can be resized subject to a grid within the sources area. Similar to the inspectors within a report window, any source can temporarily populate the whole source area for detailed examination.

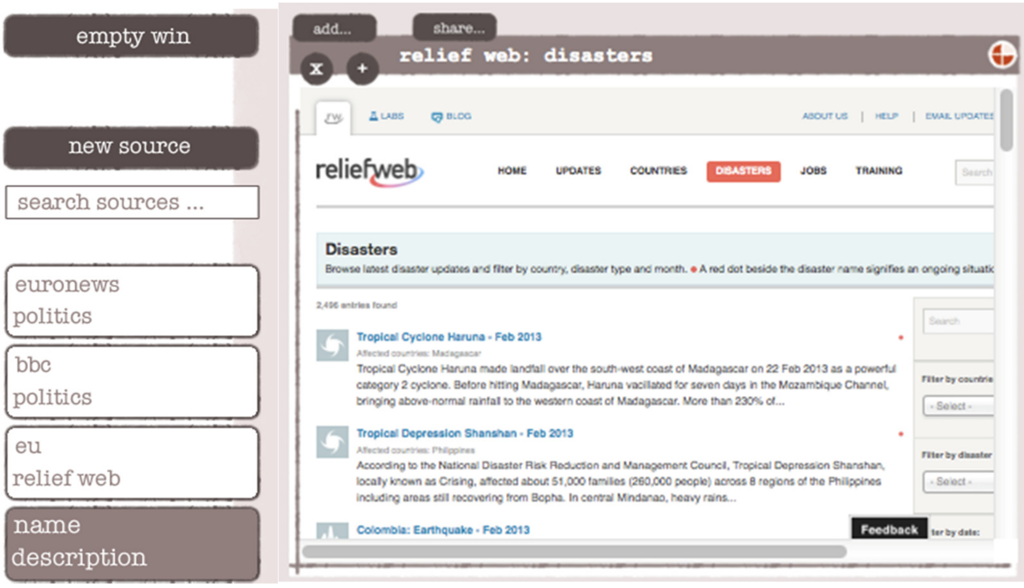


Figure 26: Web based information source displayed in sources area of CoSitRepSys.

10.7.3 Collaboration and Big Wall Display Interaction

Three user groups have been identified according to their roles and/or the devices they use to access the CoSitRepSys: coordinators, crisis room operators, and experts (either field based or collocated). Big wall displays itself can be treated as a fourth special user group.

- Coordinators are e.g., team leaders or heads of unit who connect typically via mobile devices like laptops, tablets or smart phones. Their focus is on monitoring a situation and the progress of information analysis. They are of course able to control the big wall display to get relevant data.
- Crisis room operators monitor incidents and compile SitReps if needed. They have access to fully equipped desktop workstations with large monitors. The big wall display supports them as a shared workspace that enables them to exchange sources and collaboratively compile reports.
- Field based or collocated experts are not present in the crisis room. They are located in adjunct offices, field stations, or remote institutions.

Role management can be implemented easily since operators and coordinators are connected to a big wall display which can be accessed directly to share and exchange information to be visible to all present users. As the big wall display itself is connected to a control workstation it can be treated as a special user. Multiple crisis rooms are supported in the the CoSitRepSys and can be operated cooperatively as well as independently.

10.7.4 Information Sharing

Each window in the CoSitRepSys (i.e. reports and sources) can be sent to workspaces of other operators or to a big wall display via by using a share button (see Figure 27 left). The recipient user gets a notification of the sharing request and has to select the area within his/her workspace where the incoming window will be displayed. By this necessary active acknowledgement interruption of ongoing analysis processes is minimized. In case of information to be shown on the big wall display the sharing operator decides the area to be used. Available space is visible in the sharing dialogue popup window (see Figure 27 right). Displayed windows can be rearranged.

Shared source windows have a time-stamp. The area of a filled red circle in the title bar of the respective window is reduced by a quarter every five minutes. This allows recognizing newly added sources at the big wall display.

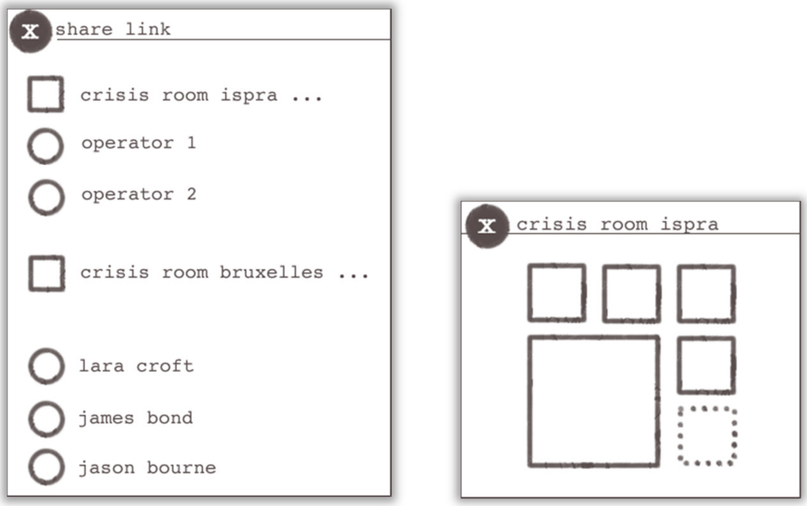


Figure 27: Information sharing. Sending sources or reports to specific users or big wall display (left) and specific areas on the respective screens (right).

10.8 Conclusion and Discussion

The described CoSitRepSys concept considered the incorporation of big wall displays in crisis rooms in the collaborative workflow of SitRep production. The focus is on the visualization of the current ongoing work and the sharing of information between the operators. External experts or field team members can be included in the collaboration processes and information sharing.

The key artefact is the big wall display and the information shown thereon. It can be controlled by the coordinators on their personal mobile devices, such as laptops, tablets or smart phones. Web technology and html-based deployment ensures a substantial independence of operating systems.

The authors developed an interactive demonstration of the CoSitRepSys (i.e. clickable wireframes showing most interactions). The next step is the discussion of this demonstration with crisis room operators and crisis managers which provides feedback to the workflow and the cooperation models designed. The adaptability of the presented concept to different situation reporting scenarios should be clarified in user discussions too.

Important open questions include: access rights and role management; processes for public release, inter-agency forwarding, or secrecy classification of reports; requirements for the export of reports for accurate map production with GIS applications; and safety and security issues (e.g., encrypted network communication).

10.9 References

Azadehdel, R., Dadashtabar, K., Enami, E.: Design and architecture of a new crisis situation room (CSR). In: Proc. of the 10th Annual Intl Conf. on Digital Government Research: Social Networks: Making Connections between Citizens, Data and Government. Digital Government Society of North America, 2009

Yuill, N., Rogers, Y.: Mechanisms for Collaboration - A Design and Evaluation Framework for Multi-User Interfaces. In: ACM Transactions on Computer-Human Interaction (TOCHI), ACM, 2012

Gryszkiewicz, A., Chen, F.: Design requirements for information sharing in a crisis management command and control centre. In: Proc. of the 7th ISCRAM Conf., Seattle, 2010

Baudisch, P.: Interacting with Large Displays. In: IEEE Computer 39(3) pp. 96-97, IEEE, 2006

Tan, D.S., Czerwinski, M., Robertson, G.: Women go with the (optical) flow. In: CHI'03 Proc. of the SIGCHI Conf. on Human Factors in Computing Systems, ACM, 2003

Andrews, C., Endert, A., North, C.: Space to think: large high-resolution displays for sensemaking. In: Proc. of the SIGCHI Conf. on Human Factors in Computing Systems, ACM, 2010

Jota, R., Pereira, J.M., Jorge, J.A.: A comparative study of interaction metaphors for large-scale displays. In: CHI '09 Extended Abstracts on Human Factors in Computing Systems, ACM, 2009

Marcotte, E.: Responsive Web Design, A Book Apart, 2011

Gouin, D., Vernik, R., Wark, S.: Using Large Group Displays to Support Intensive Team Activities in C2. International C2 journal 5(2) special issue: intense collaboration for command and control: human and technology capabilities, 2011

Sharp, H., Rogers, Y., Preece, J.: Interaction Design. John Wiley & Sons, 2009

11 Industry Presentations

Barco, eyevis, and Planar followed the invitation and gave an overview of their product portfolios in the field of big wall displays for crisis rooms and on design considerations for the systems available.

11.1 Barco

Guy Van Wijmeersch, Paolo Bravin, and Claude Desmet of Barco Belgium and Barco Italy presented key figures of Barco, its business areas, and markets. Barco's AVS division's motto is "View Better, Share Faster, Resolve Quicker":

- View Better: Visualisation of complex images & data for multiple market applications
- Share Faster: Enabling collaboration between people on one site or multiple sites
- Resolve Quicker: Enabling fast decision making through advanced visualisation

In (future) control rooms people, technology, and processes are critical parts. The respective areas of special interest are therefore: human machine interfaces, decision making processes, and technology management systems.

The purpose of a big video wall can be diverse, as is the underlying technology to realise such a display. In the support of a decision-making chain big wall displays can add value and increase both speed and quality of work processes.

Presented references of Barco display installations inlcude: Protezione Civile, Rome, Italy; Arlington County Emergency Communications Center, United States; Saudi Aramco, OSPAS , Saudi Arabia; EuroControl, Belgium;

For more information: http://www.barco.com/

11.2 eyevis

Mark Schmidt, Fabrizio Ponzo, and Fabrizio Colangeli of eyevis Germany and eyevis Italy presented key figures of eyevis and its fields of activity. The following products and features were then illustrated in detail:

- *eyeCON* control room management software which purpose is to collect sources, information & alarms, to control multiple walls, displays & clients, to deploy sources & information everywhere, and to support collaboration by sharing information & work
- *Alarm Supervisor Module* for automated triggering of alerts which aims at improving mission-critical decision making and reducing response times to known and unknown events.
- *Multimouse* for supporting collaboration by enabling multi-user interaction and group collaboration on "Big Display Walls" but also on every single display or conference system.
- *Capture & softKVM* for a better workflow in crisis rooms by allowing each operator to work with his/her keyboard & mouse on any sources (Remote Desktops) that are available on the network

For more information: http://eyevis.de/

11.3 Planar

Robert Stewart and Pierre-Yves Lambolez of Planar United States and Planar France presented key figures and the product and service portfolio of Planar.

In the context of mission critical display systems core features include responsiveness, reliability, felxibility, performance, and redundancy.

Such display systems have to cover the whole process from data acquisition, information display, interaction, to collaboration. Decisions on display technology and control room layout are influenced for instance by the processes that need to be supported, the underlying interaction model, or ergonomics.

Different interaction requirements (e.g., touch based, single- or multi-user, mouse based) demand adequte technology. Wall sized displays are complex systems and therefore a lot of intergration work needs to be done. The planning, setup, and installation processes are highly tailored to the different usage scenarios.

For more information: http://www.planar.com/

12 Summary of Discussions

On both workshop days there was room for exchange of views and ideas and concluding discussions after each thematic session (i.e. practitioners, industry, and academia). While the sessions were clearly different in terms of focus and content the discussions of course brought all stakeholders together and were not strictly moderated but allowed for similar hot topics to be addressed. Main subjects touched are listed below.

12.1 Day 1: Crisis Management Centres and Big Wall Displays

The first session focused on the presentation of participants of the practitioners group (EC agencies, member states civil protection bodies, etc.). Each organisation was invited to describe their institution, mandate, and mission. In addition, and most important of course, the ones operating crisis rooms or monitoring centres showed and described their installations, setups, and operational context.

- Practitioners who operate a big wall display in their centres are happy to have this technology available. In addition, those who currently are not equipped with large displays are looking forward to having such. Some are even in the process of acquisition already.
- Cooperation supported by big wall displays is considered important and assessed to bring added value to the operative tasks at hand.
- Some organisations have installed separate video conferencing rooms for team communication to be able to focus more on the discussions and on the other hand not to disturb the operators in front of the large displays.
- Like the mentioned dedicated rooms for remote communication, some organisations also decided to have separate rooms for collocated discussions and meetings that have no or minimal technical installations.
- At the moment many installed big wall displays are based on (front) projection technology. Some consider the switch and upgrade to more up-to-date solutions based on LCD screens.
- Collaborative tabletop computers are of particular interest to some practitioners and are considered to be very useful for some tasks. Those who investigated in that direction report that for successful deployment to situation monitoring centres dedicated software is needed which is non-existent at the moment.

12.2 Day 1: Practitioners' Requirements & Needs, Suggestions to Industry

The second session was dedicated to industry presentations. Especially the software used to interact with and operate the large displays was of interest here. This sparked a lively discussion between users and technology providers.

- Information Visualization software is far behind the requirements of the operational situation monitoring centres and crisis management headquarters.
- Specialised software is needed that allows for the automatic detection or at least supports a semi-automatic discovery of critical situations.
- Easy to use and fast to learn solutions are required. Off-the-shelf software products are missing today.
- Incoming information that has to be dealt with often does not give a neutral overview of a crisis situation that is needed for proper decision making processes in response coordination. On the contrary, information is very biased (e.g., by media coverage). This poses the danger that help is first directed to the heavily reported areas instead of the heavily affected areas that need it most urgent. That occurred e.g., during the response to the London bomb attack.
- Alarm management becomes a more and more important task since the number of data and information sensors (e.g., audio, video, environmental parameters, …) grows. As sensors are getting cheaper the use increased dramatically.
- In general the amount of information that has to be processed and considered adequately in situation awareness generation is ever growing. Processes as well as tools have to be adapted and/or developed to address this challenge..
- Decision makers happen to not be collocated with crisis management headquarter operators producing situation reports. This holds the imminent danger of misinterpretation of SitReps.
- Flexibility of layout changes on the big wall displays is considered important by practitioners. Even though at the moment it is reported that these changes do not happen often and if so only in rather standardised ways (i.e. switching from one static layout to another). This might be related to the lack of support of flexible and frequent changes.

12.3 Day 2: Presentations of Collaborative Situation Report Systems

The third and by far biggest session lasting the whole of day 2 was dedicated to academia presentations. The topics of talks ranged from relevant fundamentals of cognitive psychology, design considerations on shared workspaces, to very tangible prototypes (interactive wireframes) of collaborative SitRep systems. Following each and every presentation ad hoc discussions took place. General subjects discussed included the following:

- In SitRep production the splitting and merging of SitReps is an issue in evolving crisis situations. Therefore this should be anticipated by software designers and be supported by ICT systems.
- Role management of team members and organisational structures has to be implemented properly. For instance in some organisations it is necessary that one person is clearly in charge of and responsible for a given SitRep and its status.
- The extent of SitReps differs considerably between organisations from 1 page up to 20 pages. Interaction procedures and collaboration amongst involved staff therefore is very different. ICT systems have to reflect that (e.g., supporting handover, dealing with simultaneous input).
- Participatory design is not common in today's industrial software development processes. Concept demonstrations and design workshops using mock-ups and wireframes bringing together designers, users, and developers should be initiated in the very early stages.
- The procurement procedures and tenders commonly in place also very often do not support user-centred and participatory software design and development approaches.

12.4 Day 2: Final Wrap Up Discussion

A short break and walk from the laboratory to a general meeting room allowed for getting some distance again from the very hands-on presentations. During the final wrap up some more general subject-matter was covered:

- Industry needs input from end users like the one made possible through this workshop to make better products.
- Industry considers technology - both hardware and software - to be in a constant improvement process.
- A major future direction that is very promising is the development of software that can be deployed on different big wall display hardware platforms and legacy systems.
- Possible solutions for more platform independency are web-based applications. Open questions are the limitations of that technology and whether these imply other directions needed or not.
- Can there ever be a perfect prototypical user interface for big wall display operations in crisis rooms? Are there enough typical interactions, typical users, typical tasks that can be abstracted from?
- Crisis rooms are socio-technological systems. Therefore they have to be analysed and addressed by ICT systems as a whole including their different aspects and dimensions (e.g., physical, psychological, organisational, collaborative, political).
- Even though today's use of big wall displays is often not perceived as optimal, organisations that utilize these would not want to miss them as they already add a lot to their daily work.

13 Conclusions

The requirements of end users for big wall displays in crisis management headquarters and situation monitoring and crisis rooms are very different. This was also confirmed by the attending companies which all supply software and hardware solutions to crisis rooms. These differences are not only due to the variety of mandates of the individual organisations, but also caused by the types and scopes of the situation reports they have to produce. There is a strong demand of end users for easy to use, off-the-shelf solutions but because of the mentioned circumstances this demand can hardly be satisfied.

Interactive and distributed applications run on big wall displays are barely used at the moment. The current usage scenarios are more based on rather static layouts that primarily allow the access to most important information for collocated operators. Participating end users are mostly satisfied with the large display systems they have in use even if they might not be utilized to their full potential. Nevertheless, according to the participants these displays proved to have added value. The most important future development needs articulated are aimed at two directions: 1. simplicity and low learning effort, and 2. support for data analysis and decision making.

The general practice of tenders for software and hardware for crisis and situation rooms make it difficult to implement an iterative and user-centred design process. Diverse user groups, extensive requirements, and no early prototyping phases with users involved increase the risk of poor usability dramatically. There is substantial potential for improvement in the field of usability of today's systems. At the same time companies expect significant progress both in hardware and software solutions.

Alarm management is becoming more and more important since systems are connected to an increasing number of sensors. These information sources are calling for intelligent ICT systems to support the analysis processes. Especially drawing the attention to the most important events is of significance.

Trends are pointing to smaller screens with higher resolutions (e.g., 4K displays). These are spatially closer to the operators and could be better integrated into the widespread workflow since it will not break the desktop metaphor as much as big wall displays. To reduce the hardware-dependency web-based software solutions are an interesting option. Companies already investigate where the limits of feasibility for such applications are. Tabletop computers might become more frequently used devices in crisis room settings because their multi-touch interfaces allow for direct interaction by several users.

13.1 Challenges, Recommendations, Next Steps & Actions

Some of the biggest challenges identified in the workshop include making big wall display systems more interactive, applying participatory design and development principles, adopting InfoVis and Visual Analytics findings, and dealing with information overload (see Table 3 on page 51).

The recommendations to address these future development needs are often based on well-known scientific findings in areas like Human-Computer Interaction, Software Engineering, InfoVis and Visual Analytics, or cognitive psychology. In many cases, significant improvements are expected to be within reach by approaching experienced shortcomings in an inter-disciplinary way.

Depending on the availability and the applicability of findings by fundamental research or the need of specific applied research next steps and actions can be envisioned. The range of available research funding tools, knowledge transfer practices, or network building activities is diverse and offers an incentive to follow up:

Interaction: HCI technologies and techniques cannot easily be transferred from one scenario to another. A big wall display system is not just a bigger monitor but requires new approaches for adequate interaction models. It breaks the desktop metaphor and thus rendering some traditional and very successful HCI principles useless. Here some very fundamental research is needed addressing this very specific area.

Participatory design & development: The roots of involving stakeholders in design processes date back as far as the 60s and 70s of the last century. There are several different approaches to user-centred design that are well investigated, explored, and established. They need to be made aware of and applied properly for the sake of better software products. Networking events and workshops are an appropriate approach to bring together industry, academia, and, most important, end-users.

InfoVis & Visual Analytics: The scientific disciplines of Information Visualisation and Visual Analytics are mature and offer enormous insights and solutions to wide-spread problems. The nature of any InfoVis problem is twofold: data & tasks. In the context of crisis management or situation monitoring it needs to be investigated whether adequate solutions are available or can easily be adapted for the data and tasks at hand. The aspect of big wall displays (e.g., size, pixel density, etc.) needs special attention here, of course. Before Visual Analytics techniques can be applied successfully the above mentioned challenges in the HCI field need to be addressed first. There is need mostly for further applied research.

Information overload: Similar to the InfoVis challenge outlined above there exit established solutions in areas such as pattern recognition or machine learning that can provide proper approaches for e.g., incident detection. And HCI research makes procedures for attention management available. But the increasing amount and also the diverse types of data demand new solutions to be developed in the fields of e.g., natural language processing. So, both applied as well as fundamental research is advisable.

	Challenge	Recommendations	Next Steps / Actions in 2014+
1	**Interaction** Overcome static layouts and passive information consumption.	Develop dedicated software to add interaction and collaboration to big wall display systems enabling the exploitation of the full potential of big wall displays. This includes both the development of proper interaction models as well as accurate and suitable interaction technologies.	Applied research (e.g., Horizon 2020 Research & Innovation Action)
2	**Participatory Design & Development** Software needs to meet users' needs.	Allow for iterative and participatory software design & development in tender procedures. This approach not only has the power to make each and every single product better but applied on a larger scale bringing together industry & academia & users also can create new markets.	Networking activities and workshops (e.g., Horizon 2020 Coordination & Support Action: JRC work programme 2014-15 under Horizon 2020)
3	**Information Visualisation & Visual Analytics** Data ≠ Information ≠ Knowledge	Support knowledge generation and thus decision making by applying well known information visualisation principles based on cognitive psychology findings. Once big wall displays become highly interactive systems (see recommendation 1) visual analytics principles will then facilitate a new quality of dealing with the data at hand.	Applied research (e.g., Horizon 2020 Research & Innovation Action, Coordination & Support Action; JRC work programme 2014-15 under Horizon 2020)
4	**Information Overload** Support systems are needed	The sheer size of big wall displays and the ever growing amount of sensors and/or data to be analysed requires methods for attention management, automatic interpretation, incident detection, and alarm triggering.	Applied research (e.g., Research & Innovation Action; JRC work programme 2014-15 under Horizon 2020)

Table 3: Main challenges, recommendations, and suggested next steps/actions for 2014+.

14 Acknowledgements

Thanks to the University of Applied Sciences St. Pölten, Austria, for the great and fruitful collaboration in co-organising this workshop.

Thanks to Serena Zarbo for perfect organisational support.

15 Annex A: Workshop Schedule

European Commission

3rd JRC European Crisis Management Laboratory (ECML) Workshop: Collaborative Human Computer Interaction with Big Wall Displays

18-19 April 2013, Ispra, Italy

Organised by the European Commission Joint Research Centre &
the Institute of Creative\Media/Technologies, University of Applied Sciences St. Pölten, Austria

Thursday, 18 April 2013 — Conference Room 2, Bldg. 36b

13:30 Introduction. *Delilah Al Khudhairy (Head, Global Security and Crisis Management Unit, IPSC, JRC)*
13:40 Introduction: ECML & BigWallHCI. *Markus Rester (JRC)*

Civil Protection Presentations

13:50 Federal Office of Civil Protection and Disaster Assistance (**BBK**): German Joint Information and Situation Centre (GMLZ). *Christoph Schmidt-Taube, Giulio Gullotta, Julia Kern*
14:00 British Geological Survey (**BGS**): UK Natural Hazards Partnership. *Matthew Harrison*
14:10 Administration of the Republic of Slovenia for Civil Protection and Disaster Relief (**ACPDR**). *Vesna Predvonik, Danica Babič*
14:20 Swedish Civil Contingencies Agency (**MSB**). *Anders Olsson, Anna Garnelis*
14:30 Office of the State Government of Styria: Styria Regional Hazard Warning Centre (**LWZ**). *Günter Hohenberger*
14:40 Danish Emergency Management Agency (**DEMA**): National Operation Centres. *Brian Wesselhoff, Rolla Abas*
14:50 Frontex: Frontex Situation Centre (**FSC**). *Nicu Corlatan*
15:00 European Community Humanitarian Office (DG ECHO): Monitoring and Information Centre (**MIC**) / Emergency Response Centre (**ERC**). *Ionut-Lucian Homeag*

Crisis & Emergency Management Centre (**CEMAC**) & International Association of Emergency Managers (**IAEM**). *Luc Rombout*

Industry Presentations

15:10 **Barco**. *Guy Van Wijmeersch, Paolo Bravin*
15:30 *Coffee Break*
15:45 **Eyevis**. *Mark Schmidt, Fabrizio Colangeli, Fabrizio Ponzo*
16:05 **Planar**. *Rob Stewart, Pierre-Yves Lambolez*
16:25 **Discussion: Needs of Practitioners**
16:55 Closing Day 1
17:00 *Bus transfer: JRC Bldg. 36b - hotels*
19:45 *Bus transfer: hotels - social dinner*
20:00 Social Dinner *(Hotel Belvedere, Ranco)*
22:00 *Bus transfer: social dinner - hotels*

Friday, 19 April 2013 — ECML, Bldg. 68

08:45 *Bus transfer: hotels – JRC ECML, Bldg. 68*

Academia Presentations

09:30 **Organising information on big walls - human perception and large displays.** *Margit Pohl (Vienna University of Technology, AT)*
09:55 **Perceptual affordances of wall-sized displays for visualization applications.** *Anastasia Bezerianos & Petra Isenberg (LRI & INRIA, Université Paris-Sud, FR)*
10:20 **The interplay between personal and collaborative computing at big wall displays.** *Kim Halskov & Clemens Klokmose, Aarhus University, DK*
10:45 *Coffee Break*
11:00 **Situation reporting as co-creation of prospective interpretations with situated visualizations and crafted abstractions.** *Jonas Landgren (Chalmers University of Technology, SE)*
11:25 **Activity-based crisis management and collaboration in smart space environments.** *Jakob Bardram (IT University of Copenhagen, DK)*
12:00 *Lunch*
13:40 **The CrisisWall application.** *Tom De Groeve (EC, Joint Research Centre, IT)*
14:05 **Multi-user twitter analysis for crisis room environments.** *Harald Reiterer & Simon Butscher (Konstanz University, DE)*
14:30 **Collaborative interactions in future crisis rooms.** *Johannes Schöning (University College London, UK; Hasselt University, BE) & Hans-Christian Jetter (University College London, UK)*
14:55 **Collaborative situational report production on big wall displays.** *Peter Judmaier (University of Applied Sciences St. Pölten, AT)*

15:40 *Coffee Break* — **Conference Room 2, Bldg. 36b**

15:55 **Discussion: Usefulness of Big Wall Displays for Collaboration & Directions for Future Research and Development**
16:55 Closing Day 2 & Workshop
17:00 Bus transfer: JRC Bldg. 36b - airport

www.jrc.ec.europa.eu

Contact Dr. Markus Rester
European Commission • Joint Research Centre
Institute for the Protection and Security of the Citizen
Crisis Monitoring and Response Technologies
+39 0332 78 3805 • markus.rester@jrc.ec.europa.eu

Joint Research Centre

16 Annex B: Invitation to Academia / Design Challenge

European Commission
European Commission
Joint Research Centre
Institute for the Protection and Security of the Citizen
Global Security and Crisis Management Unit

21 December 2012

Invitation for Participation

3rd JRC European Crisis Management Laboratory (ECML) Workshop:
Collaborative Human Computer Interaction with Big Wall Displays
18-19 April 2013, Ispra, Italy

Workshop Overview

The 3rd JRC European Crisis Management Laboratory (ECML) workshop on collaborative Human Computer Interaction with big wall displays will be held on 18-19 April 2013 at the European Commission Joint Research Centre in Ispra, Italy. It is organized by the Institute for the Protection and Security of the Citizen, Global Security and Crisis Management (GlobeSec) Unit, Crisis Monitoring and Response Technologies (CriTech) Action and will be hosted in the ECML.

The purpose is the presentation, demonstration, and exploration of human computer interaction techniques, design considerations and/or any kind of prototypes for supporting collaborative tasks at hand in high level situation monitoring and crisis management rooms in the context of humanitarian aid and civil protection equipped with a large display areas.

Proper ICT tools are needed to support the daily work of information analysts and crisis managers. Monitoring centres on EU member state level or European Commission level have to deal with large amounts of incoming (real-time) information (e.g., early warning systems, news, media, metrological data, satellite imagery). In an imminent or evolving crisis situation sophisticated CSCW systems, Visual Analytics tools, etc. have to be available to crisis room staff. An ideal tight coupled software suite would cover the whole workflow of procedures essential in crisis room operations (e.g., monitoring, incident identification, data collection, event prioritization, decision support, report production, briefing support).

Goals

1. Presentation and demonstration of collaborative task execution and information processing scenarios
2. Identification of tasks and their support through ICT that go beyond displaying information and that benefit of large displays

A scenario based design challenge for ICT solutions for crisis room operations combined with a collaborative assessment discussion on presented ideas will identify promising directions for fostering the benefit of big wall displays to support collaboration in crisis rooms. The scenario is based on interviews with information analysts on their daily work of producing situational reports for the European Commission on developing an ongoing crisis worldwide.

Publication of Contributions

Contributions will be published in the workshop report: "**Collaborative Human Computer Interaction with Big Wall Displays: Outcomes of the 3rd JRC ECML Crisis Technology Workshop**", a JRC Scientific and Policy Report published by the Publications Office of the European Union, Luxemburg. Full-text will be available online both at http://publications.jrc.ec.europa.eu/ and https://bookshop.europa.eu/ with **ISBN**, **ISSN**, and **doi**.

Participation is on invitation basis. Please provide an extended abstract (max. 1 page) by 31 January 2013. Final contributions (papers max. 6 pages; position papers max. 2 pages) are due 2 weeks after the workshop at the latest, i.e. 03 May 2013.

Venue

JRC takes care of taxi transfers between nearby airports and train stations, the JRC, and the hotels in the area. Our secretariat supports you in booking nearby hotels. Accommodation and travel costs are at the participants' expenses.

European Commission (EC) - Joint Research Centre (JRC)	http://ec.europa.eu/dgs/jrc/
Institute for the Protection and Security of the Citizen (IPSC)	http://ipsc.jrc.ec.europa.eu/
Global Security and Crisis Management (GlobeSec) Unit	http://ipsc.jrc.ec.europa.eu/?id=40
Crisis Monitoring and Response Technologies (CriTech) Action	http://ipsc.jrc.ec.europa.eu/?id=244
European Crisis Management Laboratory (ECML)	http://ipsc.jrc.ec.europa.eu/index.php?id=659
Inauguration of ECML 2012 by EC President Barroso	http://www.youtube.com/watch?v=buREBB0jQP0
Via Enrico Fermi 2749, I - 21027 Ispra (VA) Italia	http://en.wikipedia.org/wiki/Ispra

Target Audience

The workshop will bring together 4 stakeholders in the design, development, and use of ICT tools in crisis room operation:

1. **Academia experts** of fields including:
    a. HCI – Human Computer Interaction
    b. CSCW – Computer Supported Cooperative Work
    c. InfoVis & VA – Information Visualisation & Visual Analytics
    d. IxD – Interaction Design
    e. UxD – User Experience Design
    f. UID – User Interface Design
2. **Manufacturers & technology providers** of big wall displays and respective ICT systems for their operation
3. **Practitioners** of information analysis and crisis management, operating national or European situation rooms.
4. **JRC staff** operating the ECML, providing information analysis and early warning systems to the United Nations, the European Commission, EU member states, and the humanitarian and disaster relief community.

Academia experts are invited to present novel system designs. Presentation and demonstration (e.g., wireframes, mock-ups, functional prototypes) of ideas is compulsory. Respective papers (max. 6 pages) and position papers (max. 2 pages) will be included in and published as contributions to workshop report.

Manufacturers & technology providers will have room for presentation of their solutions and products related to the workshop topic. Showcased ICT systems and products will be added to the ECML knowledge base of relevant crisis management technology and described in the workshop report. In the collaborative assessment discussion of the status quo and future development needs and directions they will provide the important industry viewpoint needed for outcomes of broad validity.

Practitioners will have the opportunity to see promising designs of relevant tools for their work. The more important is their end user perspective in the assessment discussions and the chance to give directions for future development needs of needed ICT systems.

Scenario / Storyline / Workflow

Interviews with information analysts who produce daily reports on evolving and ongoing crisis situations worldwide for the European Commission Monitoring and Information Centre (MIC) in Brussels give the following picture of a typical workflow. Submissions can range from dealing with specific sub-processes to even a generalized framework for a system design.

Goals

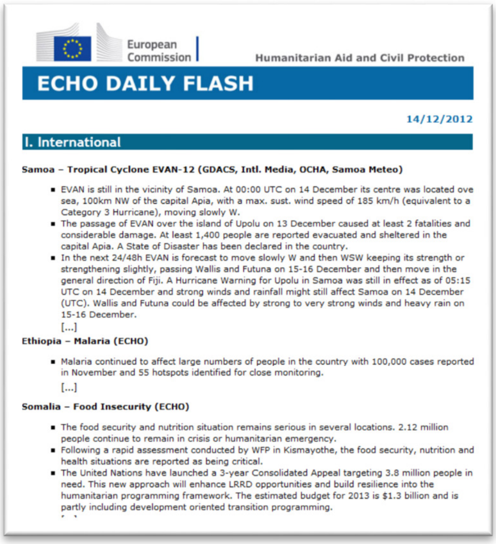
- Search for, analysis, comparison, and updating of information
- Collaborative production of situation reports.

Not relevant is e.g.,:

- Time-critical decision making on tactical level (e.g., command & control of first responders; military domain)

Tasks

Scenario 1: Daily Newsflash. First thing in the morning is providing an overview of what is going on worldwide with respect to humanitarian crisis, natural disasters, disease outbreaks, conflicts, etc. (see Figure 28). A typical bulletin contains 1-5 international items with brief facts and/or analysis and 1-5 European items [cf. http://ec.europa.eu/echo/news/echo-flash/index_en.htm].



European Commission

Humanitarian Aid and Civil Protection

ECHO DAILY FLASH

14/12/2012

I. International

Samoa – Tropical Cyclone EVAN-12 (GDACS, Intl. Media, OCHA, Samoa Meteo)

- EVAN is still in the vicinity of Samoa. At 00:00 UTC on 14 December its centre was located ove sea, 100km NW of the capital Apia, with a max. sust. wind speed of 185 km/h (equivalent to a Category 3 Hurricane), moving slowly W.
- The passage of EVAN over the island of Upolu on 13 December caused at least 2 fatalities and considerable damage. At least 1,400 people are reported evacuated and sheltered in the capital Apia. A State of Disaster has been declared in the country.
- In the next 24/48h EVAN is forecast to move slowly W and then WSW keeping its strength or strengthening slightly, passing Wallis and Futuna on 15-16 December and then move in the general direction of Fiji. A Hurricane Warning for Upolu in Samoa was still in effect as of 05:15 UTC on 14 December and strong winds and rainfall might still affect Samoa on 14 December (UTC). Wallis and Futuna could be affected by strong to very strong winds and heavy rain on 15-16 December.

  [...]

Ethiopia – Malaria (ECHO)

- Malaria continued to affect large numbers of people in the country with 100,000 cases reported in November and 55 hotspots identified for close monitoring.

  [...]

Somalia – Food Insecurity (ECHO)

- The food security and nutrition situation remains serious in several locations. 2.12 million people continue to remain in crisis or humanitarian emergency.
- Following a rapid assessment conducted by WFP in Kismayothe, the food security, nutrition and health situations are reported as being critical.
- The United Nations have launched a 3-year Consolidated Appeal targeting 3.8 million people in need. This new approach will enhance LRRD opportunities and build resilience into the humanitarian programming framework. The estimated budget for 2013 is $1.3 billion and is partly including development oriented transition programming.

II. Europe

Bosnia and Herzegovina – Extreme Weather Conditions (Ministry of Security)

- Snowfall and extreme cold temperature started on 8 December 2012. It is reported that three persons are died due to extreme cold. The situation is under control.

Serbia – Extreme Weather Conditions (Ministry of Interior)

- Heavy snowfalls and extreme cold started on 8 December. Six Municipalities still have in force declared State of Emergency with their local Emergency HQs in constant sessions and all available means and resources activated and put into action.
- Five people have been reported dead due to extreme cold, while 900 people have been rescued and/or evacuated from trapped vehicles on the road or from remote villages due to heavy snowfall by the Emergency services.

Meteoalarm – Red and Orange Alerts

- Ice and Snow in western **Czech Republic** – Red Alert
- Heavy rain in NW **Portugal** – Red Alert
- Low temperatures in southern **Serbia** – Red Alert
- Low Temperatures in western **Bulgaria**, eastern **Croatia**, northern **Montenegro** – Orange Alert
- Ice and Snow in SE **Switzerland**, southern **Germany**, northern **Denmark**, central-northern and NW **Italy**, northern Netherlands and central and northern **Serbia** – Orange Alert

Figure 28: Daily Flash by EC Directorate General for Humanitarian Aid and Civil Protection (DG ECHO)

Scenario 2: Daily Report. For selected incidents or crisis situations daily reports are prepared. A typical daily report consists of one page usually giving a map, key facts, and a brief summary of the situation (see Figure 29). Preparation time is about 1-3 hours per report. Staff involved: 2 analysts, 1 domain expert (hurricane, tsunami, earthquake, etc.).

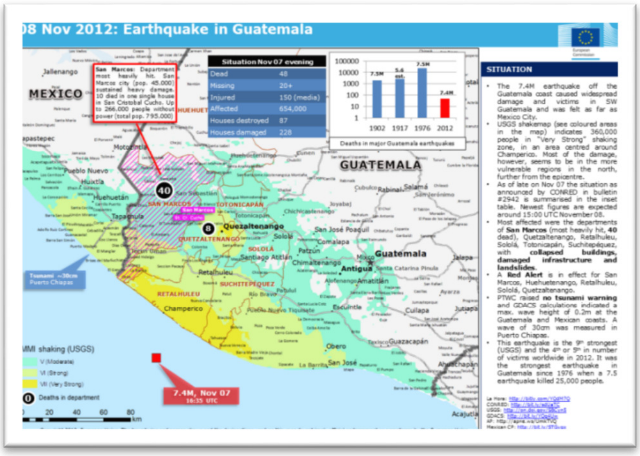


Figure 29:JRC Daily Report: 08 Nov 2012, Earthquake, Guatemala. Prepared for DG ECHO.

Scenario 3: Detailed Report. For selected situations a detailed report may be requested. This in depth analysis takes 1-4 day to prepare and is usually between 5 and 20 pages long containing maps, timelines, InfoVis. Depending on the situation it includes components like sophisticated GIS analysis, forecasts based on prediction models, risk assessments, vulnerability estimations, and impact assessments. Staff involved: 3 analysts, 2 experts, 1 team leader, 1 head of unit. Examples are:

- Overview and current state of Nigeria floods (Aug – Nov 2012), 20 Nov 2012. 19 pages including e.g., current situation, timeline of evolution and events, historical context, current humanitarian situation, remote sensing data (optical, passive microwave). 4 days preparation time.
- Tropical Cyclone Isaac, Dominican Republic and Haiti (Update 2), 24 Aug 2012. 7 pages including e.g., current situation, timeline of event alerts by GDACS, NOAA NHC warnings, impact assessment (wind, storm surge, rainfall), historical comparison. 2 days preparation time.

Data Sources

If there is an indication of an incident a directed information search is done by the analysts. This includes websites, newsfeeds, or live streams of official sources (national metrological/geological institutes, national civil protection), media sources (news agencies, national broadcasting stations, local newspapers), and private sources (twitter feeds of trustworthy NGOs or individuals). For examples of relevant sources see Table 4.

Source	Type	URL
DMA Monitor EMM Top Stories	Website	http://dma.jrc.it/monitor?user=SituationRoom
DMA Flood Map	Website	http://dma.jrc.it/map/?application=FLOODS
DMA Cyclone Map	Website	http://dma.jrc.it/map/?application=CYCLONES
EMM Newsbrief	Website	http://emm.newsbrief.eu/NewsBrief/clusteredition/en/latest.html
EMM MediSys	Website	http://medisys.newsbrief.eu/medisys/clusteredition/en/latest.html
GDACS	Website	http://gdacs.org/
UN OCHA	Website	http://reliefweb.int/organization/ocha
Bookmark collection by country (official sources, weather forecasts, media & news agencies, etc.)	Websites	
ReliefWeb	Website	http://reliefweb.int/updates
Euronews	TV, Website	http://www.euronews.com/news/
BBC	Website	http://www.bbc.co.uk/news/
CNN	Website	http://edition.cnn.com/
Twitter feeds (official & trusted)	Feed	

Table 4: Examples of relevant information sources.

Challenges

- Sharing of information between all team members
- Monitoring of ongoing evolution of events
- Collaborative analysis and production of SitRep
- Inclusion of nearby experts available for meetings but not stationed in crisis room (e.g., GIS experts)
- Inclusion of distant experts at remote locations (national contact points, field office contacts) in the workflow

Typical Workflow

24:00 Screening of media web sites. Natural disaster occurred.
01:00 Finishing of first information compilation document.
06:30 Watching breaking news on EuroNews, BBC, CNN.
07:00 1st analyst arrives in office, reading selected tweeds (official, trusted private), starting directed data search, opening of report file.
08:00 2nd analyst joins (+ rest of the collocated team members needed): review of report file and taking over information search
09:00 Bulletin is sent to Brussels via email
09:15 Assignment of responsibilities/tasks for daily report: information search, writing, and map production
15:30 Daily report is sent to Brussels
Optional: Opening of detailed report anytime if requested

Design Challenge

Interactive support of situational report team by **collaborative** ICT system utilizing **big wall display** and desktop PCs:

- Interacting with big wall display
- Finding of relevant information
- Dynamic display and layout of information
- Sharing of information (collocated, remote)
- Attention management (new, changing info)
- Assessment of information
- Adding of information
- Processing of information
- Writing of report
- Visualisation of worldwide disaster overview
- Visualisation of current situation(s) and according documentation
- Visualisation of evolving situation(s)
- Presentation of and briefing on final situational picture.

Discussion

After the presentation and demonstration sessions a collaborative assessment discussion with all participants takes place. Lessons learned, state of the art in ICT solutions for crisis rooms, and interesting directions for further development are outlined.

ECML Crisis Room Hardware Setup

The European Crisis Management Laboratory acts as a research, development and test facility for ICT focused solutions which integrate devices, systems, models and relevant information sources to support crisis management needs, such as threats analysis, situational awareness, early warning, response and coordination, and collaborative decision making. Functional prototypes could be deployed as web based application and demonstrated via full-screen view of a browser running on the server or as desktop application (please inquire for details). For the design challenge the following ECML setup shall be considered:

Video Wall

- 5x3 matrix (5m x 2.22 m) rear projection video wall
- Overall resolution 5120x2304 pixels
- Up to 6 simultaneous digital video inputs
- Up to 4 analogue video inputs
- Touchable over the whole surface (single touch, medium precision)

Other hardware

- Professional video conferencing system, landline phones, webcams, microphones, sound system
- A0 plotter
- SMART Board interactive whiteboard (single touch)
- Guest WiFi
- Meeting table

Computers

- 4 workstations to feed the video wall, 2 used to control it
- 1 server (Windows 7) to control the video inputs

Figure 30: European Crisis Management Laboratory (ECML)

For more information please contact:

Alessandro Annunziato	alessandro.annunziato@jrc.ec.europa.eu	+39 0332 78 9519
Tom De Groeve	tom.de-groeve@jrc.ec.europa.eu	+39 0332 78 6340
Markus Rester	**markus.rester@jrc.ec.europa.eu**	**+39 0332 78 3805**

European Commission
EUR 26396 – Joint Research Centre – Institute for the Protection and Security of the Citizen

Title: **Collaborative Human-Computer Interaction with Big Wall Displays - BigWallHCI 2013.**
3rd JRC ECML Crisis Management Technology Workshop.

Editors: Markus Rester, Peter Judmaier, Tom De Groeve, Alessandro Annunziato

Contributors: Margit Pohl, Anastasia Bezerianos, Petra Isenberg, Peter Dalsgaard, Kim Halskov, Clemens N. Klokmose, Jonas Landgren, Fredrik Bergstrand, Jakob E. Bardram, Tom De Groeve, Markus Rester, Martin Atkinson, Yaniv Steiner, Brian Doherty, Alessandro Annunziato, Daniele Galliano, Simon Butscher, Jens Müller, Andreas Weiler, Roman Rädle, Harald Reiterer, Marc Scholl, Hans-Christian Jetter, Johannes Schöning, Yvonne Rogers, Peter Judmaier

Luxembourg: Publications Office of the European Union

2013 – 60 pp. – 21.0 x 29.7 cm

EUR – Scientific and Technical Research series – ISSN 1831-9424

ISBN 978-92-79-34935-5

doi: 10.2788/50183

Abstract
The 3rd JRC ECML Crisis Management Technology Workshop on Human-Computer Interaction with Big Wall Displays in Situation Rooms and Monitoring Centres was co-organised by the European Commission Joint Research Centre and the University of Applied Sciences St. Pölten, Austria. It took place in the European Crisis Management Laboratory (ECML) of the JRC in Ispra, Italy, from 18 to 19 April 2013. 40 participants from stakeholders in the EC, civil protection bodies, academia, and industry attended the workshop.

The hardware of large display areas is on the one hand mature since many years and on the other hand changing rapidly and improving constantly. This high pace developments promise amazing new setups with respect to e.g., pixel density or touch interaction.

On the software side there are two components with room for improvement: 1. the software provided by the display manufacturers to operate their video walls (source selection, windowing system, layout control) and 2. dedicated ICT systems developed to the very needs of crisis management practitioners and monitoring centre operators.

While industry starts to focus more on the collaborative aspects of their operating software already, the customized and tailored ICT applications needed are still missing, unsatisfactory, or very expensive since they have to be developed from scratch many times.

Main challenges identified to enhance big wall display systems in crisis management and situation monitoring contexts include:

1. Interaction: Overcome static layouts and/or passive information consumption.
2. Participatory Design & Development: Software needs to meet users' needs.
3. Development and/or application of Information Visualisation & Visual Analytics principle to support the transition from data to information to knowledge.
4. Information Overload: Proper methods for attention management, automatic interpretation, incident detection, and alarm triggering are needed to deal with the ever growing amount of data to be analysed.

LB-NA-26396-EN-N

As the Commission's in-house science service, the Joint Research Centre's mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle.

Working in close cooperation with policy Directorates-General, the JRC addresses key societal challenges while stimulating innovation through developing new standards, methods and tools, and sharing and transferring its know-how to the Member States and international community.

Key policy areas include: environment and climate change; energy and transport; agriculture and food security; health and consumer protection; information society and digital agenda; safety and security including nuclear; all supported through a cross-cutting and multi-disciplinary approach.

Publications Office

ISBN 978-92-79-34935-5