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Towards Context-Aware, Real Time and Autonomous Decision Making Using Information Aggregation and Network Analytics

Position Paper

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Motivation

- Current decision support systems mostly work with passive information
  - Limited context awareness
  - Analyze static data to make recommendations
  - Reduces efficiency of human decision makers; especially in critical situations

Proposed Solution

- Make the decision making process
  - Context aware,
  - Real time,
  - Automated (Semi-automated)
- Use data and network analysis tools
  - *Analyze* dynamically arriving information
  - *Extract* useful parts for human decision maker
- Use agent based decision making techniques
  - *Aggregate* collected information from diverse sources
  - *Assess* quality of current decision making
  - *Suggest* new information that should be collected to improve decision making

Research Question

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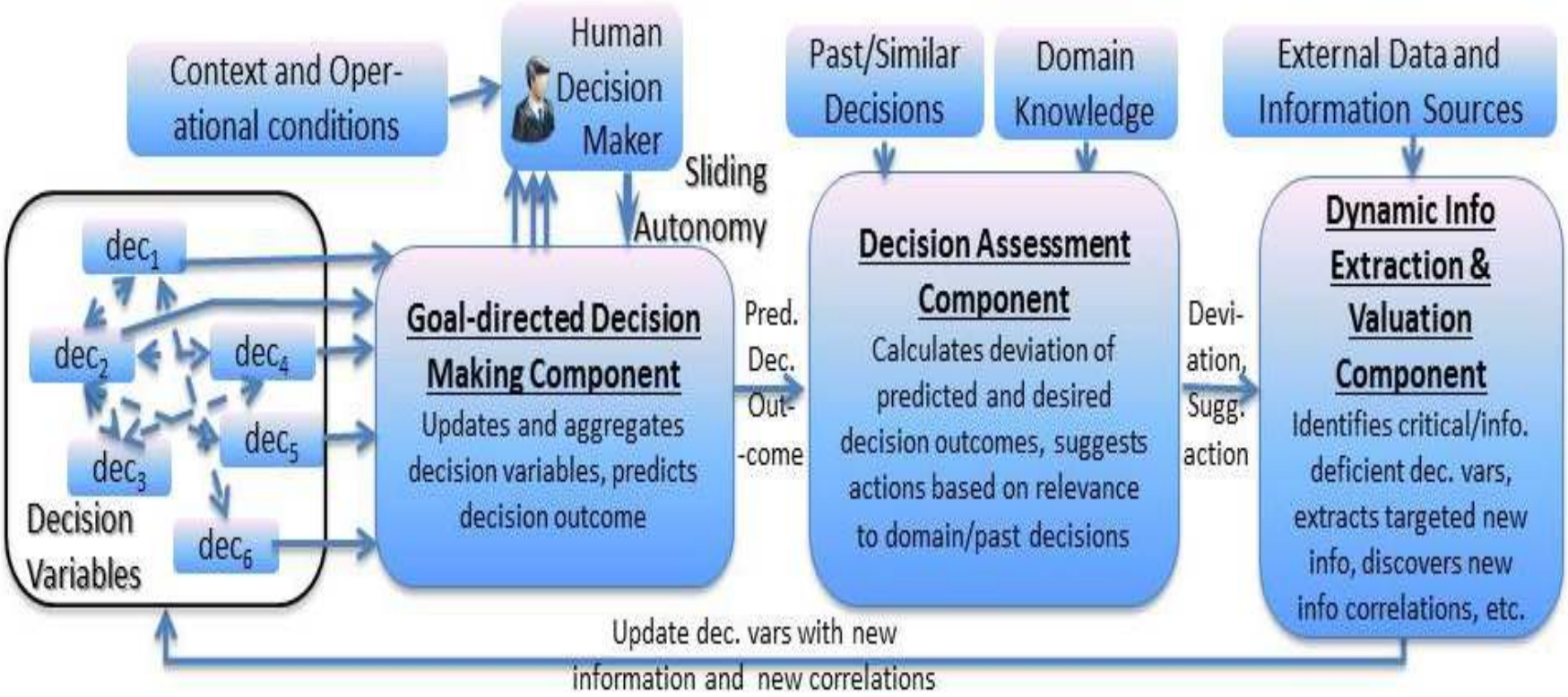
  - Use that information to update, correlate and aggregate the decision variables dynamically
  - Assess quality of aggregated decision outcome (prediction) to successively reduce the divergence between the predicted and desired decision outcomes

CONRAD (CONtext aware Real time Adaptive Decision Making) System



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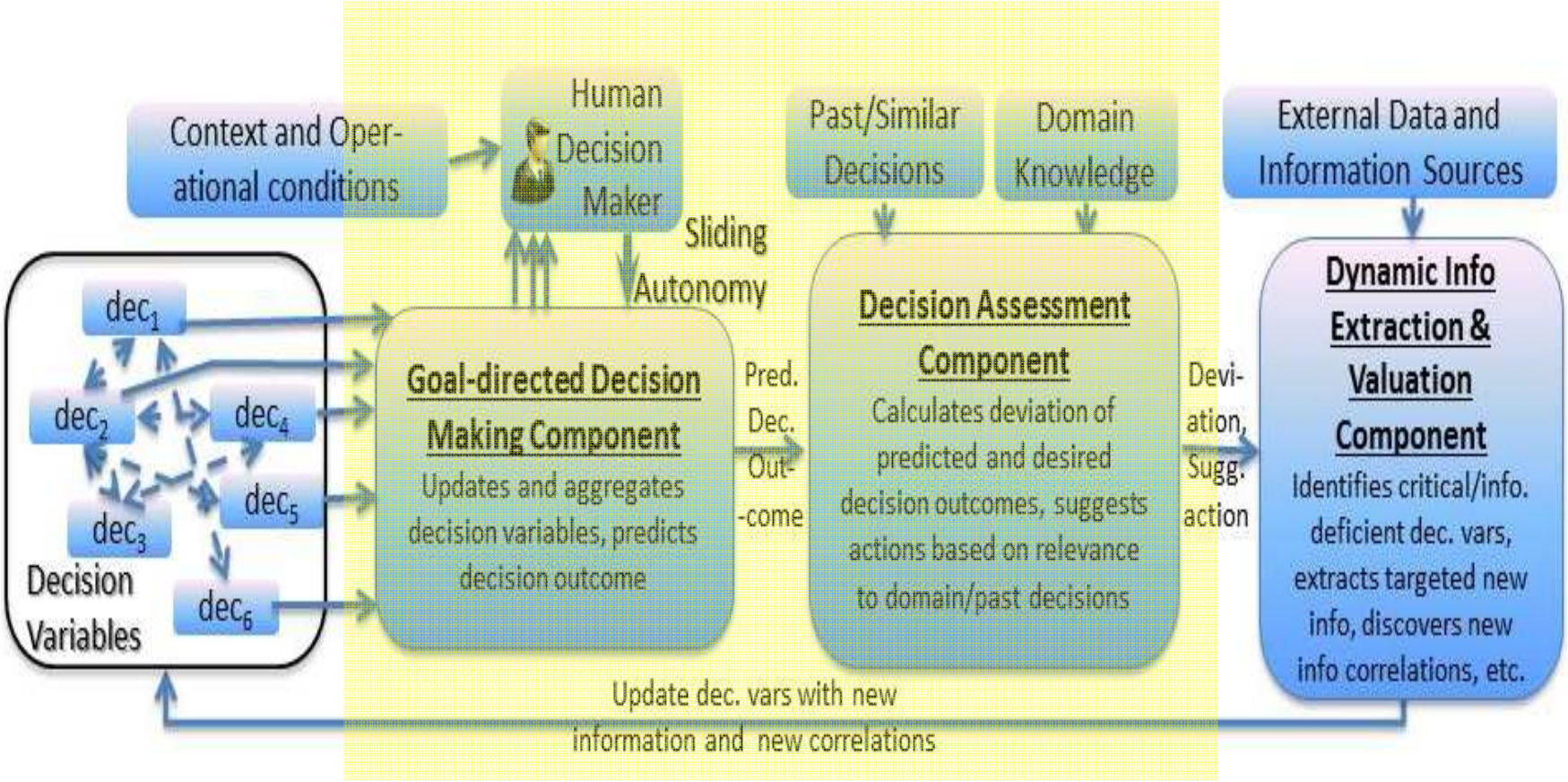
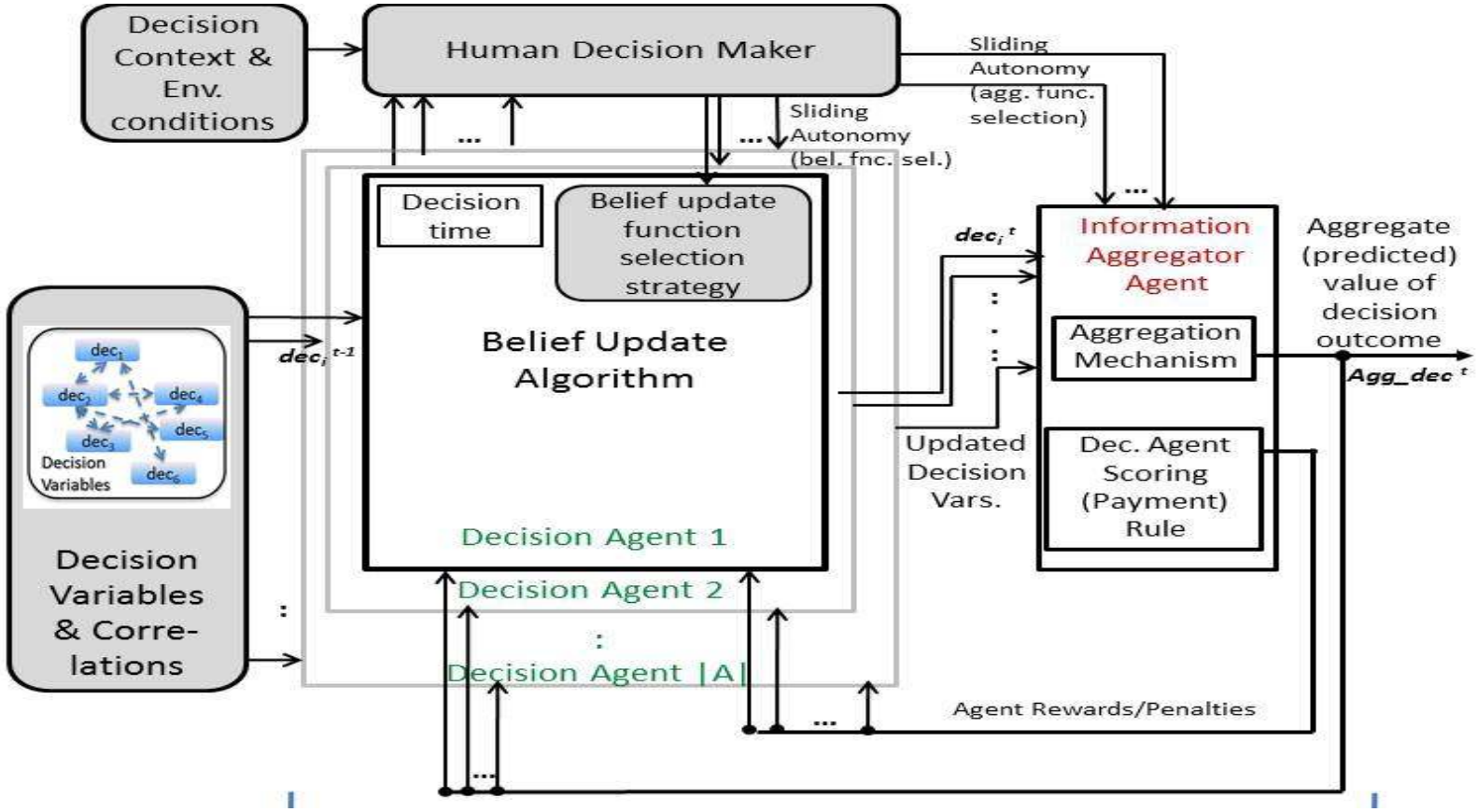
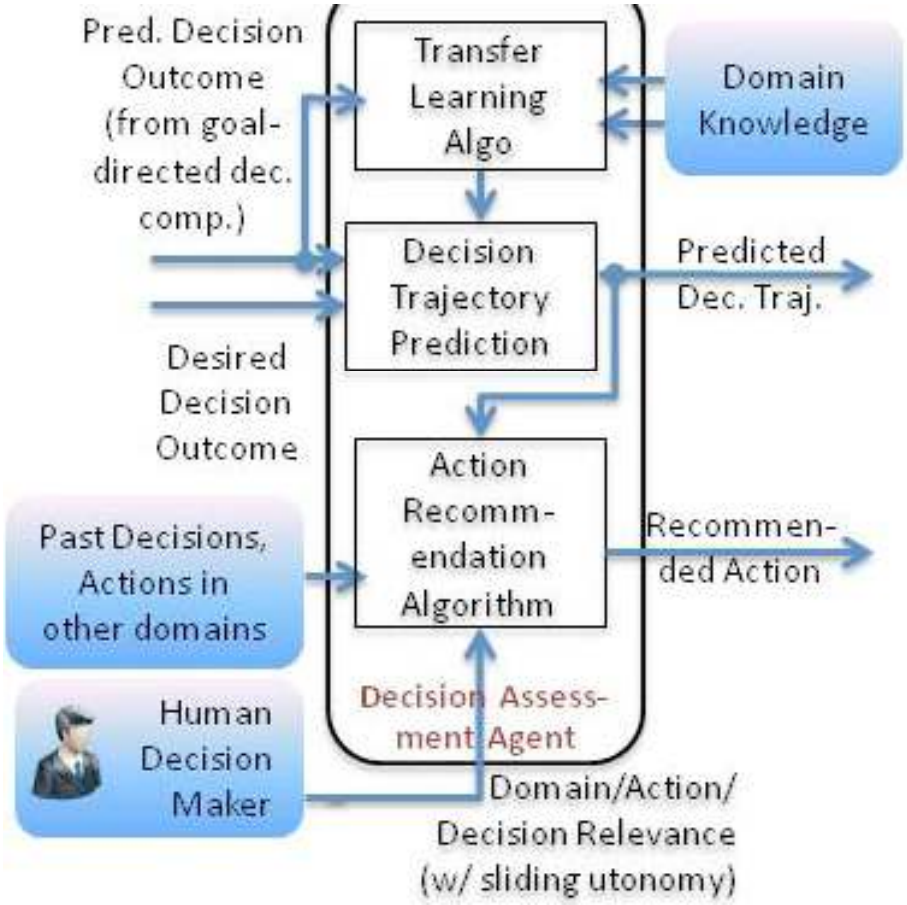


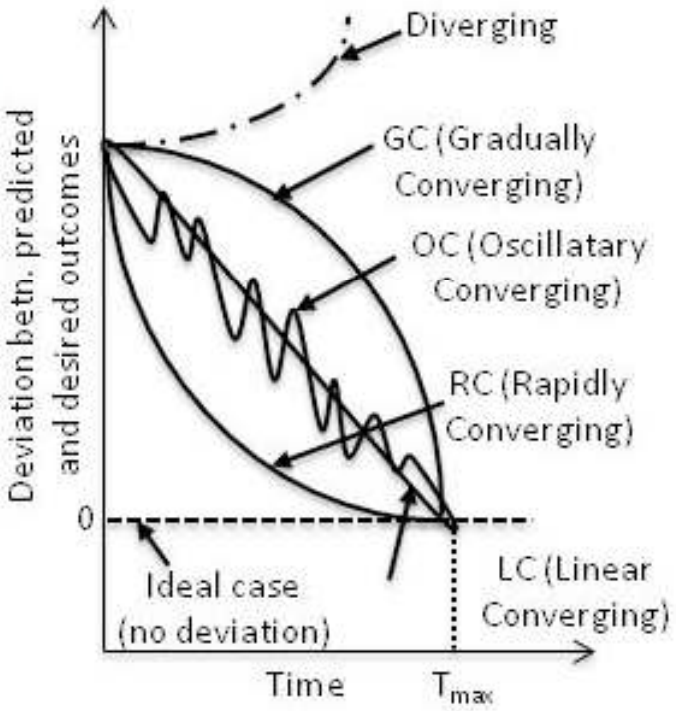
CONRAD: Decision Making Component



J. Jumadinova and P. Dasgupta, "Mutlirobot autonomous landmine detection using distributed multisensor information aggregation," *Proc. SPIE 8407, Multisensor, Multisource Information Fusion: Architectures, Algorithms, and Applications,* 2012.

CONRAD: Decision Assessment Component





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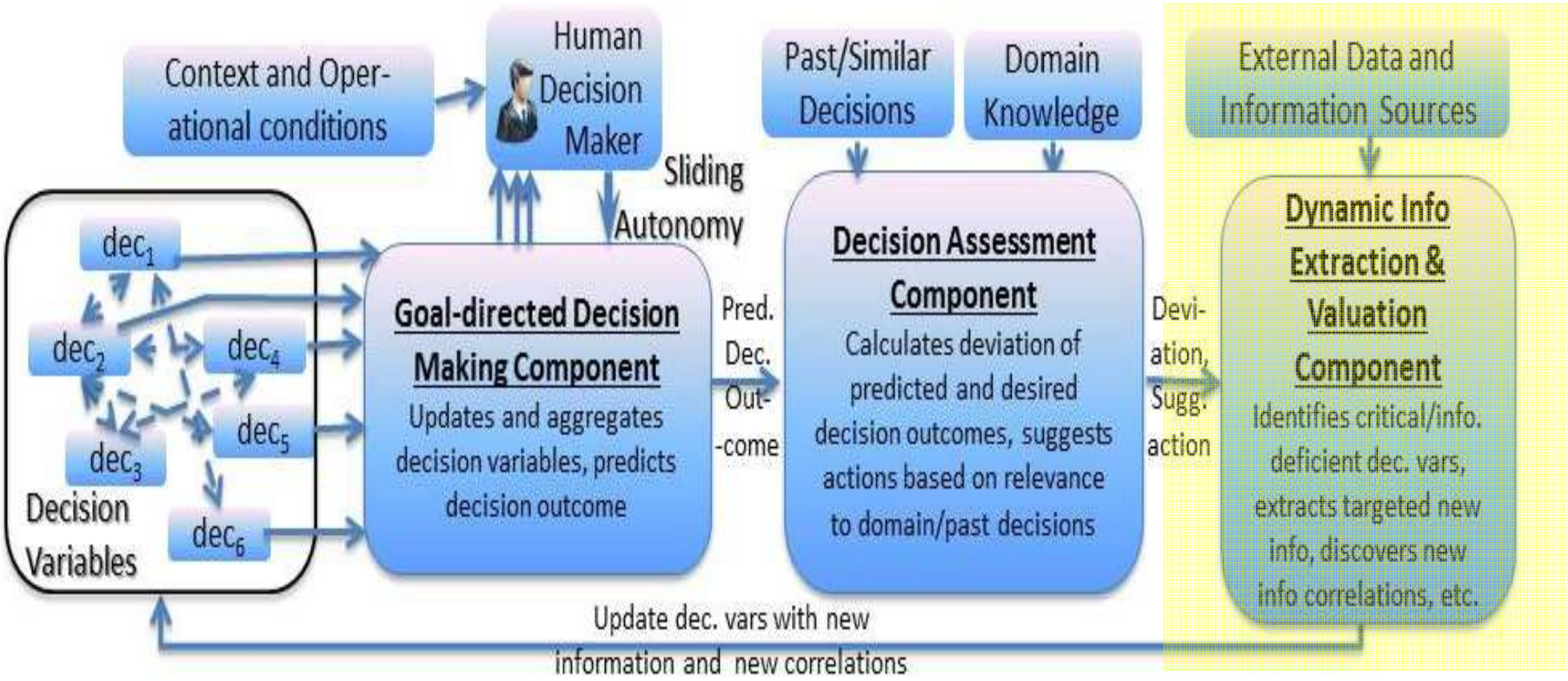
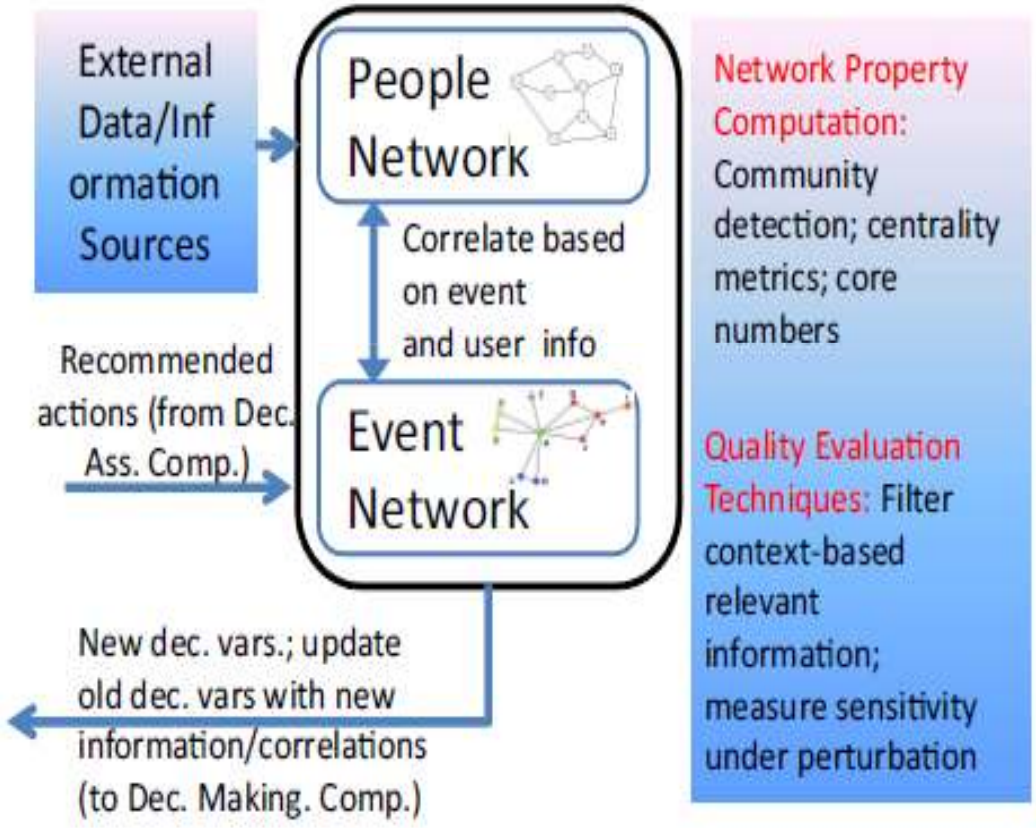
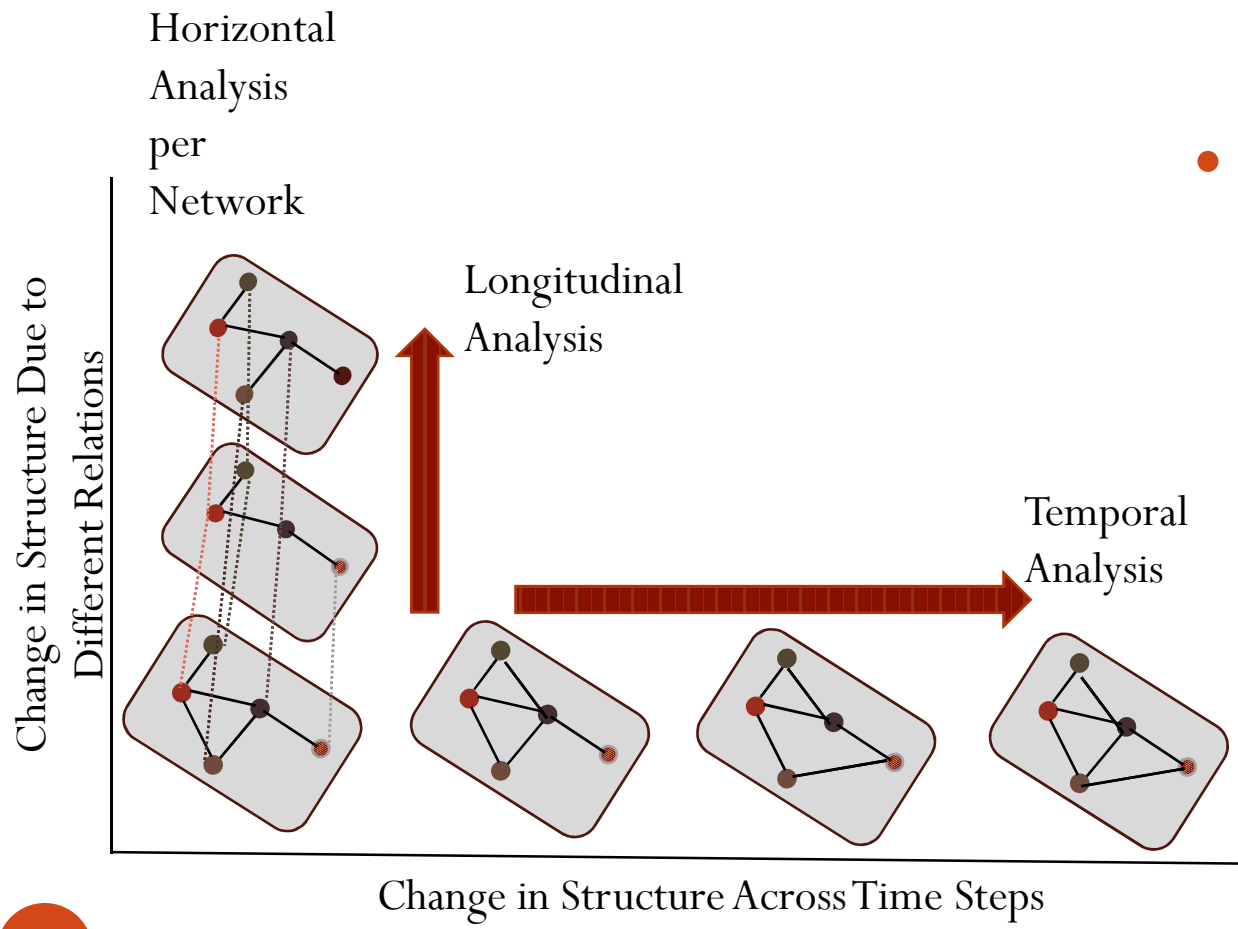


CONRAD: Information Extraction and Valuation Component



- Extracts information from various sources, e.g., Twitter, National Hurricane Center, etc.
  - Data enriched by semantic information
- Modeled as networks (entity = node; correlated nodes linked by edges)
- Use network properties (community detection, centrality metrics) to analyze underlying system.
- Parallel algorithms for real-time analysis

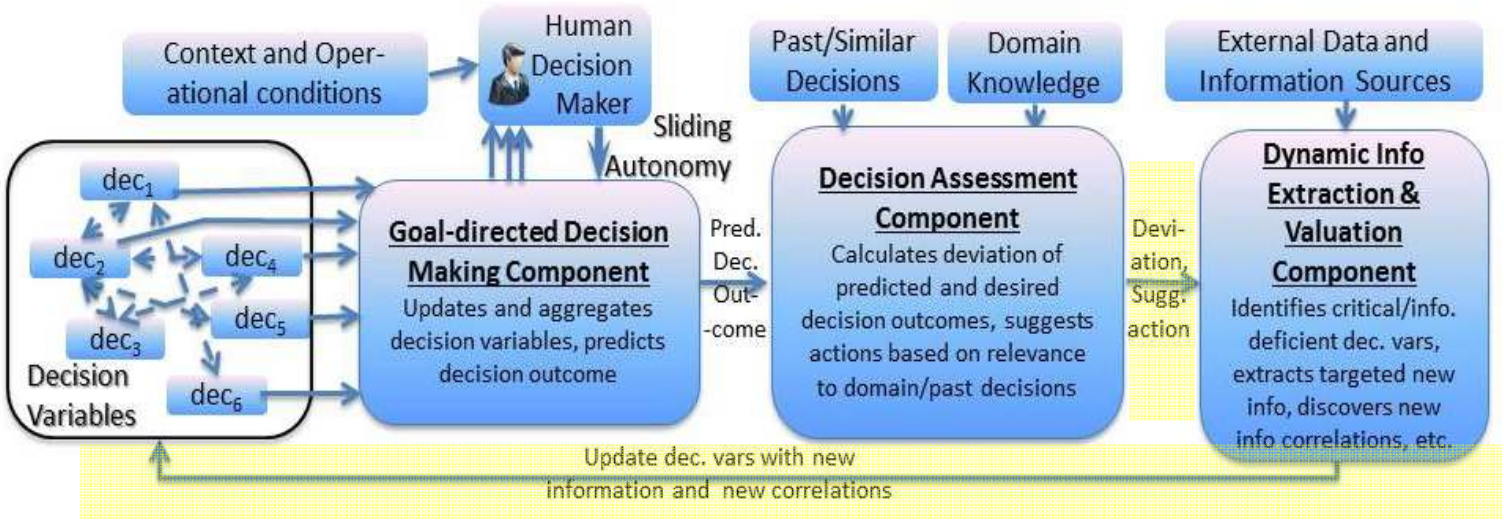
Data Analysis Across Multiple Levels



- 3-dimensional description of the data pattern and flow.
- Networks analyzed at three levels
  - Horizontal (information from one source at a certain time stamp)
  - Longitudinal (information from multiple sources at a certain time stamp)
  - Temporal (information from one source over multiple time stamps)

Integrating Data Extraction and Decision Making

- Send data to decision support system to update information
- Recommendation returned from decision system to improve;
  - Data Volume: achieved by including multiple sources
  - Data Quality: achieved by filtering out "non-essential" data
  - Speed of Processing: achieved by measuring trade-offs between accuracy of results and computation time.



Conclusions and Future Directions

- CONRAD system proposed to improve context awareness of decision makers in decision process
  - Real-time, autonomous decision support
  - Combined network analysis and decision making
  - Feedback from ongoing decision making for real-time network/context analysis and update
- Ongoing work: Implement system and integrate components for critical, decision making domain

Thank you

Questions

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