Crisis Management: Theories and Methods

Decision making in crisis situations
Definitions, models, methods and research issues

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« .... Classical science .... rejected the accident, event, hazard, the individual. Any attempt to reinstate them could seem anti-scientific under the old paradigm .... »

Edgar Morin, Introduction to complex thinking
Summary

- Definition Issues
- Models & research issues
- Methods & methods issues
Which speaks about CM?

- **Domains**
  - Political
  - Organization Management
  - Tourism
  - Health (Emergency plan, Epidemiology, …)
  - Military (C&C, Bioterrorism, Epidemiology…)
  - Maritime domain
  - Civilian security
  - Aviation (a few)
  - Networks (material, energy, information)….

- **Disciplinary Fields**
  - Management / Organizations theories…
  - Sociology
  - Cognitive Sciences (cognitive engineering, psychology, ergonomics, Computer Science, Decision Science…)
  - Scheduling/ Automation…
Definitions

« Crisis, often reduced to major events..., are traditionely perceived as exceptional situations. » Roux-Dufort (2007, p. 105)

● Hermann (1972):

“ The crisis situation is a threatening phenomenon, surprising because non-planned”... A crisis is a situation which created an abrupt change on one or more variable(s) key(s) of the system”

« We propose analyzing crisis as a process of organizational weakening .... » Roux-Dufort (2007, p. 106)
Definitions

- Faulkner (2001):
  - A **triggering** event, which is so significant that it challenges the existing structure, routine operations or survival of the organization.
  - High threat, short decision time and an element of surprise and urgency.
  - A perception of an inability to cope...
  - A turning point (Keown & McMullan, 1997).
  - Characterized by fluid, unstable, dynamic situation (Fink, 1986).
Definitions

- Rogalski (1996):
  - « Borderline case» of dynamic environment management
  - “Overt” environment

- Rogalski (2004)
  “There is a crisis when a system is confronted with an event, generally unexpected, of which the consequences are going to develop in time with a dynamic which can be very fast, producing significant risks which exceed the pre-existing resources in terms of procedures of actions and actors”
Event or Process or twice?
- Discrete or continuous
- Implies different possible approaches

Are there any common or shared dimensions?
« Shared » dimensions

- Triggering event & Uncertainty about evolution
  - Surprise, Threat, Turning point, Dysfunctions' production
    - Hwang & Lichenthal (2000), 2 possible dynamic of crisis' occurrence
      - Abrupt crisis (Catastrophes)
      - Cumulative crisis (Ruptures)
  - Unpredictable
    - Access to information, planning, ...

- Emergency/ Temporal constraints
  - « Simple » Emergency
  - Crisis + Emergency
« Shared » dimensions

- **Control**
  - Perceived lost of control
    - Before and during crisis
    - On consequences but also on causes
  - Resources overtaking (Rogalski, 2004)
    - Procedures’ level
      - Distinctions between emergency, crisis, catastrophe & disaster (Borodzicz & van Haperen, 2002)...
    - Operator’s level
      - Processing requirements exceed the individual operator capacity
    - Operators’ organization level
      - Unpredicted Situations ⇒ non adapted organizations
Others dimensions

- **Complexity**
  - Chaotic dynamic
  - Multiple parameters
  - Different temporal dynamics
  - Changing high level’s goals

Representation/ Situation Awareness (individual, team)
• **Collective**
  - Different levels
    - Individual and team (command and control team)
    - Collective (CC + fields teams)
    - Organizational
    - Socio-cultural
  - Intra/inter organization
    - Distributed knowledge and competences
    - Structure of organizational hierarchy and operational hierarchy relationships
      - More or less rigid
    - Communications flows “doctrines”
      - Dissociation between 3C & information about actions
Others dimensions

● Experience
  ■ Professional vs Novices or Mix
    ● Different knowledge, competences,....
    ● Asymetry, communication fragmentation, misunderstanding....

Knowledge, Mental models, Procedure, Rules....
(compatibility/incompatibility, share/individual, additional/antagonist)
CM definition: issues

- In order to elaborate “well sized” models and methods
  - Refine typology(s) according to:
    - Entry levels (individual cognition, operators’ networks, and so on)
    - Dimensions & entry concepts
  - Consequences’ nature of crisis
  - Action’s objects (from material to human)
  - Implications on cognitive processes
  - Implications on used models
  - Implications on used methods

- Uncertainty, Risk, Security, Reliability, Sensemaking, Representation, SA, Understanding, Robustness, Distributed Cooperation, Emotions, Stress, Temporal Pressure
2 group of models

1. Systemic/Organizational approach: strategic level

- Relationships between management and planning activities with the crisis’ phases of the crises
  - 4 phases (Fink, 1986):
    - Prodromic phase, acute phase, chronic phase & resolution phase
  - 4 classes of activities (Richardson et Richardson, 1992; Johnson & Scholes, 1993)
    - Strategic analysis, Strategic choice, Strategies' implementation & control, the feedback and the evaluation of the organized strategies

- Networks & collective organization
  - C&C, C3I
2 group of models

2. Macrocognition models

- Cognitive functions implemented in natural decision making complex situations
- Macrocognitive functions and support processes described by Klein, Ross, Moon, Klein, Hoffman & Hollnagel (2003) are congruent with main dimensions of crisis process

Decision models & Understanding models (Chauvin & Rogalski, 2011)
Macrocognition : Decision Models

- **Klein's RPD**: decision induced by pattern matching
  - Situation evaluation
  - Action control not taken in account, (Chauvin & Rogalski, 2011)
  - How to identify patterns in unknown situation (Flin)

- **Rasmussen “extended” models**
  - Tactical Reasoning (Rogalski & Samurçay, 1991; Rogalski, 2004):
    - SRK levels of control
    - In “overt” dynamic environments
    - Representation elaboration’s loops which integrate operators goals

Individual cognition
Macrocognition: Understanding models

- Endsley’s SA model
- Rasmussen “extended” models
- NDM’s Sensemaking
  - Klein (2006):
    “Sensemaking is a motivated, continuous effort to understand connections (which can be among people, places, and events) … in order to anticipate their trajectories and act effectively.”

Individual and team SA
Focus on situation

Mental representation
“leads” cognitive control
Focus on control levels

Data-frame theory
How to study a situation of crisis management: method and tools

Methods
EAST method

Event Analysis for Systemic Teamwork

Stanton et al., 2005; Walker et al. 2009

➡ Method developed by the HFI DTC (Human Factors Integration Defence Technology Center)

➡ Method used to study the command and control sociotechnical networks (C2)

➡ Describe the emergent properties of a sociotechnical network arising from interaction between its different components (Humans/technical devices)

➡ This method has been implemented to analyze and model sociotechnical networks. This method allows to model three networks (The aim of the method)

➡ This method is operationalized by using the WESTT software (also developed by the HFI DTC)
The main studies were interested in characterizing the impact of new technologies on the Distributed Situation Awareness (DSA) (i.e. central dimension regarding quality of the decision-making process) (Salmon et al., 2010; Walker et al., 2009).

DSA concept is central to the EAST method (Stanton et al., 2006).

DSA is systemic (unlike the SA which is focused on the individual, Endsley, 1997).

According to these authors, DSA is "the activation of an appropriate knowledge for a specific task within a network ».

In a crisis situation, the performance of the network depends directly on the quality of the DSA.

Measuring the DSA is useful to predict the network performance.
Propositional Network (= Knowledge Network):

- Interaction between agents and the knowledge objects (i.e. information that circulates within the network)

- Modeling the flow of information within the network: Agent A – knowledge objects Z – Agent B / Informational artefact S

- The propositional network is used to characterize the flow of information within a network (information required to decision making). This network is therefore relevant to study the DSA.

Task Network: chronological representation of performed operations (OSD: Operation Sequence Diagram)

Social Network: it represents a modeling of the relationships between actors.
Exemple: The Specialized Aerodrome Emergency Plan
PLAN DE SECOURS SPÉCIALISÉE
Aérodrome
Lorient / Lann-Bihoué
Phase N°1

Phase N°2

Phase N°3

Phase N°4

WESTT & MARS
Phase N°2 : live observation

- **CTA / CODIS**
  - Cellule de crise

- **CLEACH Gwénaëlle**
  - Caméra fixe C2 + pied P2

- **TOUR DE CONTROLE**
  - Préfet
  - DOS
  - **BORVON Tiffanie**
    - Dictaphone D1 sur préfet caméra C3 + Micro M3
  - **MERIT Justine et Braham**
    - Caméra C5 + dictaphone D3 + (pacha)

- **VLPD SUR LE TERRAIN**
  - COS
  - **JULIENNE Maxime**
    - Dictaphone D4 + caméra C6

- **ZONE DU CRASH**
  - Aspect technique
  - **OLLER Martin**
    - Caméra C7
  - Aspect sauvetage
  - **BUHANNIC Maxime**
    - Caméra C8

8 Cameras + micros
6 dictaphones
14 Observateurs
## Phase N°2 : Verbal transcripts

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<thead>
<tr>
<th>Temps réf.</th>
<th>Heure</th>
<th>Temps début</th>
<th>Temps fin</th>
<th>Durée</th>
<th>Qui</th>
<th>Vers qui</th>
<th>Information</th>
<th>Mode</th>
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## Phase N°2 : CDM

**Critical Decision Method**  
*Klein et al., 1989*

<table>
<thead>
<tr>
<th>Spécification des buts</th>
<th>Quels ont été vos buts aux différents moments de la prise de décision ?</th>
</tr>
</thead>
</table>
| Identification des indices | ⇨ Quels indices avez-vous recherché quand vous avez formulé votre décision ?  
⇦ Comment saviez-vous que vous deviez prendre une décision ?  
⇦ Comment saviez-vous quand vous deviez prendre une décision ? |
| Attente | ⇨ Vous attendiez-vous à prendre ce type de décision durant le déroulement de l’événement ?  
⇦ Décrivez en qui cela a affecté le processus de prise de décision ? |
| Conceptuel | ⇨ Existe-t-il des situations dans lesquelles votre décision aurait eu des résultats différents ?  
⇦ Décrivez la nature de ces situations et les caractéristiques qui auraient modifié le résultat de votre décision. |
| Influence de l’incertitude | ⇨ Y a-t-il eu des moments où vous avez été incertain sur la fiabilité ou la pertinence de l’information disponible ?  
⇦ Y a-t-il eu des moments où vous avez douté de la pertinence de la décision ? |
| Intégration de l’information | Quelle a été l’information la plus importante dans la décision que vous avez prise ? |
| Conscience de la situation  
(Situation Awareness) | De quelles informations disposiez-vous quand vous avez pris votre décision ? |
| Evaluation de la situation  
(Situation Assessment) | ⇨ Avez-vous utilisé toute l’information disponible quand vous avez formulé la décision ?  
⇦ Existaient-il des informations complémentaires que vous auriez pu utiliser et qui vous auriez aidé à formuler la décision ? |
| Options | Quelles étaient les alternatives disponibles ? |
| Stress | ⇨ Y a-t-il eu des moments, durant le processus de prise de décision, pendant lesquels vous avez trouvé difficile de traiter et d’intégrer l’information disponible ?  
⇦ Décrivez précisément la nature de cette situation ? |
Phase N°3 : Social Network Analysis
Phase N°3: Social Network Analysis

![Image of a network diagram with nodes labeled DGS, PSC, PSSA, etc., and connections between them.]

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**Annexe 15**

Schématisation du flux de l'information
Le recensement du nombre de victimes

**Annexe 16**

Schématisation du flux de l'information en fonction du temps
Le recensement du nombre de victimes
WESTT offers a set of metrics (metric: an indicator designed to measure a property of the sociotechnical network) useful to characterize the sociotechnical network: workload, error, situation awareness, time, “teamwork**” (centrality, sociometric status, network density).

WESTT was tested for the PSSA exercise. Results were not conclusive because of the limitations of the software.
Phase N°4: the networks & metrics

MARS SOFTWARE

Social Network
Phase N°4 : the networks & metrics

MARS SOFTWARE

Propositional Network
Phase N°4 : the networks & metrics

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![Phase N°4 Table](image-url)

**Task Network**
Phase N°4: the networks & metrics

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Filtering by knowledge objects: AVAILABLE
EAST method is appropriate to study crisis management

Many difficulties have been found:

- Requires important technical and human resources
- EAST method is difficult to implement to study large networks
- Verbal transcripts: it takes a very long time!
- Coupling of different databases: very difficult to do!
How to represent several flows of communication that occur at the same time, by different agents that are located in different places?

Tools such as WESTT and MARS are undersized.

More fundamentally, is it relevant to study a crisis simulation while we know in advance what it will happen (scenario pre-established)? We should study a real crisis in order to capture the real functioning of the sociotechnical system.
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