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Task-centred Adaptation of Geographic Information to support Disaster Management

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22 March 2005

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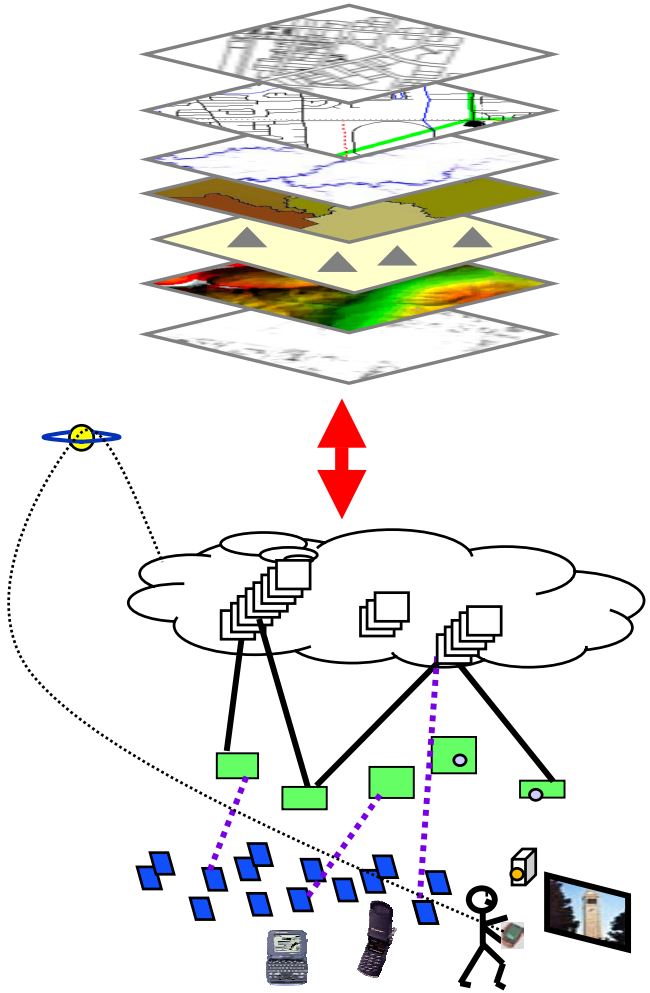

Spatial data infrastructure development

- Increasing need for/use of geo-information

Mobile and hand-held technology development

- Wireless access to geo-information

Enabling opportunities for applications involving

- **Navigation**
- **Incident assistance**
- **Location-based supply of resources**
- **Anticipated information supply**

e.g. ***Disaster Response***

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Challenge of geo-information overload

(more information than a human or a device can handle at one time)

- Too many available services
- Too much information per service
- Too much for human cognition

In *Disaster Response* this challenge is intensified by

- Limited resources (power, display, memory, bandwidth)
- Changing environmental conditions
- Limited time
- Limited expertise of personnel

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Accessing geo-databases in such disaster response conditions

→ information overload for Mobile GIS

Need for adaptation processes / methods

- enhance the utility of information delivered to field staff
- enable unambiguous information communication among diverse users
- decrease cognitive overhead
- satisfy resource constraints

.. in order to ensure MGIS is a worthwhile tool for disaster response

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Existing adaptation approach

- Compression techniques
- Colour depth reduction
- Changing to particular format
- Limited scale

Limitations of existing approach

- Techno-centric
- Apply to characteristics of data alone
- May result in degradation of data
- Generic

... need for objective (task) centred adaptation approach

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If we represent the problem as a resource allocation scenario

- we can maximise the utility by adapting data, subject to constraints

$$Maximize \sum_{i=1}^{n} u_i X_i$$

$$subject\ to: \sum S_i X_i \leq C$$

$$with\ X_i \in \{0,1\}$$

$$for\ i=1,\ldots..,\ n.$$

Existing Approach

- or we can incorporate the goal of the scenario

The essential element here is the existence of an *Objective* (a function that best satisfies the user need)

Task centred approach

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The task level adaptation approach consists of

- Identifying the data domain of interest
- Identifying the goal, objectives, tasks and actions
- Determining the utility of the datasets (the fitness / affordance)
- Identifying the optimal compromise in the current context

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- Domain

The *Domain* describes the set of objects considered relevant to the user

$$e: \Omega \rightarrow \Omega$$
$$s: \Omega \rightarrow Boolean$$

- Utility

The *Utility* is a measure of affordance possibilities among the relevant objects

$$U(O_i) = W_i$$
$$P: 2^{\Omega} \rightarrow Int$$

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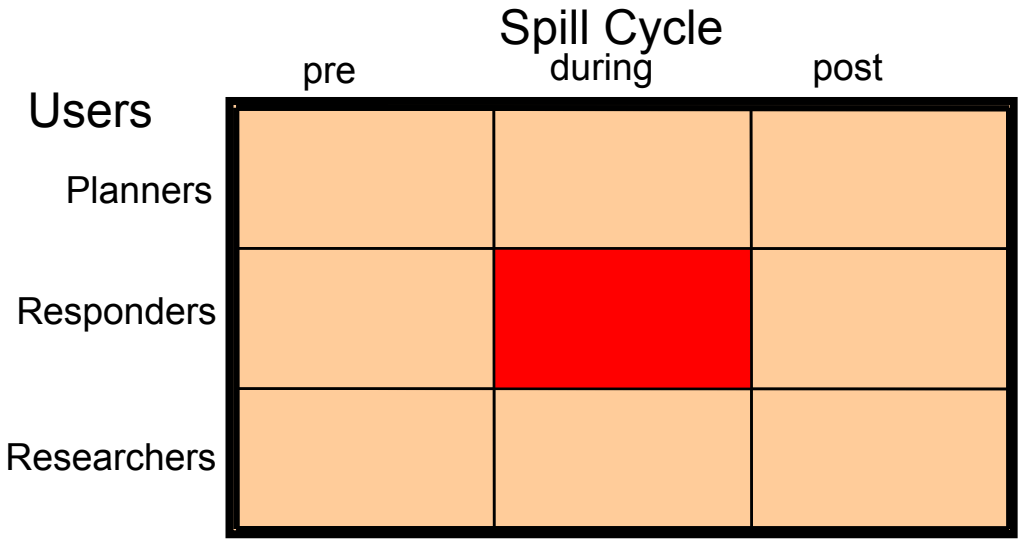
Domain

- Spill management cycle and users as intervening variables for influencing information of interest
- Cells in matrix contain a given party's ESI data needs at each stage of management cycle
- Example of task characteristics used



TASK CHARACTERISTICS	PLANNERS	RESPONDERS
Consideration of future	High	Low
Period / extension	Long	Short
Rationale / nature	Creative	Disordered
Data flow	Slow	Very fast
Density / amount of data	High	Low

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Utility

- Table shows ESI response task typology that describes the response tasks and action properties

INCIDENT RESPONSE OBJECTIVES AND TASKS	ACTIONS FOR ACHIEVING THE OBJECTIVES						
	Locating	*Proximity*	*Identifying*	*Deployment*	*Evacuation*	*Navigating*	
Ensure safety of citizens/personnel Tracking & Surveillance Transportation on road, water and air	x				x	x	
Control Source of Spill Ship, truck, pipelines, storage facility	x	x		x			
Maximize protection of sensitive environment Establish geographic response plan Establish site zoning			x				
Contain & recover spill material Site for skimmers, booms, storage tank deployment		x	x	x			
Minimize economic impact Identify resource at risk	x		x				

- Affordances as the crucial link that map action properties to affordance possibilities of objects

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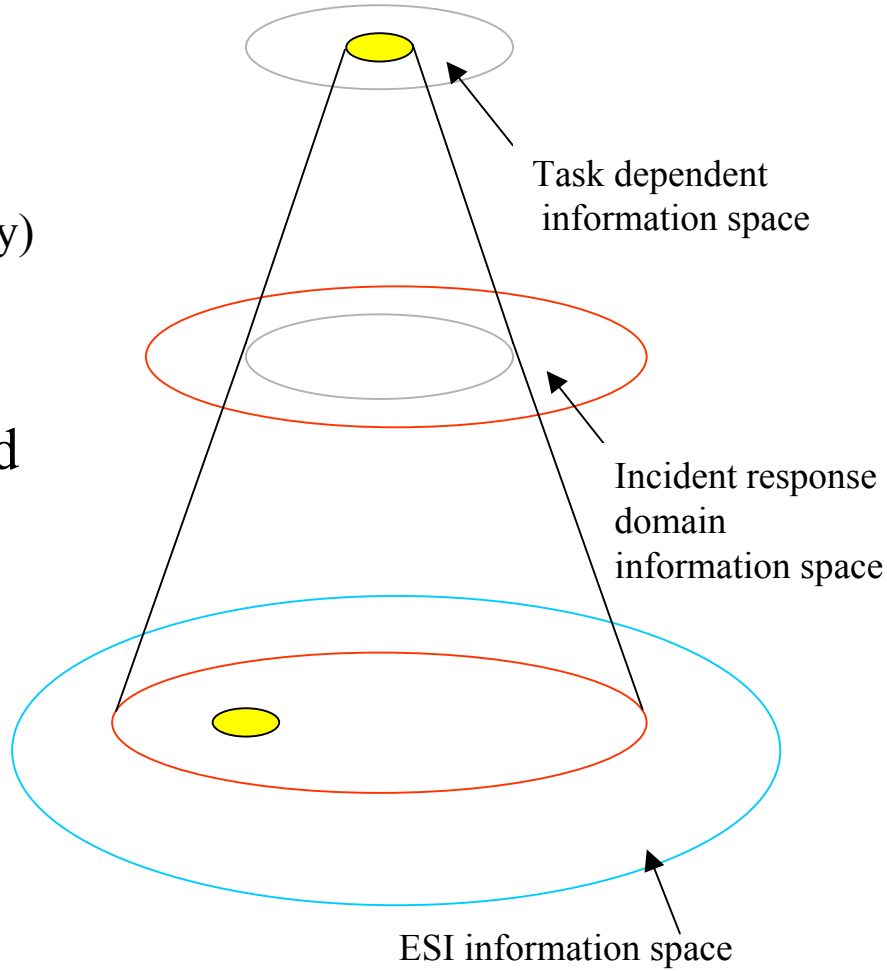
Optimised ESI information
(with high relevance and optimal utility)

- will fit the incident response in terms of both situation and tasks



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Conclusions

- Information designers must consider fast-changing working environments
- Research must investigate ways of facilitating effective and unambiguous communication between information providers and information users constrained by their working environment
- Advances in geo-information adaptation will play a significant role in the development of mobile geographic information services for fields such as disaster response
- Task-centred adaptation approaches to evaluating utility in GI will help reduce user biases, complexity in data handling and may be a key addition to current user data requirement analysis methods

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