Using Multi-Media to Support Command and Control functionality in Crisis Management Systems

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Operative crisis management

- Should be carried out to support and diminish the consequences of ongoing crises.
- Should support prevention of escalating chain reactions during the incidents.
- Should be supported by a command and control system.

Aspects on command and control for crisis management

A C²-system should be used to
- prevent and/or decrease the risks for severe damage on human and assets in the society,
- plan, lead and coordinate the activities during different types of crises,
- unwind and rebuild what have been damaged.

Preconditions

- Handling crises require involvement of many organizations.
- Impact of crises are not limited to national and regional boarders.
- Some types of crises are rare in one area but can be frequent others.
- Emergency authorities in different countries have different responsibilities, economical and cultural prerequisites, organizations, legislation and access to technical support.

Media types

- Generally, optimal use of the human perception, maximising the bandwidth of the information channels between system and users is of utmost importance.
- In theory optimal results can be achieved by using the five senses vision, hearing, taste, smell and touch.
- Vision and signal oriented sensors are the primary channels presented here.

Technological challenges

- Inter-organizational and international collaboration concerning how to
  - monitor the environment at the development of the crises,
  - coordinate and collaborate during the crisis handling,
  - Share available resources.
- Interoperability - connecting distributed and independent emergency organizations.
  - The ability to share information and other capabilities.
- Inter-organizational coordination requires increased situational awareness, i.e.:
  - what has happened and what have other responders done,
  - what is happening and what are other responders doing.
Examples of applications/crises

- Fires and storms
- Criminal/terrorist activities
- Accidents related to transportation of dangerous gods
- Registration and monitoring of pandemics.

Synchronisation and coordination of activities

- Sharing of different resources.
- Dependency on other activities (responders).
- Interoperability with respect to integration and coordination.

High level structure

C2-organization

coordinator

actors

Area of operations

Request for information

Registration/analysis of observation data

Decisions

Data, information and decision support flow

Data from the area of operations

Services for collection of external information

Services for analysis of information

Decision making

Services for transmission of decisions

Data from other actors

Data for other actors

Information from other actors

Information for other actors

Decisions

The service concept

An IT-service can be

1. available via the network,
2. a function available at specified quality and cost,
3. a function that allows integration of different subsystems,
4. an abstraction that should create value to a consumer without describing how it is performed,
5. services can be either synchronous (through dialogs) or asynchronous (subscriptions).

Main service types

In this work services can be of four types

- User allocated
- Mandatory
- Service allocated (services to services)
- System allocated
**Decision support tools**

A decision support tool is generally a user allocated service.

Examples of decision support tools
- for manipulation of geoinformation (e.g. GIS),
- data mining,
- query languages,
- risk evaluation,
- logistics.

**Collection of information**

Information collection can be carried out through:
- Production, subscription and selective collection of information through queries to a priori databases.
- Services corresponding to different data sources, e.g. sensors, where relevant information can be selected and fetched via queries.
- Access to meta and context databases.

**An illustration to sensor data acquisition**

Something is moving down. Looks like some vehicles driving. OK, I’ll go there and have a look.

I am tracking! Two cars!

**Why should data from sensors not be visualized?**

Clue: which images show the same scene?

**Sensor data independence**

- Is related to data independence in traditional database systems.
- Is required from a user perspective for simplification of manipulation of large data volumes from multiple sensors.
- Also required to diminish the workload of the users.
- To increase the users’ trust in the system
- To support interoperability.

**The basis for sensor data independence**

- The ontological knowledge based system controls which sensor data and which recognition algorithms that should be used.
- An ontologi integrated into a knowledge based system can be used to accomplish sensor data independence.
- New sensors can be attached without informing the users.
- Users do not need to know, which sensors that are used at a given moment and the sensor types can vary over time.
- Other information of importance is weather, time of the day och sensor meta data.
Common Operational Picture (COP)

• A COP means an operational picture that with respect to the available information matches the operational pictures of all other responders.
• Responders interpret the information in the COP in different ways depending on their background, knowledge and other pre-requisites.
• Through the COP the responders can
  – follow the evolution of the crises,
  – get support for the decisions to be taken,
  – make predictions regarding the evolution and termination of the crises.

Crisis response through knowledge acquisition

A COP instance

Time dependencies

• The user must be able to separate information over time, to see when something occurs.
• Visualization of the dynamics in the situation is also required, e.g. changing relations to other monitored objects.
Web Map Service: Combining maps for geo-data visualization

Levels of cueing

Fusion of matching resultat

The application database

A C² model

An example
Systems for preventive crisis management

To support the responders with early and reliable warnings, e.g. to discover potential attempts of break in into establishments.

How can this be done?

• Detection of threats against the establishment.
• Information collection by means of sensors and intelligence sources.
• By determination of behavior of vehicles and/or humans.
• By means of technical decision support systems.

Object types to protect

• Isolated establishments:
  – stores,
  – Jails
  – Nuclear power plants etc.
• Infrastructure establishments
  – harbors,
  – airports,
  – subway and railway stations
  – interlocking-plants for electrical distribution,
  – gas distribution plants etc.

Object types to observe

• Humans,
• vehicles,
• cameras and field-glasses,
• telecommunication equipment,
• weapon and tools.

Examples of queries regarding observed objects

• Has the object been observed earlier at the same location?
• Does the object appear at a reasonable time of the day?
• Is it a stolen vehicle or are the license plates wrong?
• Has any lens been registered (from a camera or field-glasses)?

Conclusions

• Aspects of multimedia, service and network orientation for crisis management have been discussed.
• Such an approach has a number of advantages:
  – Allows manipulation and fusion of multiple sensor data
  – Allows adoption of roles, which are flexible with respect to how services can be changed over time.
  – The network approach supports development of cooperation between organizations.
• a flat command and control structure,