



Modelling crisis management for improved action and preparedness

Reference model for response decision simulation

ITEC2015

28-30.4.2015 Prague

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This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 284552 "CRISMA"

Content

- Some definitions
- Situation Awareness modelled as Marked Point Process
- Black Box modelling and virtual training

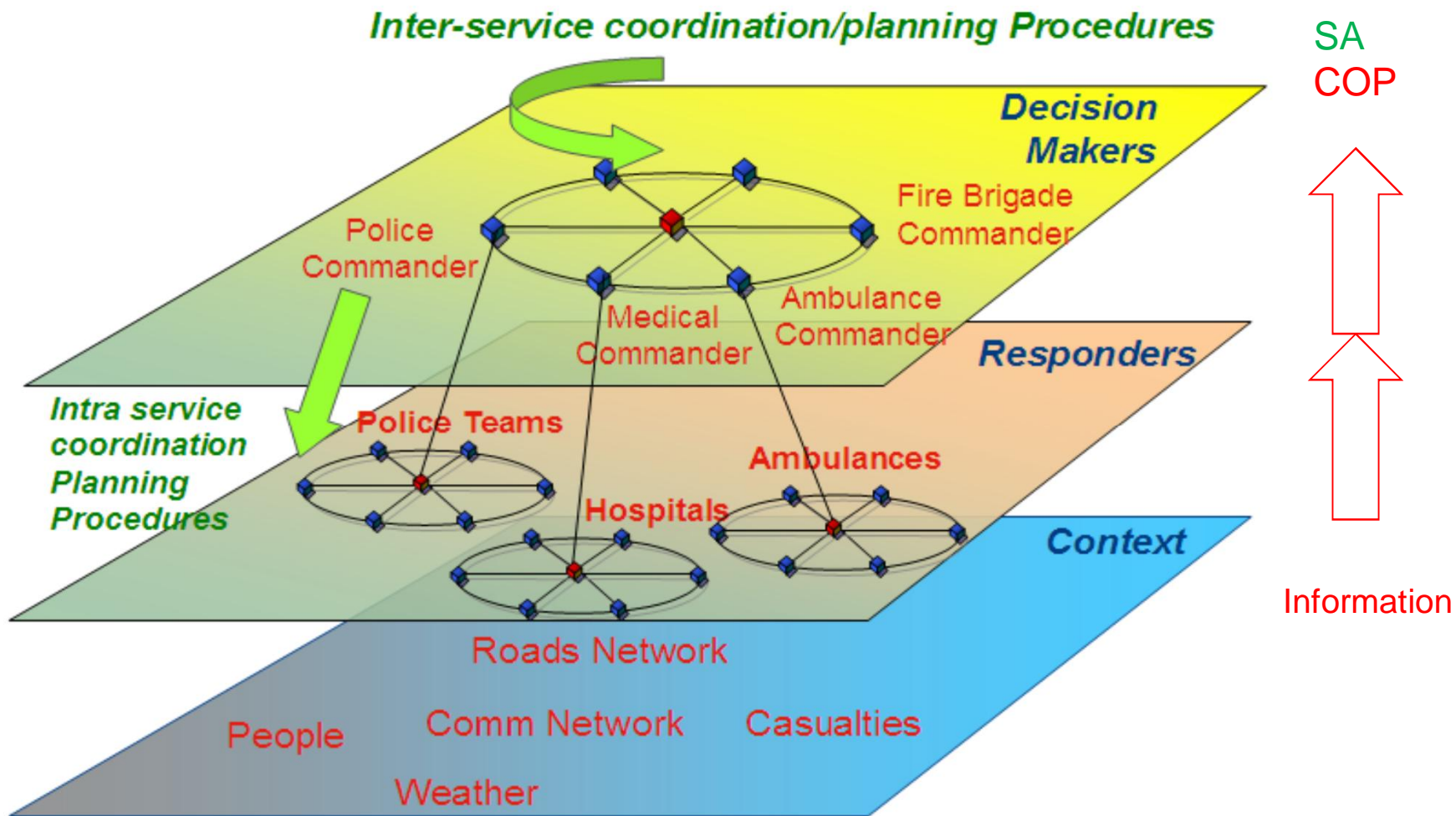
Situational Awareness, Situation Awareness, SA

- Endsley (1988) : “Situation awareness is the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future”
- The 3-level model (also by Endsley): “SA level 1: Perception, SA level 2 = Comprehension, SA level 3 = Projection” has been criticized
- **A note:** no uncertainty, no risk in the definition, nor in the model
- Response decision are based on (spatiotemporal) **imperfect information**, and thus made under uncertainty!
- Thus, there is always the possibility of making decisions that are **ineffective**, even detrimental (in the light of hindsight)

$$\text{Risk}(t) = \text{Subjective } P(C > c | SA(t))$$

Command structure related to disaster management

ACRIMAS
EU-project
(2010):



"Situational Risk Awareness" SRA vs. Common Operational Picture COP

COP: information display of observations – *objective information*

SRA: experience-based insight about what are the **risks**, and what actions to take for effective risk control

- *subjective information*



However, if the command centre has *perfect information*, then COP → common SRA

SRA is spatiotemporal and dynamic

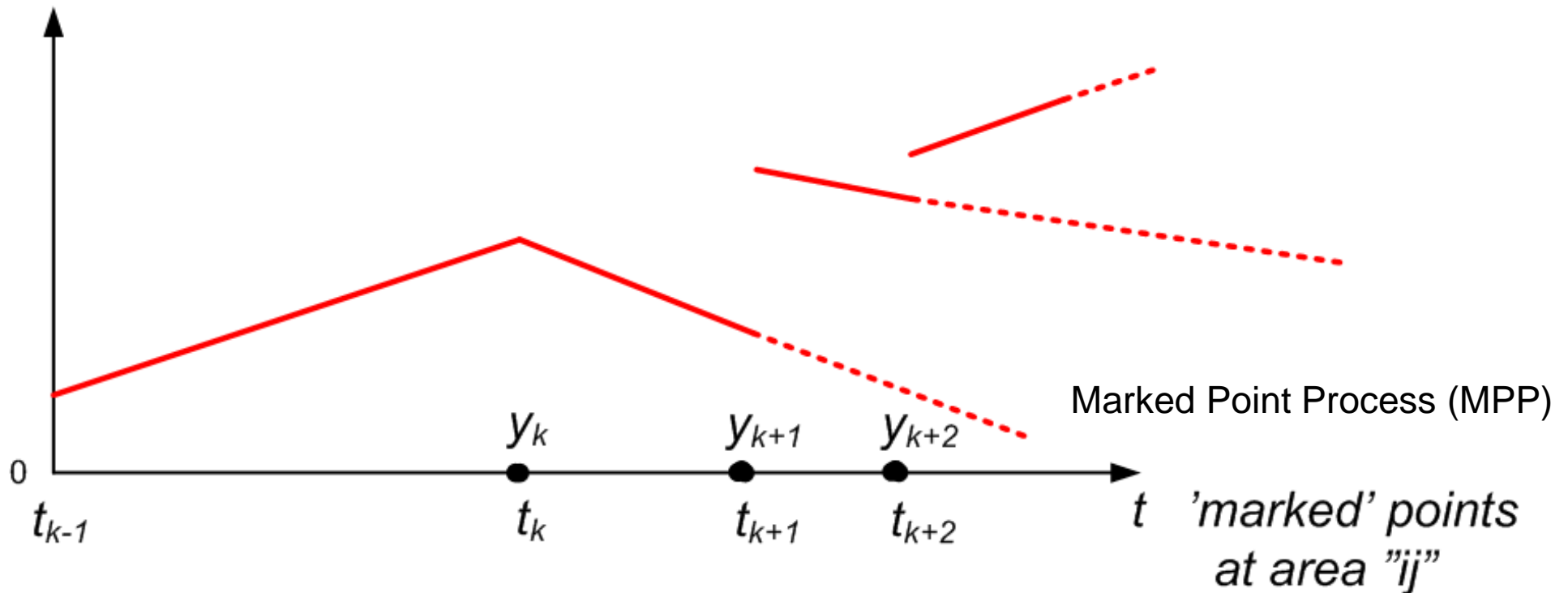
'laws':

- 1) SRA: subjective (perceived) risk increases under inaction of 'waiting'
- 2) SRA: subjective (perceived) risk decreases under response actions
- 3) A decision to 'respond' **or** 'wait', based on SRA at time t , will change SRA

Example of perceived risk X at area 'ij' given information history H to time t_q

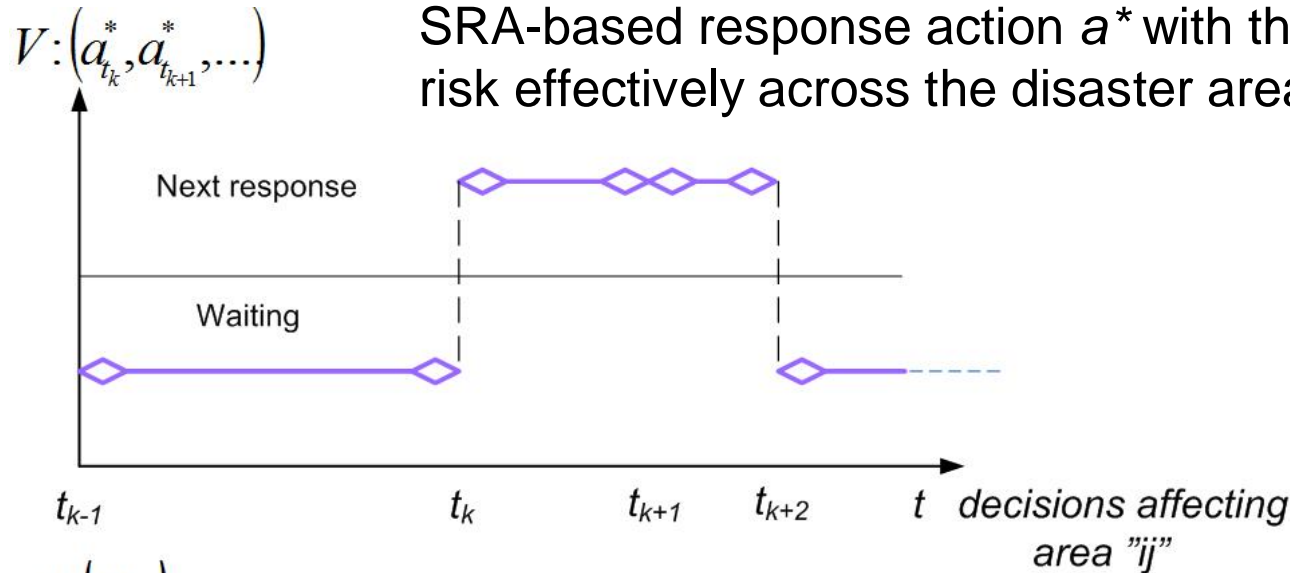
$$X_{ij}(H_{t_q})$$

$(Y_k, T_k)_{i_k j_k}$ = the k 'th **mark** denoting information **and** a decision affecting risks in area 'ij' at time t_q



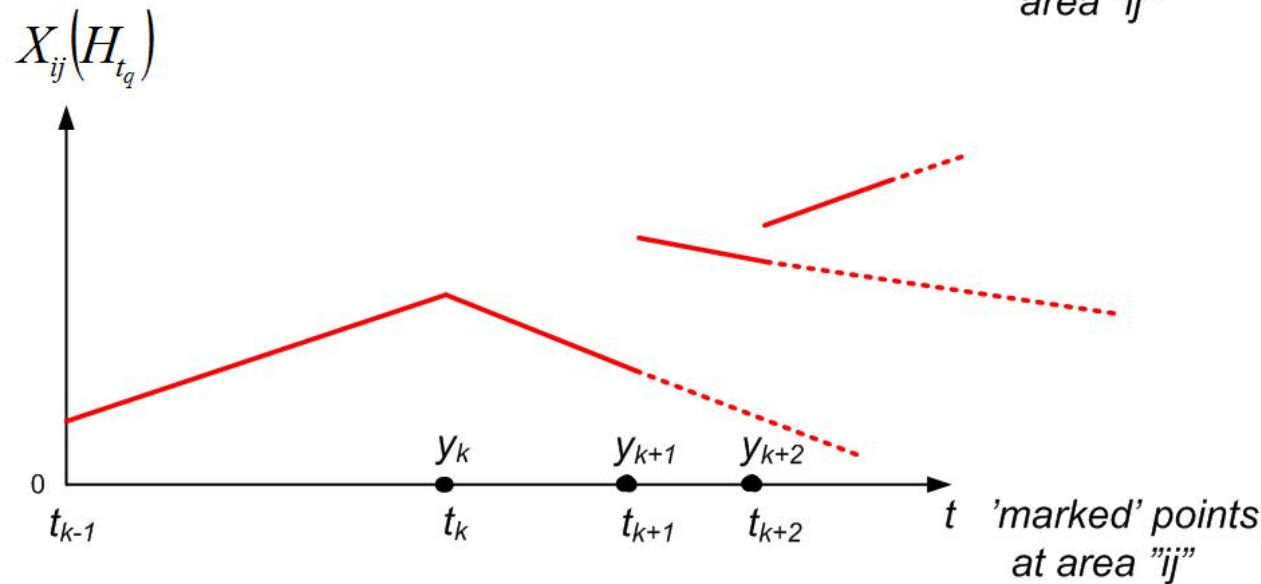
Response decisions based on SRA

SRA-based response action a^* with the capability of controlling risk effectively across the disaster area:



$$V : \arg \left(\mathbf{X} \left(H_{t_q}, a_{t_{q+}}^* \right) \rightarrow 0 \right)_{a_{t_{q+}}^* \in A_{t_q}}$$

otherwise $a_{t_{q+}}^* = a_0 = \text{'wait'}$



Commanders' SRAs triggers response decisions given availability of effective resources at the time!

Different SRA among Commanders does not stop decision-making: a transformation (V) from SRAs to response decision always exists!

Black box modelling and virtual training



Virtual human-in-the-loop training and **comparative assessment** of **Key Performance Indicators (KPIs)**:

- An experienced commander's performance
- An ideal performance ('gold standard')
- Previous performances of the trainee
- Computer agent's performance

Contact

- Contact: tony.rosqvist@vtt.fi (H2020 – proposal !)
- See also conference paper on ITEC web site

Thank You!

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