Teamwork support challenges in emergency management domain (Future incident site of tomorrow)

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Members of the Firefighter Department and Civil Defense

PPGI PROGRAMA DE PÓS-GRADUAÇÃO EM INFORMÁTICA

ABRRD Associação Brasileira de Redução de Riscos de Desastres

ISCRAM

Centro de Referência em Tecnologias para Gestão de Desastres · UFRJ ·

GRECO GRUPO DE ENGENHARIA DO CONHECIMENTO - PPGI/UFRJ

Agenda

- The GRECO Research Group
- Motivation for the Talk
- Emergency Plans: Adaptation for Unforeseen Situations
- Recent Activities & Publications
- Collaboration Possibilities

GRECO Research Group

- Faculty

- Marcos Borges (DCC/IM) - PhD East Anglia, UK, 1986
- Maria Luiza Campos (DCC/IM) - PhD East Anglia, UK, 1993
- Jose Orlando Gomes (DEI/POLI) – D.Sc. UFRJ, Brasil, 2004
- Paulo Victor Carvalho (IEN) – D.Sc. UFRJ, Brasil, 2003
- Adriana Vivacqua (DCC/IM) – D.Sc. UFRJ/Compiègne, Brasil/France, 2007
- Jonice Oliveira (DCC/IM) - D.Sc. UFRJ, Brasil, 2006
- Giseli Rabello Lopes (DCC/UFRJ) – D.Sc. UFRGS, Brasil, 2012

GRECO Research Group

- International Research Partners
  - José H. Canós (UP Valencia, Spain)
  - Pedro Antunes (Victoria University, Wellington, New Zealand)
  - David Woods (OSU, Ohio, USA)
  - David Mendonça (RPI, USA)
  - Sergio Ochoa (U. Chile)
  - Liam Bannon (Limerick, Ireland)
  - Erik Hollnagel (University of Southern Denmark)
- In Progress
  - **BRICS**

Emergency Management

- It is not an area of study. It is an application domain
- It works as a motivation for problems and applications we develop in our specific research
- It has some interesting and different problems that we don't find in other domains

- It has interesting relationship with the social studies in Brazil and in South America

Our current topics/problems

- Situation “Awareness”
- (Group) Decision making in Complex situations
- Team Support
- Resilience Engineering
- Human Factors
- Information Visualization
- Linked Open Data
- Plan Adaptation

Disasters – How do you Plan for them?

- **Challenges:**
- Too many event variations
- Unpredicted Situations
- No resources for appropriate planning
- Unpredicted Needs
- Wrong Planning
- Lack of Appropriate Training
- Lack of Realistic Simulations
- Lack of Resources

"If you fail to plan, then you plan to fail"

Formulating a Plan

OK! Let's Plan

Article #4

A good plan

- Resilient
  - Accommodate some level of stress
- Flexible
  - Accommodate a variety of Scenarios
- Reliable
  - Tested for the most likely scenarios
- Adaptive
  - To the changes of the situation assumed
- Team Work

Plan Execution

What if a Plan is not working ?

- Give up or Change the Plan
- Give up or Adapt the Existing Plan
- Give up or Improvise using previous knowledge
- Give up or Improvise using Intuition
- Give up or return to a previous option

All this in a very short time and on-the-fly

All this as a team work

Plan Execution

What if a Plan is not working ?

Other ISSUES:

- HOW DO WE KNOW THE PLAN IS NOT WORKING ?
- WHAT IS NOT WORKING ?
- HOW EASY IS TO PUT IT BACK ON TRACK ?
  - Resilient?
- WHAT ARE THE BASIS FOR ADAPTATION ?
- DO THEY HAVE SUPPORT FOR IMPROVISATION ?
- HOW DOES ONE DEVELOP INTUITION ?

Cahotic at First – Gradually organized

First Responders

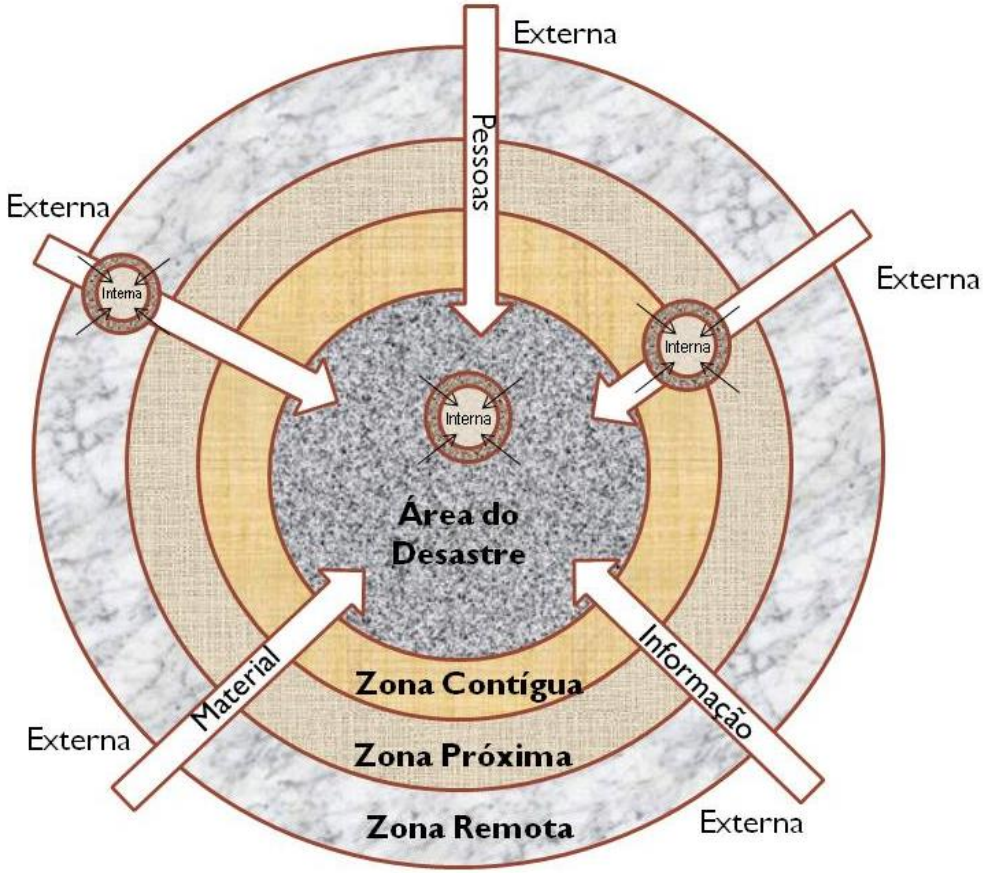
- Local (to the disaster center) - Source of initial information
- Victims friends and relatives
- Volunteers (depending on the event)
- Response Teams

It depends on the type of event and on the resources available

Convergence Behavior in Disasters

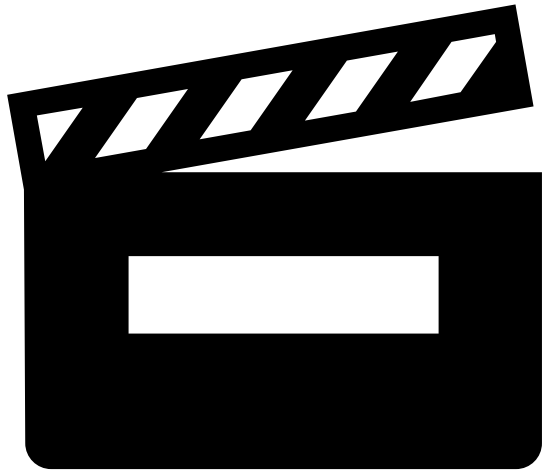
Zones and Movements

- Disaster Area
- Contiguous Zone
- Proximate Zone
- Remote Zone
- **Impact on Social Media usage (see slide ahead)**



Fritz, C. E. e Mathewson, J. H. (1957) Convergence Behavior in Disasters: A Problem in Social Control, Committee on Disaster Studies, Washington, DC, National Academy of Sciences, National Research Council.

An example of a Disaster (two weeks ago)



Current and future “announced” disaster(s)

- As for yesterday
  - 134 deaths (120 identified)
  - 199 missing
  - 13 million cubic meters of iron rejects
  - 2,7 million square meters of forest
  - 98 Km from the Dam

- Potential disasters
  - 3.387 Dams similar to this
  - 7 in a very bad situation

What are the main problems we are working on ?

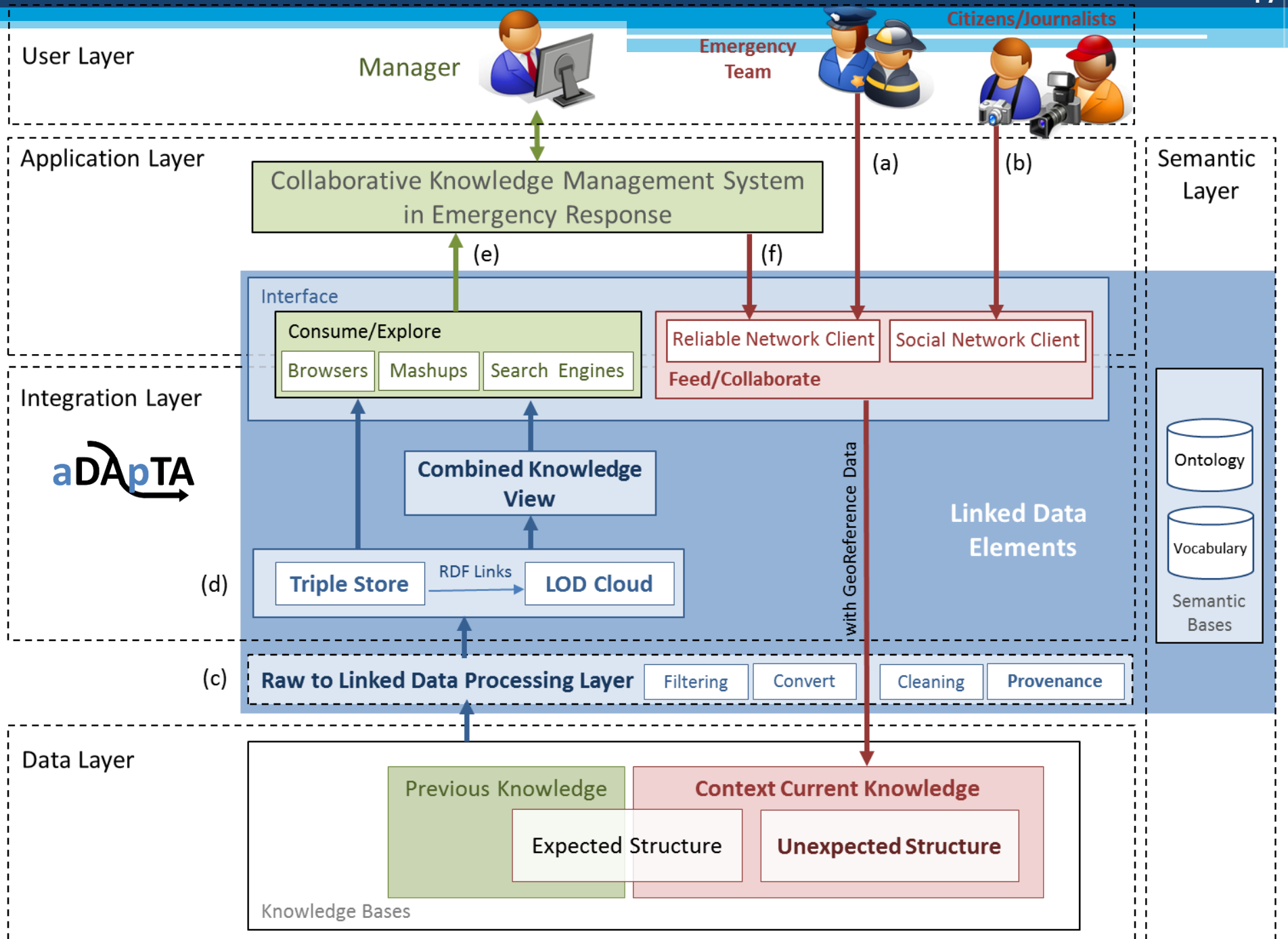
- Situation “Awareness”
  - Very Dynamic, Incomplete, Unpredictable evolution
  - It is key to Appropriate Plan Enactment
- Plan versus Reality
  - Plan Adaptation
  - Improvisation
  - Intuition
- Planning
  - An exercise of “logical speculation” of behavior - Semiotics
  - Generating a better plan (prepared for failure!)

aDAptTA

Ph. D. Thesis of Kelli Medeiros (2015)

- Assumption
  - Not all information required to the C&C during an Emergency Response can be predicted
- Research Question
  - How to retrieve new information and integrate it, on the fly, with the existing Information Bases ?
- Proposal
  - Adaptive Integration of Information using an open data approach for supporting Decision Making

Article #6, 2015 and #17.


User Layer
Manager
Emergency Team
Citizens/Journalists
Application Layer
Collaborative Knowledge Management System in Emergency Response
(a)
(b)
(e)
(f)
Semantic Layer
Interface
Consume/Explore
Browsers
Mashups
Search Engines
Reliable Network Client
Social Network Client
Feed/Collaborate
Integration Layer
aDAptA
Combined Knowledge View
Linked Data Elements
with GeoReference Data
Ontology
Vocabulary
Semantic Bases
(d)
Triple Store
RDF Links
LOD Cloud
(c)
Raw to Linked Data Processing Layer
Filtering
Convert
Cleaning
Provenance
Data Layer
Previous Knowledge
Context Current Knowledge
Expected Structure
Unexpected Structure
Knowledge Bases

Unforeseen situations

- Complex environments commonly face events affecting the prior developed plan
  - Events lead to unforeseen situations which may lead to Disruptions of the plan

- They may arise due to
  - lack of knowledge during planning
  - Uncertain results of planned actions
  - occurrence of unexpected events

Plan adaptation in unforeseen situations

- Goal: Assisting the response team in diagnosing unforeseen situations and making adjustments while a prior developed plan is being applied
  - Assisting, not deciding for the team

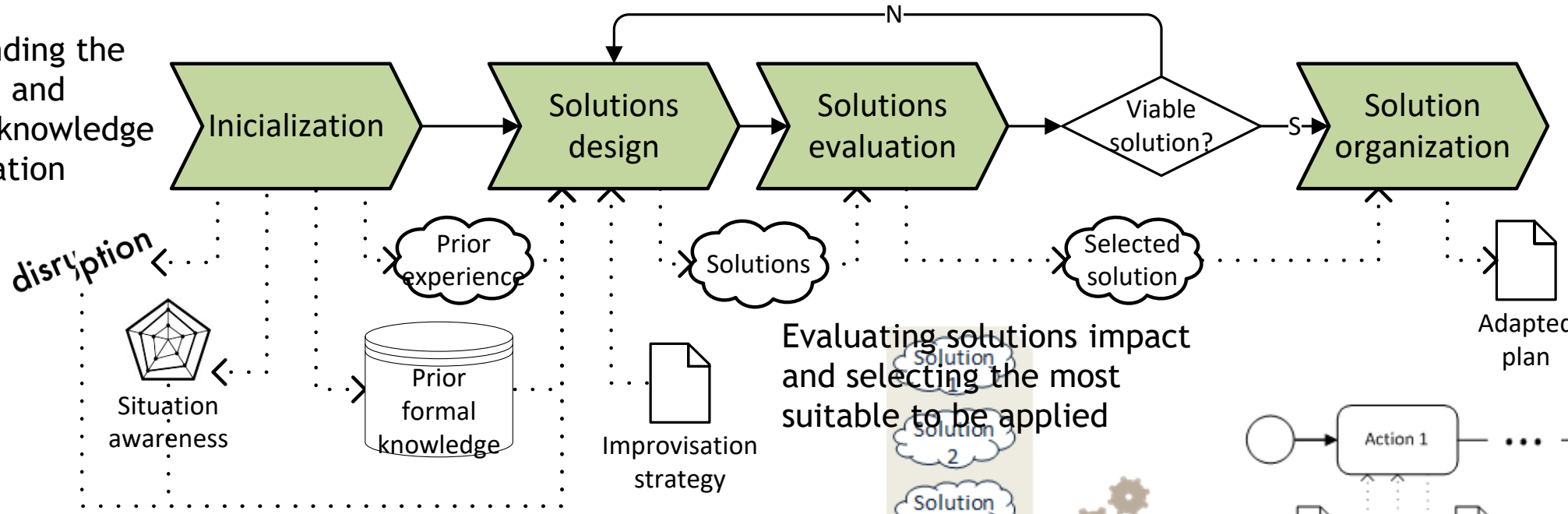
- Diagnosis and adaptation based on knowledge arising from phenomenon evolution
  - It allows a better understanding of the phenomenon and devising solutions that may inspire or be applied to the unforeseen situation
  - Quite common
    - Serious games and treatment for diseases

Prior/current knowledge, comprising the observed situation; plans, guides and reports describing prior handling; and experience in similar phenomena

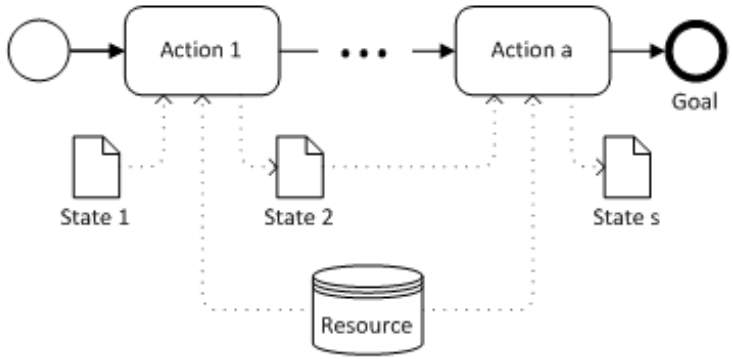
Articles #13 and #15

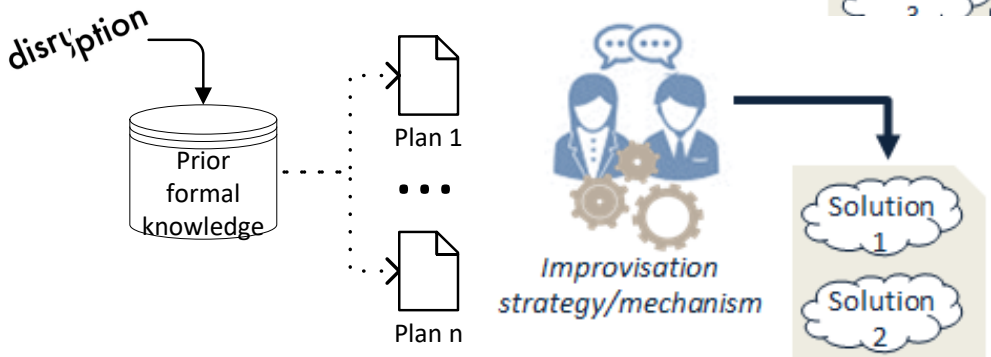
Plan adaptation

Understanding the disruption and available knowledge for adaptation



Evaluating solutions impact and selecting the most suitable to be applied





Research opportunities

Planning

- Devising mechanisms (plan) that allow re-definition or adaptation at runtime
- Propose
  - Meta-models for their representation
  - Plans that show points that require attention or are more likely to change during execution

Handling

- To apply, monitor and adjust a prior developed plan to the ongoing irregular phenomenon
- Propose mechanisms to
  - Identify inputs for defining or implementing relevant changes in the plan
  - Adjust the existing plan at runtime

Evaluation/Feedback

- Providing more suitable plans for handling future irregular phenomena
- Propose mechanism to
  - Collect information from phenomenon handling
  - Use success/failures as input for plan adjustment and evolution

PROBLEM

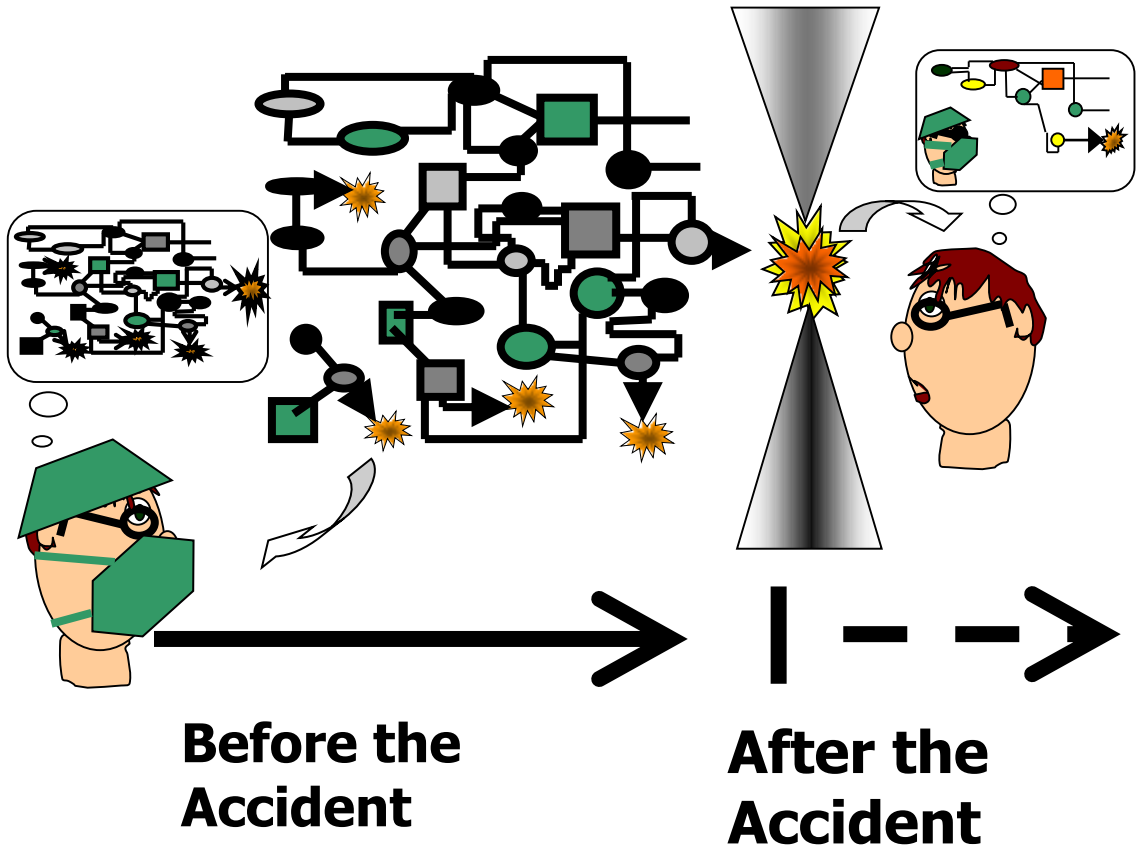
the difficulty in diagnosing unforeseen situations and adjusting prior developed plans at runtime, under very high pressure.

Disaster/Plan Evaluation

- What worked / what not ?
- Lessons learned
  - That influence the planning
    - **Careful with Hindsight Bias and Swiss Cheese Model**
- Response investigation
  - Plan versus reality
- A disaster is always different one to another
  - Extract the essence of the response
    - Actions
    - Resources

Back to Planning

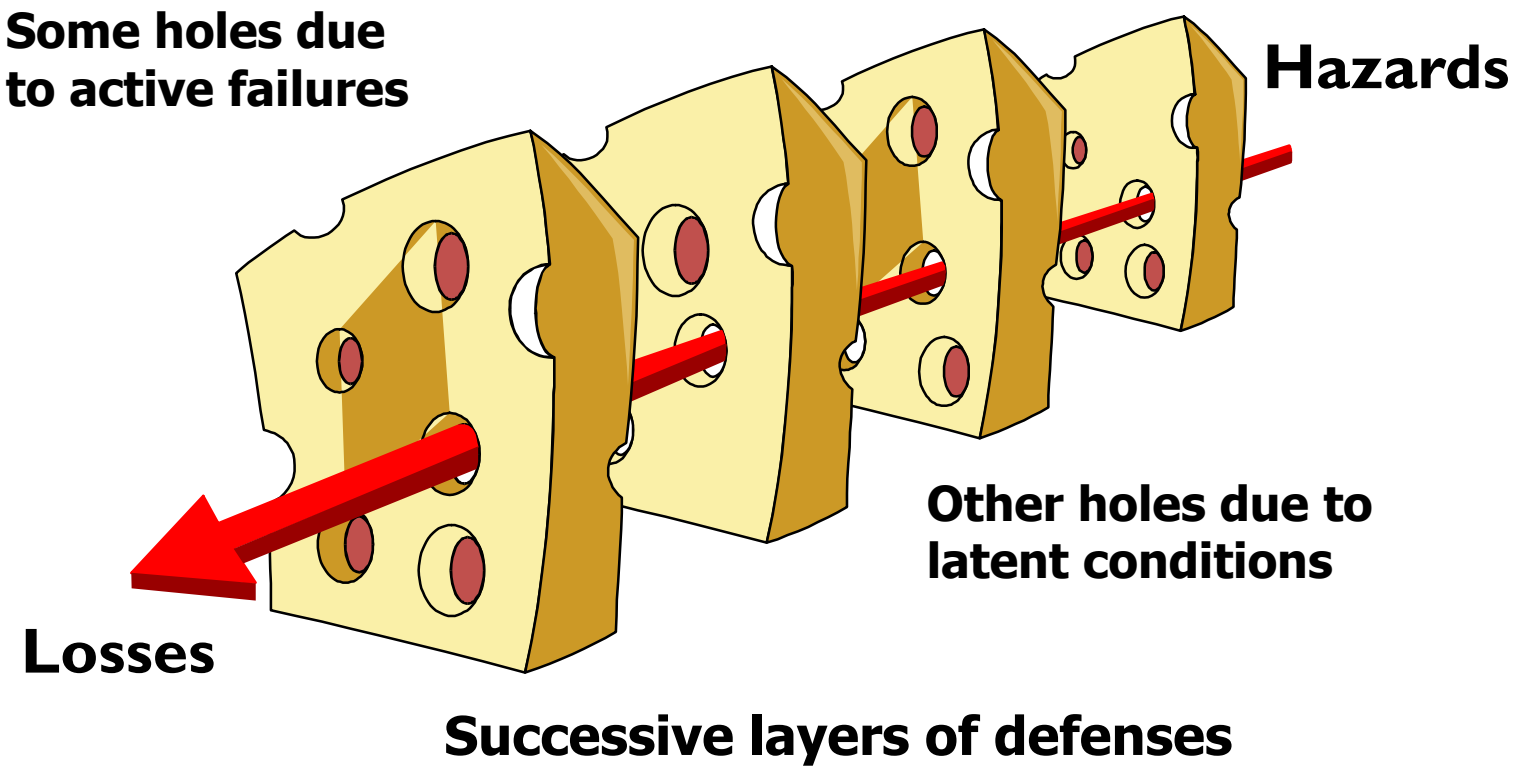
Avoiding Hindsight Bias Evaluations



The tendency to believe, after the fact, that one would have foreseen it.

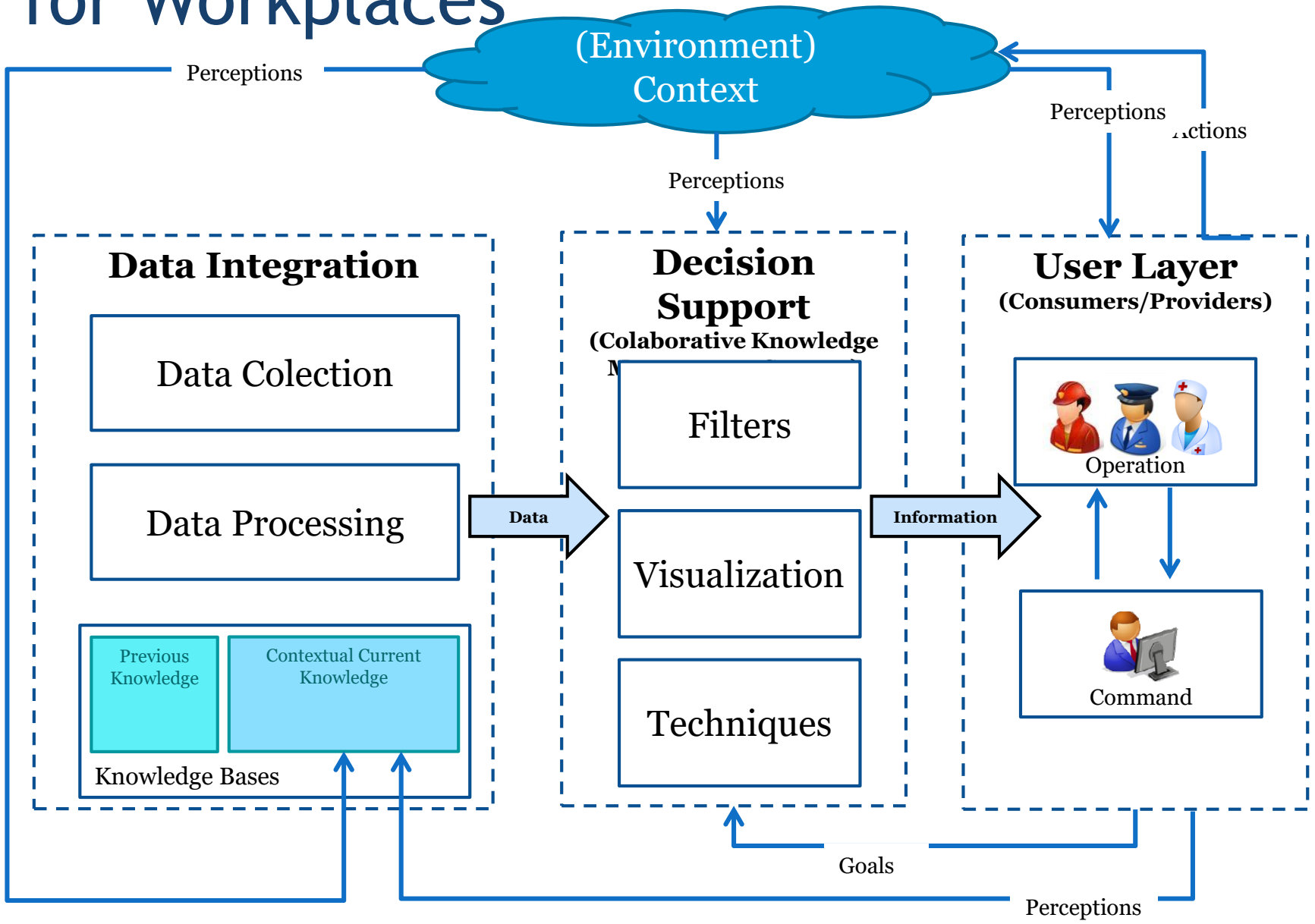
WYLFIWYF means that an accident investigation usually finds what it looks for; in other words, the assumptions about the nature of an accident constrain the analysis

The ‘Swiss cheese’ model of organizational accidents



Dashboards for Workplaces

Articles #11 and #14



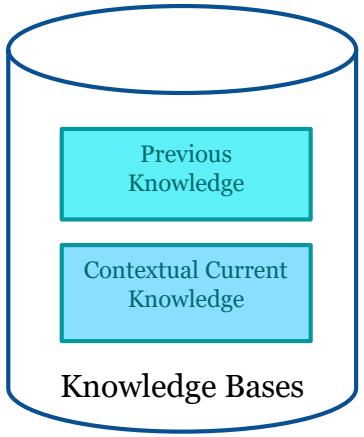
Monitoring potentially hazardous situations

From Practitioners (referring to Information)

Good Enough
is
Good Enough

Dashboards for Workplaces

Raw Data

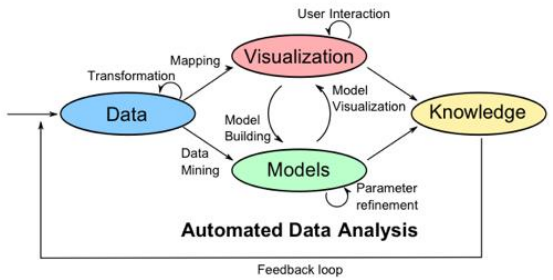


Visualization Engine
Priorities
Select data
Choose Device
Choose Analytics
Define Visualization

Dashboards

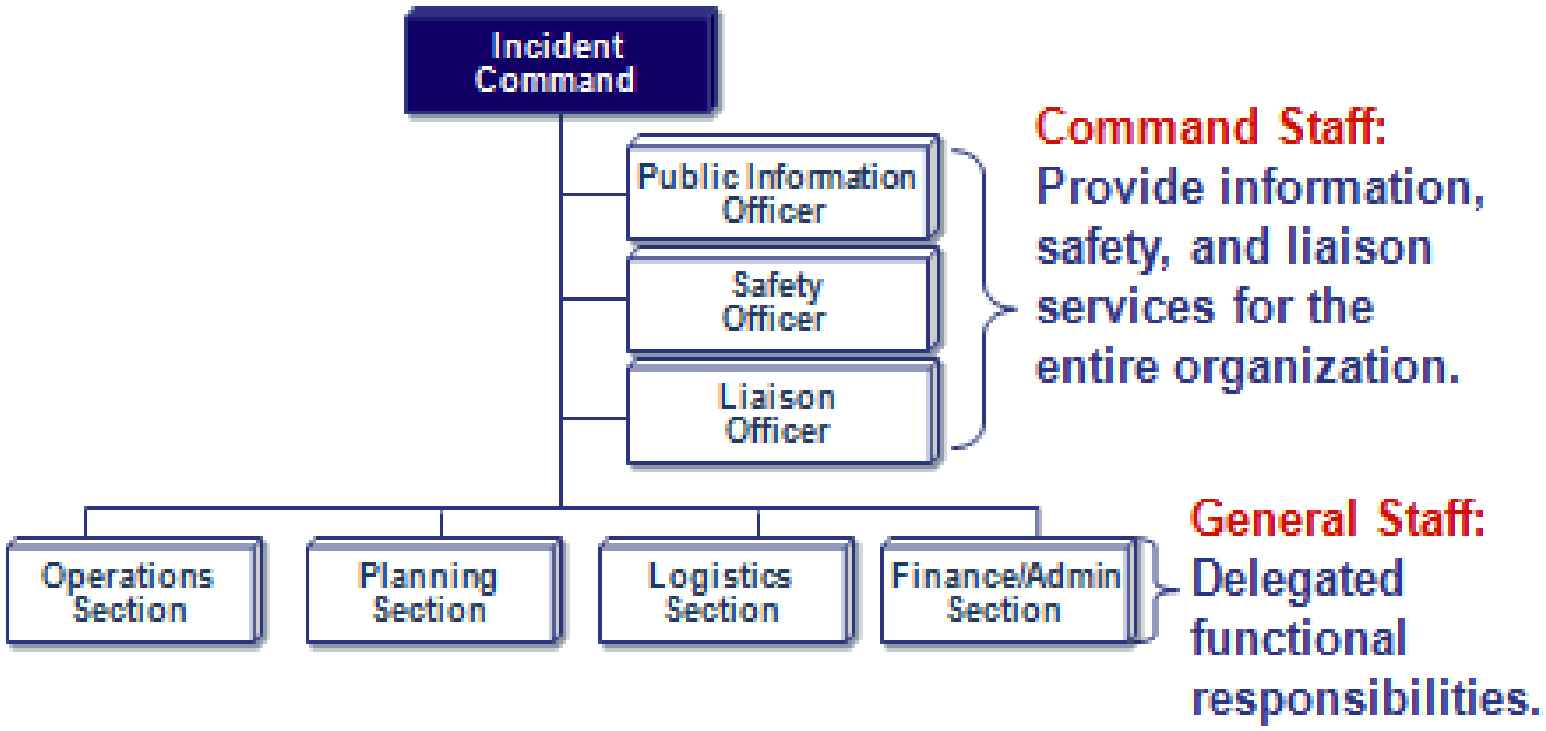
Uses

Visual Data Exploration



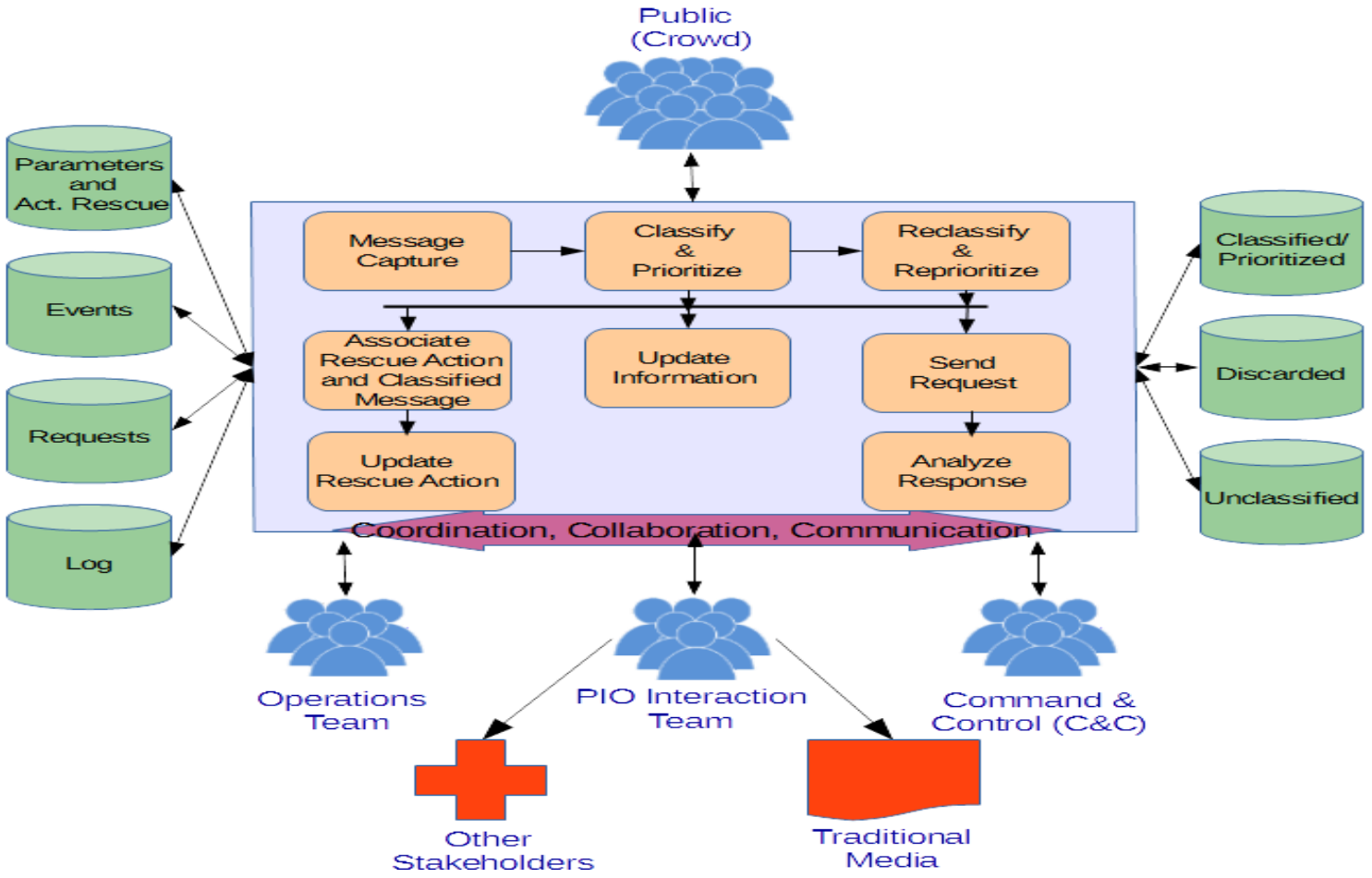
The PIO in the ICS Model

Articles #10 and #12



Framework for dealing with social media interactions in emergency situations

Solving the puzzle: Organizing social media disaster information during an emergency response. Submitted to a Journal



Intuition and Group Intuition

- Expertise-based Intuition plays an important role in decision making.
- Intuition is “alogical” (i.e. neither contradicts nor follows the rules of logic) and at the end of an intuitive process, the outcome is usually tacit.
- We are studying intuition support in Decision making of C&C in Disaster Management. We are particularly interested in Collective Intuition support (see articles #24 and #25)

Challenges

- Handling irregular phenomena requires being prepared for adaptation
  - How to adapt to unforeseen situations? Training, improvisation, human intuition
- How to detect the current situation (Situation “Awareness”)
  - Capturing events, actions, outcomes, forecast, integration from different sources, human “sensors”
- How to Plan for the unexpected
  - Flexible Plans, Simulation scenarios, Training
- How to Support Teamwork at various levels (CSCW)
  - The 3 Cs – Coordination, Communication, Collaboration

Social Disasters (Future)

- Medium and long term consequences of disasters
  - Are government agencies prepared for that?
- Back to the “Brumadinho” and Mariana example
  - How many people are homeless?
  - How many people lost their income (fishing)?
- Refugees
  - Dozens of thousand people crossed the border between Brazil and Venezuela in a single day
    - Lack of infrastructure

ISCRAM – Information Systems for Crisis Response and Management

https://iscram2019.webs.upv.es/

http://www.iscram.org/

Teamwork support challenges in emergency management domain (Future incident site of tomorrow)

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Obrigado! Tack! Thank you!