Distributed Network Systems

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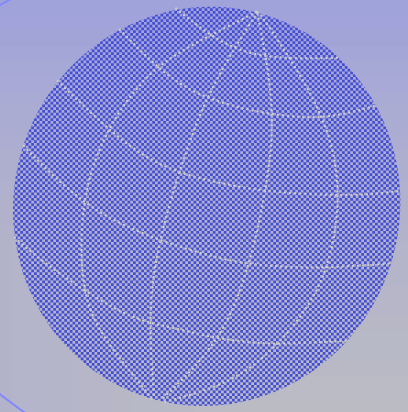

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Topics …

- Basic issues affecting the performance of lifeline systems.
- A framework for identifying research needs in lifeline loss assessment.
- One researcher's view of the maturity of research in specific areas.
- An assessment of general research directions to improve our ability to measure the system performance of distributed systems.

Questions

- What is the Big Picture regarding the current status of SRA tools for highway and electric power networks? What are the major shortcomings?
- What are the biggest uncertainties in the analysis procedure that drive the reliability of current SRA tools? What are the biggest gaps in data/information that drive uncertainty

What makes lifelines lifelines?

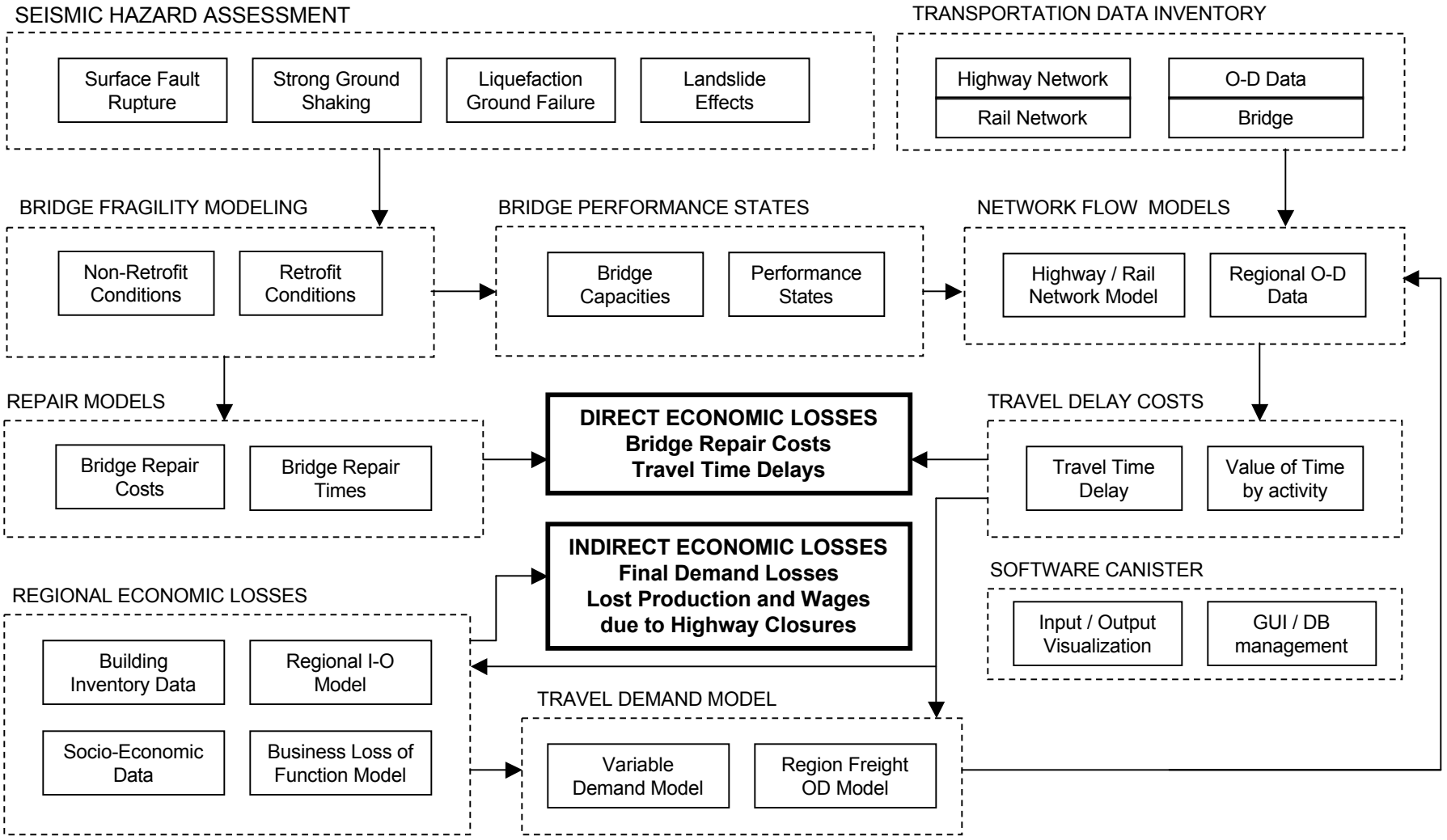
- They are essential for the welfare and safety of a community.
- They consist of nodes that are linked together to form networks.
- There are significant interdependencies between lifelines.

What makes these systems vulnerable to earthquake effects?

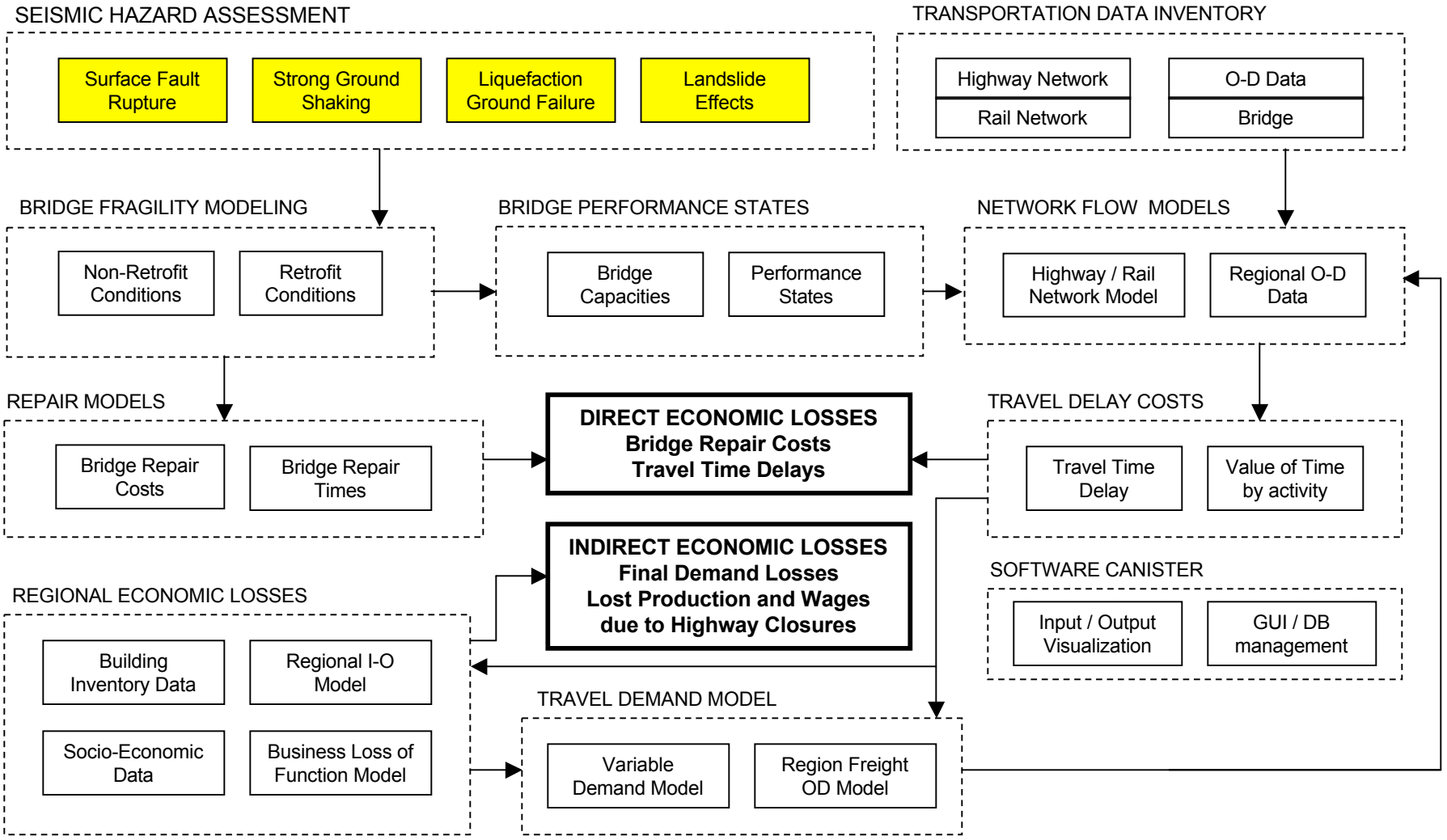
- They are largely distributed systems.
- The are susceptible to a wide range of seismic hazards.
- Their performance is often dependent on the operation of other systems.
- There are no consensus-based standards for evaluating or design these "systems" for seismic effects.

Framework for discussion …

- Focus on some framework for characterizing lifeline performance.
- This framework should allow for identifying key research needs or gaps.
- The framework should provide a basis for tracking research progress on specific projects.



Comprehensive Loss Estimation Framework for Highway Systems



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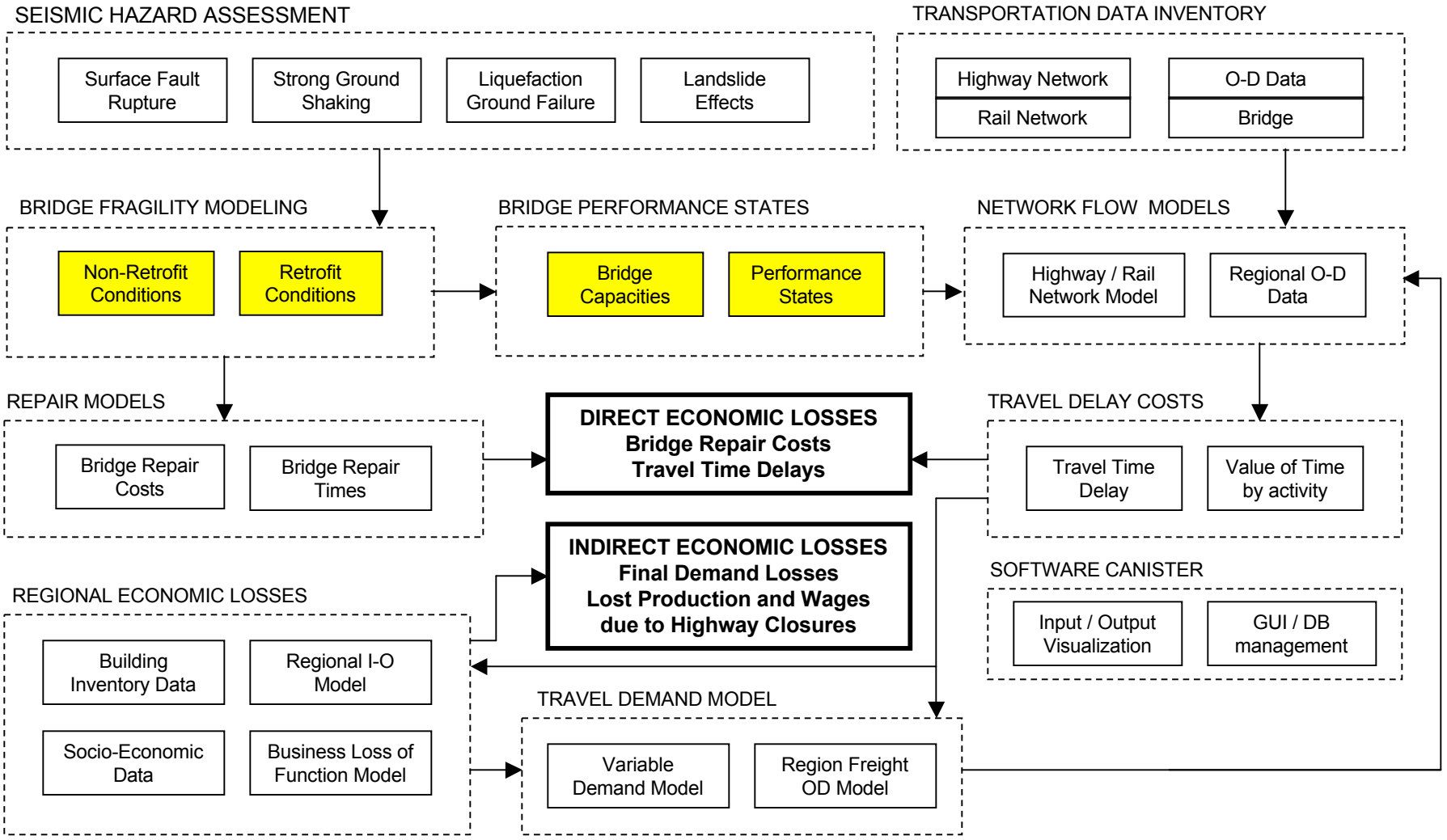

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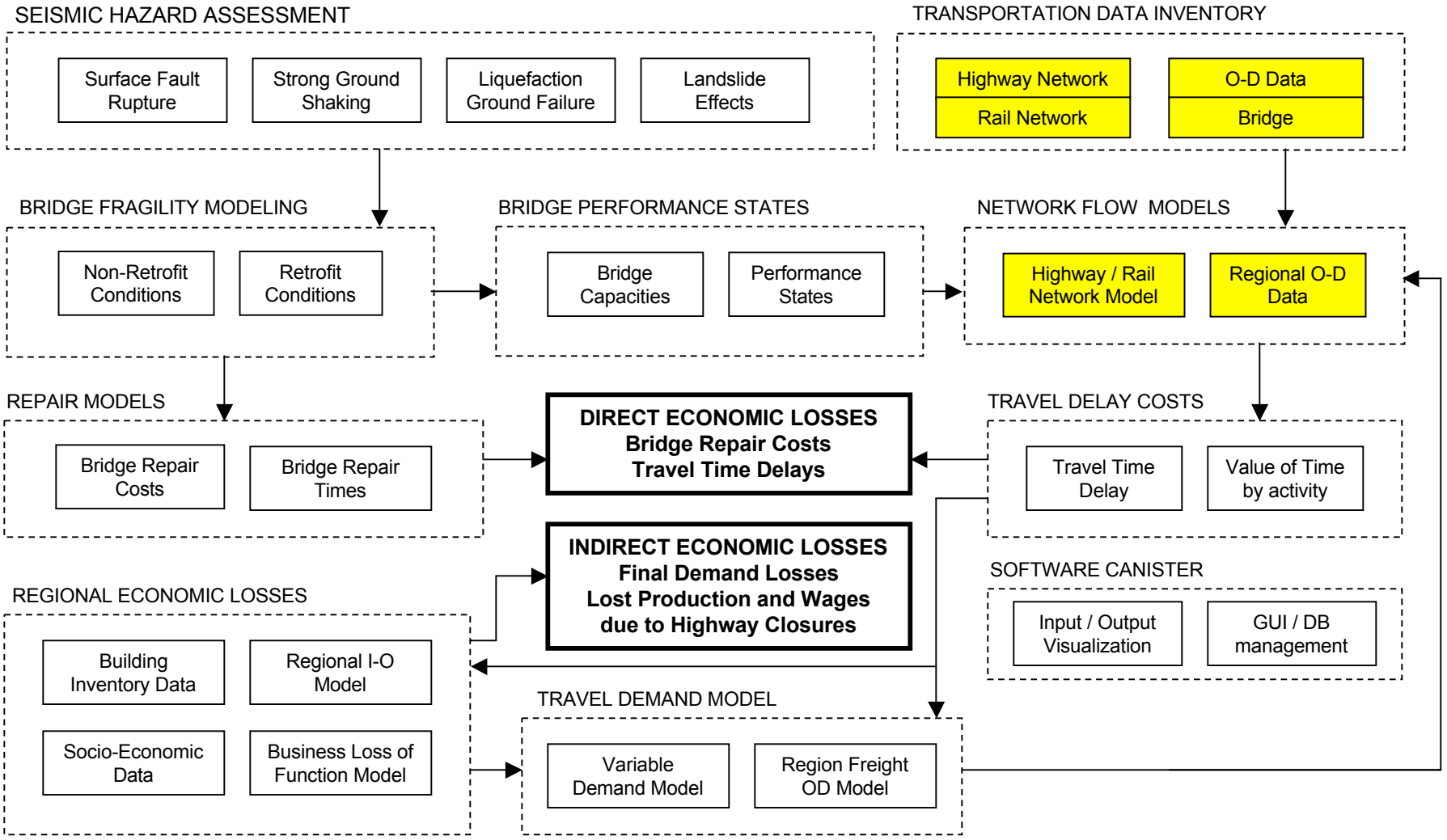

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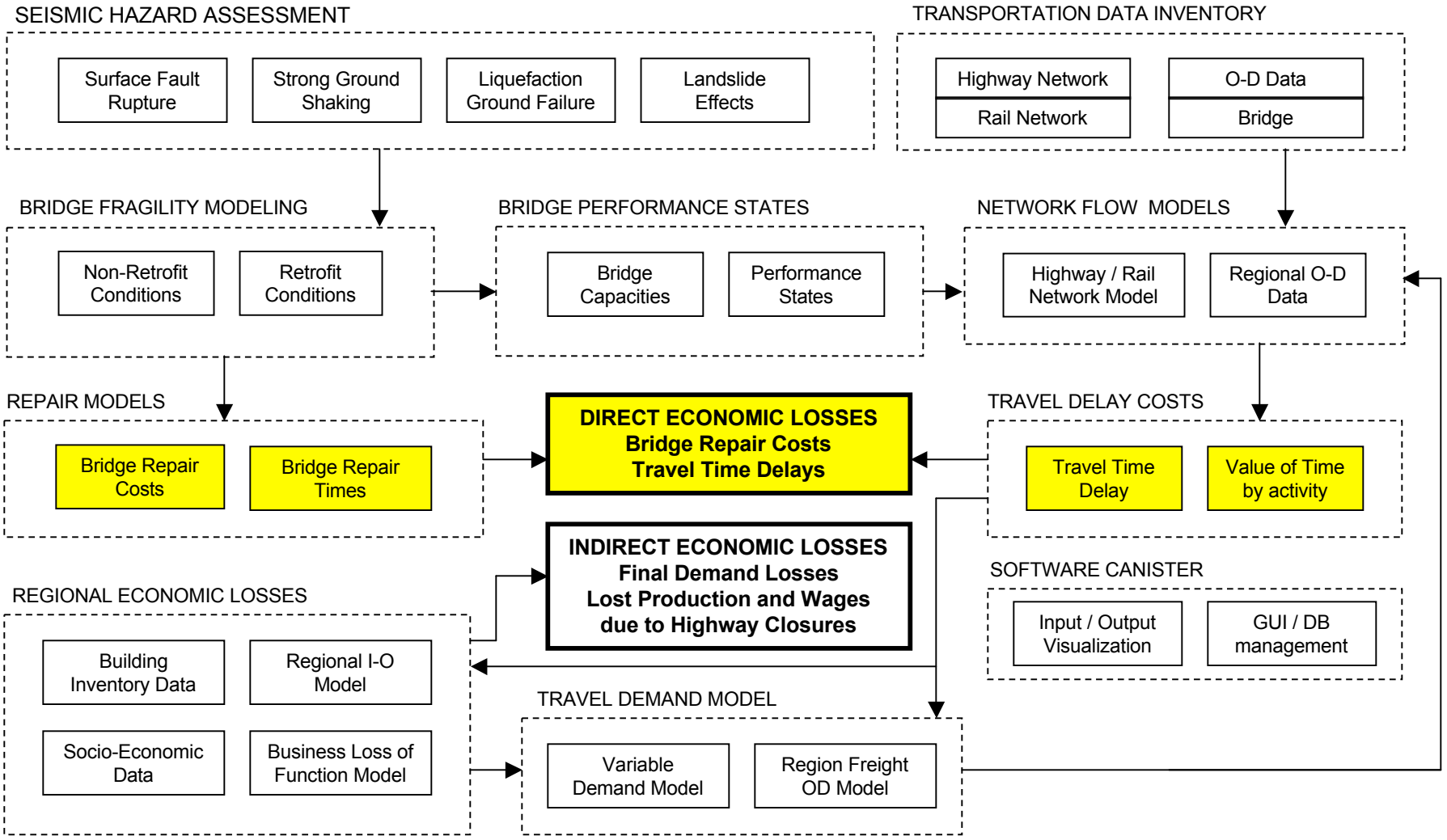

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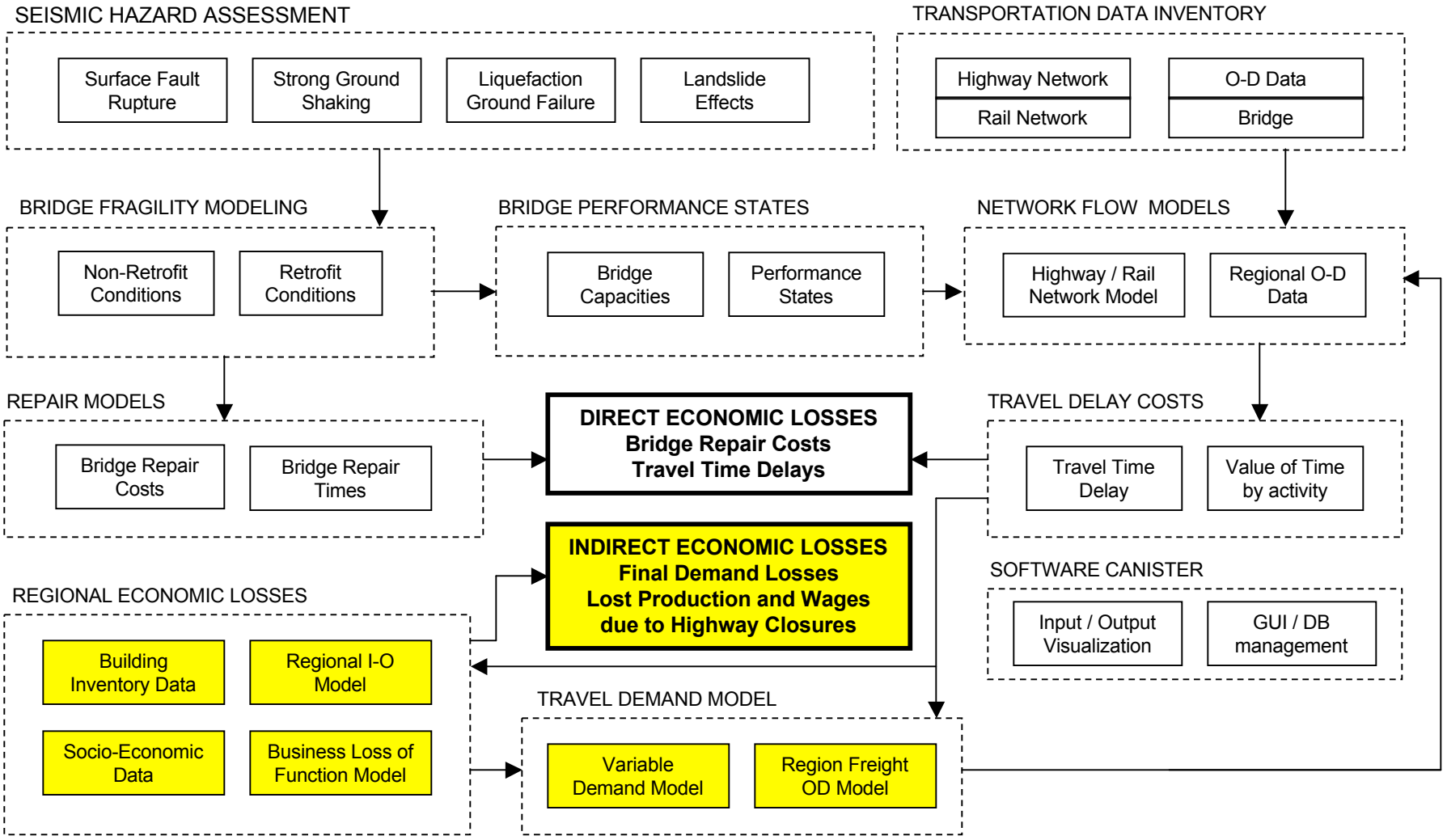

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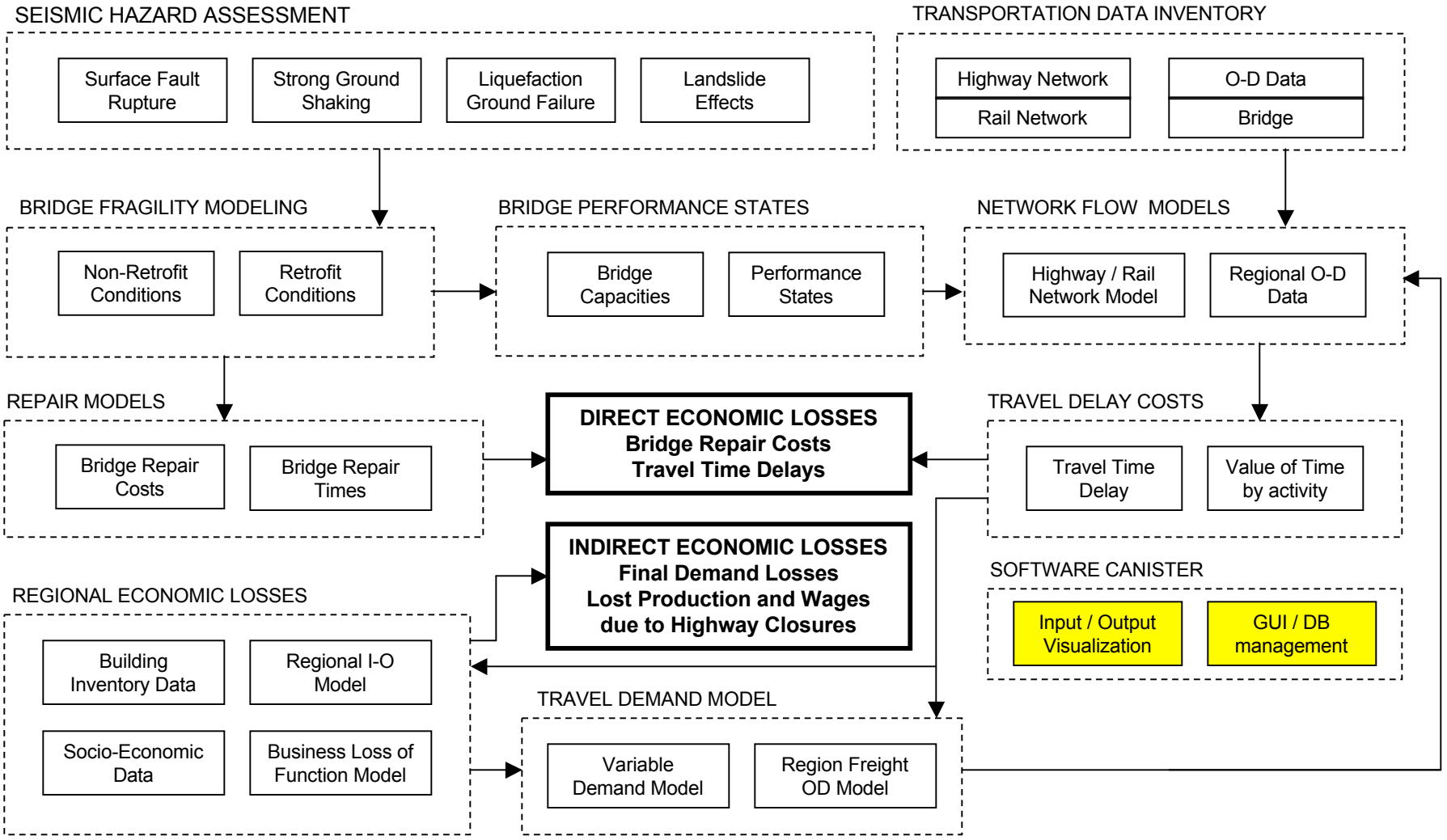

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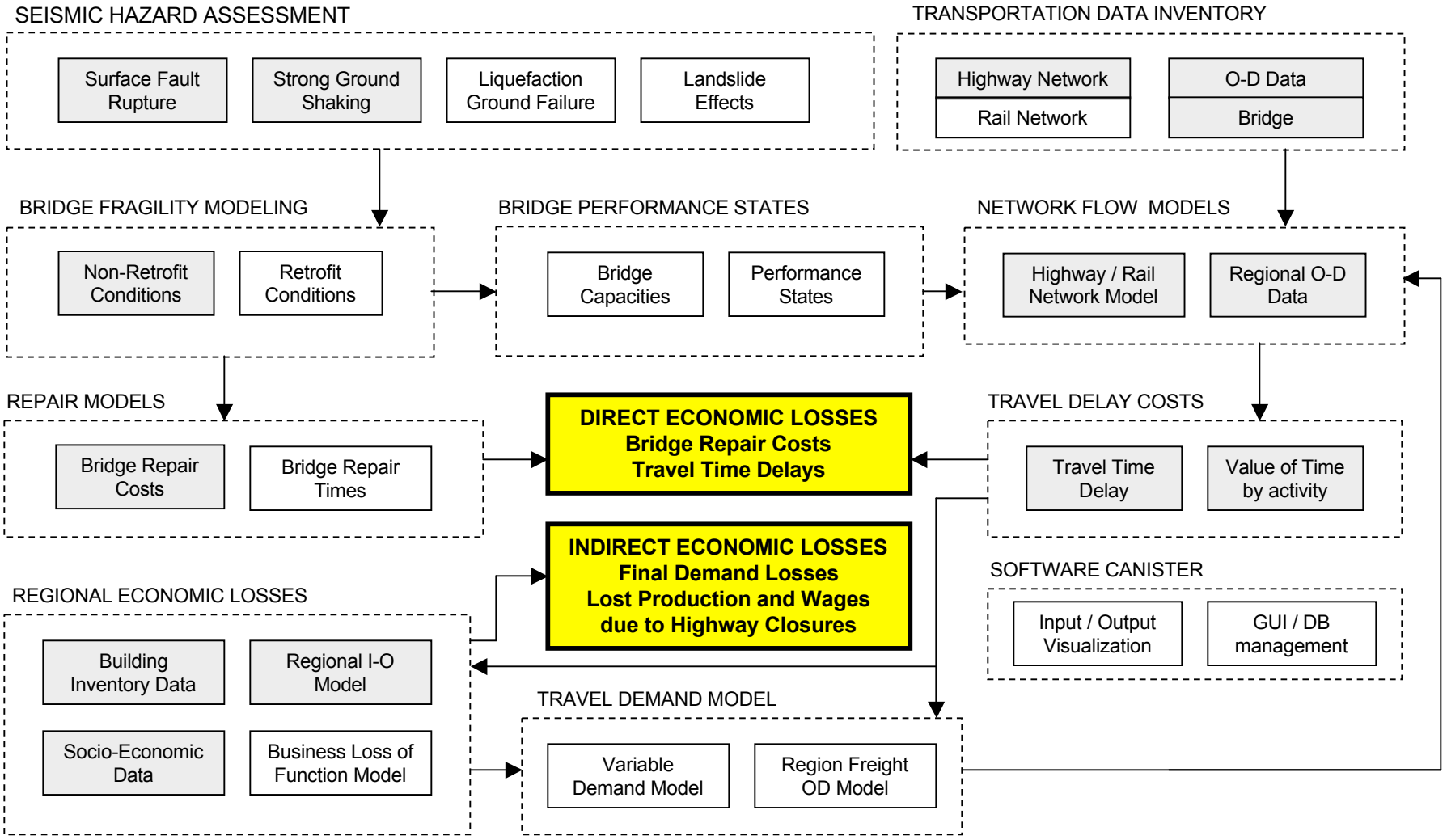

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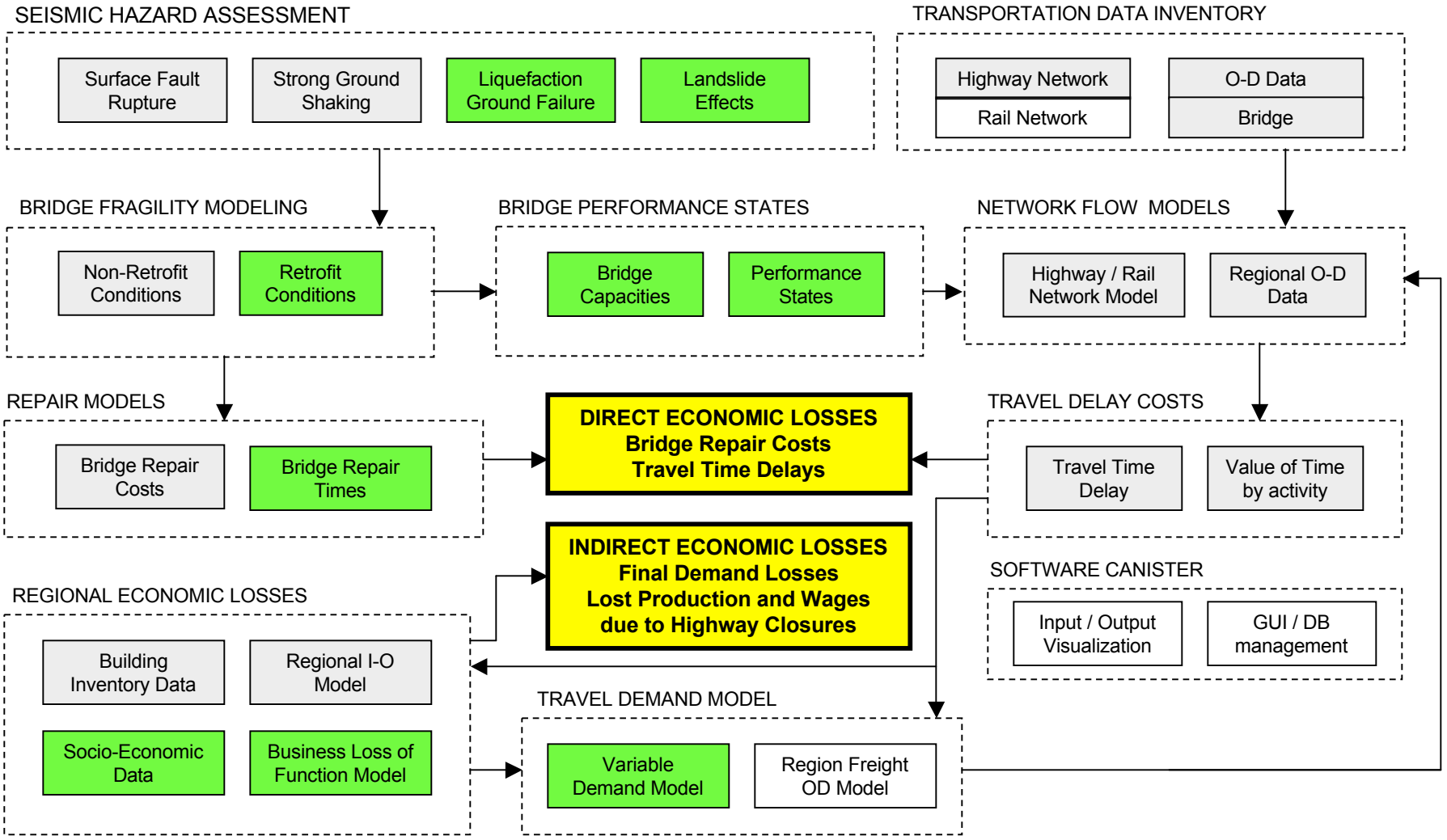
AREAS SHOWING SOME LEVEL OF MATURITY



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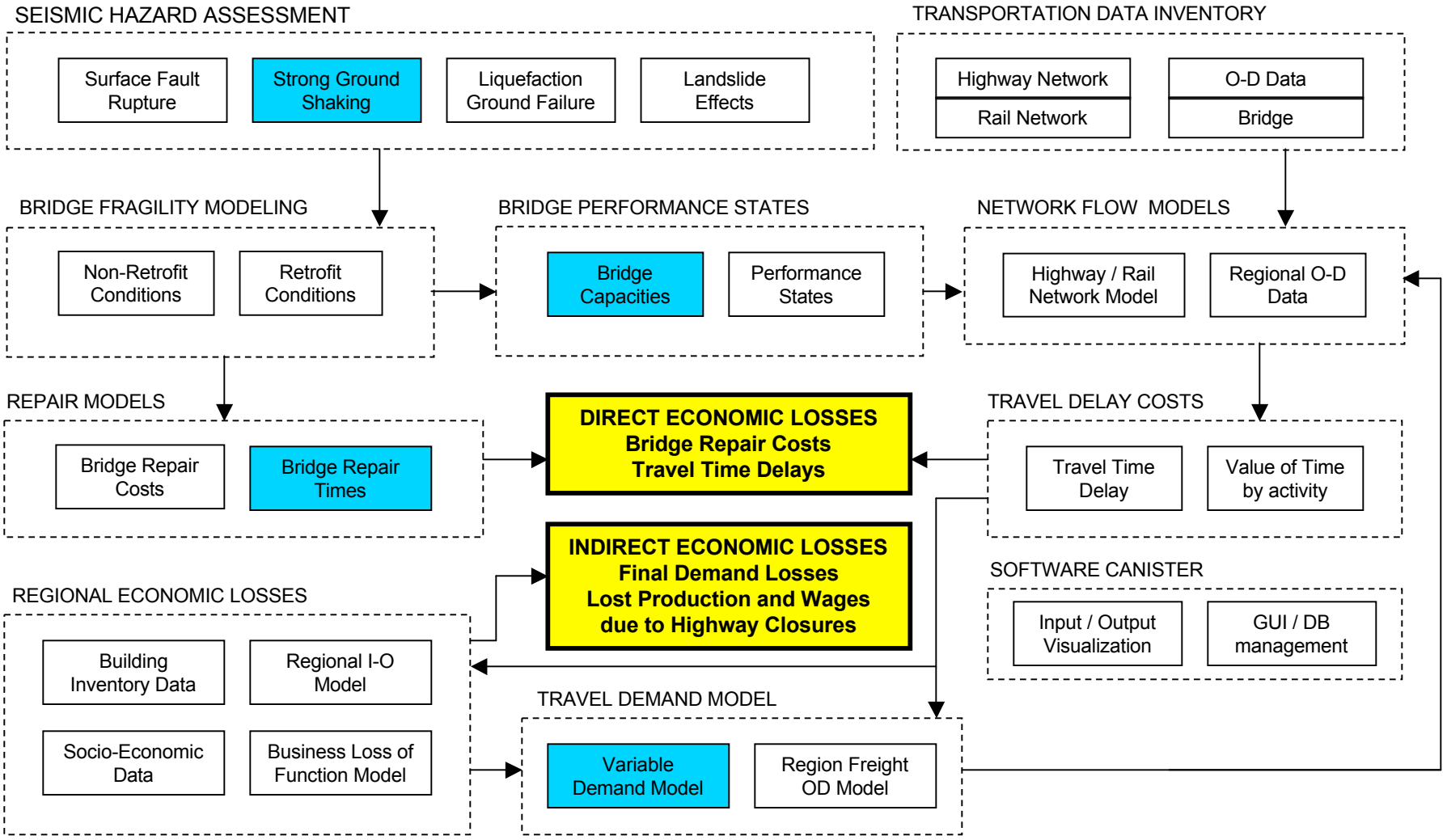
AREAS REQUIRING MORE RESEARCH



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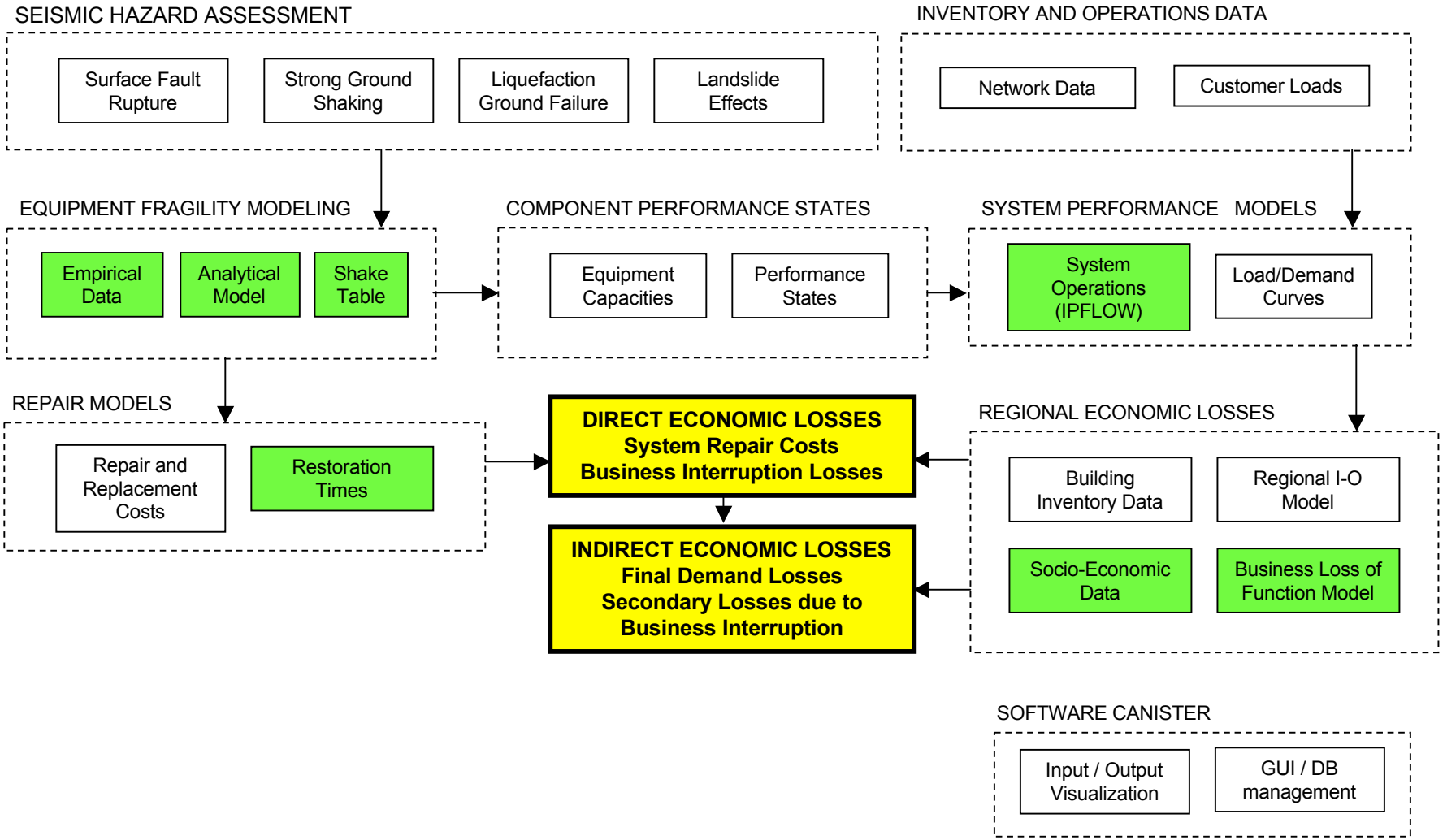
"KEY" AREAS WITH SIGNIFICANT UNCERTAINTY



Comprehensive Loss Estimation Framework for Electric Power Systems

AREAS REQUIRING MORE RESEARCH

Conclusions …

- We've made tremendous progress in SRA modeling – measuring direct and indirect economic costs
- We need to better understand the sensitivity of our final loss estimates to uncertainties in individual models or modules
- We need to pay more attention to validation studies – current loss models tend to over-predict losses in small events and under-predict losses in large events