Executive Information System (EIS) for the Aviation System Risk Model (ASRM)

M.S. Thesis Defense

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# Research Overview

## Problem Statement
- Historical Accident Rate
- Overview of Risk Management
- FAA Office of System Safety
- NASA Aviation Safety and Security Program

## Literature Survey
- Risk Analysis
- Bayesian Belief Models
- Knowledge Management
- Aviation System Risk Model
  - V 1.0: Explanation of DSS
  - V 2.0: Explanation of EIS

## Initial Results
- #1 Knowledge Displays
  - Case Displays
  - Haddon Matrices
  - Multi-Factor Plots
- #2 GAP Analysis
  - Taxonomy
  - Haddon Matrices
- #3 Sensitivity Analysis (SA)
  - Birnbaum Importance
  - IF Tool
- #4 Optimization
  - Algorithms
  - Linear Program
  - Genetic Algorithm

## Research Outcome (EIS)

## Further Remarks
Problem Statement

- To develop and disseminate methods, tools and feedback necessary to evaluate the risk impact of the NASA AvSP product portfolio (48) upon the 1990-1996 aviation accident baseline period.

- An Executive Information System is required for the Aviation System Risk Model (ASRM) to gain an improved understanding of the interactions of the NASA AvSP products.

- Aggregate data from the 20 ASRM risk models needs to be displayed in a meaningful way to NASA analysts, managers and executives.
Boeing Summary of Commercial Airplane Accidents

1. **Aircraft Self-Protection and Preservation** – Protect and prevent damage to aircraft due to abnormal operations and system failures.

2. **Hostile Act Intervention and Protection** – Increase resiliency of the Air Traffic System against threats and hostile acts.

3. **Human Error Avoidance** – Prevent unsafe flight situations due to breakdown between human and machine interface.

4. **Environmental Hazards Awareness and Mitigation** – Detect and/or mitigate the effects of natural hazards that could compromise safe Air Traffic System operations.

5. **System Vulnerability Discovery and Management** – Identify and inform users of potential Air Traffic System vulnerabilities.

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**Source:** [http://avsp.larc.nasa.gov/pdfs/Program_P](http://avsp.larc.nasa.gov/pdfs/Program_P)
Literature Survey

- Risk Analysis
- Bayesian Belief Models
- Knowledge Management
Risk Management Overview

**Qualitative Risk Management**

"Swiss Cheese” Model” – Dr. James Reason → Blame is not always on human, focuses on systems approach

**Human Factor Analysis and Classification System (HFACS) – Drs. Scott Shappell and Doug Weigmann →** Analyze the hazards and causal factors of an accident, looks at organizational influences, unsafe supervision, preconditions for unsafe acts, and unsafe acts

**Quantitative Risk Management**

Bayesian Belief Networks – Exploit the power of a qualitative risk management approach with the use of Baye’s estimators in Conditional Probability Tables (CPTs), also may introduce decisions into an “Influence Diagram”

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**James Reason’s “Swiss Cheese” Risk Model**

![Swiss Cheese Model](image)

Source: [http://www.bmj.com](http://www.bmj.com) BMJ Volume 320 18 March 2000 James Reason
Human Factors Analysis & Classification System (HFACS)

Bayesian Belief Networks

A causal network is a graphical representation of a situation for reasoning under uncertainty:
- events are clustered into variables with states.
- causal relations between events are indicated with directed edges.

- Task / Environmental Factors
- Individual Factors
- Organizational Factors

Further Remarks
Influence Diagram

A Bayesian Belief Network with extended facilities of a Decision/Action node and/or a Utility node is called an Influence Diagram.

Decision / Action Nodes:
- On/Off “switch” for Decision/Action
- Used in our Framework to Model Products

Utility Nodes:
- Additive to Utility Function of BBN
- Not used in our Framework as of now.

Knowledge Management (KM)
- KM exposes a method to disseminate and apply knowledge to improve organization performance with educated decision-making.
- “Know-what” === Information, Declarative
- “Know-how” === Steps, Procedural
  - Composite of “Know-what” and “Know-how” is “Know-why” === Reasoning

Source: Yim, Kim, Kim and Kwahk, 2004
ASRM Case Architecture

- Products (48) - Causal Factors (HFACS) - Accident

ASRM V1 DSS V2 EIS

Projects #1 KD #2 GAP #3 SA #4 Opt.

Research Further Remarks

20 Models Developed

- Controlled Flight Into Terrain (CFIT)
- Loss of Control (LOC)
- Maintenance (MAIN)
- Engine Failure (EF)
- General Aviation (GA)
- Runway Incursion (RI)
Decision Support System → ASRM 1.0

(Jalil, 2003)
Executive Information System - ASRM 2.0

- **What is an EIS?**
  - Provides a methodology to expose high-level knowledge gleamed from models and databases.
  - Supports environmental information, strategy formulation and strategy implementation.
  - Intent is not to directly support an organization’s objectives, but may guide the organization to a better solution, whether that is cost, time, or reducing the accident rate.

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Executive Information System - ASRM 2.0

- **Questions to strengthen the EIS...**
  1) What *techniques/tools* do we need to incorporate with an EIS that will effectively evaluate and prioritize *decision matrices* most efficiently and effectively for *executives and upper-level management* by national program level offices?
  2) Another question derived from the original question is: What do the *developers of an EIS need to consider and research* in order to *validate/verify* the information system and tools developed?
  3) What are the *tradeoffs* developers may take to make a more *comprehensive and useable* system for decision-makers?
### Differences ASRM 1.0 (DSS) vs. ASRM 2.0 (EIS)

<table>
<thead>
<tr>
<th>Description of Comparison</th>
<th>ASRM 1.0 (DSS)</th>
<th>ASRM 2.0 (EIS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ease of Use</td>
<td>Requires hands on use, Has user-friendly interface, Knowledge of Excel needed</td>
<td>Automated usage, User-friendly interface, Limited knowledge of Excel</td>
</tr>
<tr>
<td>Cross-Case Capability</td>
<td>Not readily available</td>
<td>Automated</td>
</tr>
<tr>
<td>Strategy Formulation</td>
<td>Complex</td>
<td>Genetic Algorithm and LP analysis.</td>
</tr>
<tr>
<td>Knowledge Required to Use</td>
<td>Not very complex</td>
<td>Complex knowledge needed</td>
</tr>
<tr>
<td>Graphic Output of All Models</td>
<td>Limited to None</td>
<td>Graphical</td>
</tr>
<tr>
<td>Analysis of Causal Factors</td>
<td>No Cross Case, Harder to get this detail</td>
<td>Provides Cross Case “What If” Analysis</td>
</tr>
<tr>
<td>Budgetary Optimization</td>
<td>None</td>
<td>Connection to Case Studies</td>
</tr>
<tr>
<td>Robustness Measure of Models</td>
<td>None</td>
<td>Gap Analysis provided</td>
</tr>
</tbody>
</table>
Masters Thesis Research Projects

Research Project 1 → Knowledge Displays
- Useful combination, presentation and dissemination of multiple streams of information collected.

Research Project 2 → GAP Analysis
- Provide summary statistics to Level 2 managers at NASA and gain feedback for model development.

Research Project 3 → Sensitivity Analysis
- Use Birnbaum Sensitivity Analysis measures to determine how much one causal factor affects another. Determines which nodes require more investigation and other methodologies.

Research Project 4 → Optimization
- Use Genetic Algorithms, Simulated Annealing, and Tabu-Search in combination with developed database to give budgetary and accident rate optimization.
More Detailed Representation of Thesis

Executive Information System (EIS)

Post-Modeling Analysis Analysts

ASRM – Decision Support System (DSS)

Modeling SMEs/Databases

Risk Management NASA/FAA Executives

CASE DISPLAYS
HADDON MATRICES
MULTI-FACTOR PLOTS
PARAETO CHARTS

SENSITIVITY ANALYSIS
GAP ANALYSIS
OPTIMIZATION

LOC, CFIT, RI, MAIN, EF, GA
Research Project 1  → Knowledge Displays

- Case Displays

- Portray the models “best” scenarios overall and with different product suites turned on and off.

- Uniqueness of different scenarios may be easily acquired by an analyst.

Research Project 1 & 2  → KD and Gap Analysis

- Haddon Matrices

- Proposed by Haddon in 1970 is also divided into pre-crash, crash, and post-crash phases.

- Differentiates the role of the human, vehicle and environment.

- Haddon Matrices did not capture interactions; however, BBNs capture these nuances.
System Technologies, comprised of ASMM and SWAP, affect Organizational Causal Factors with 48.9% of the direct links.
Research Project 1 \rightarrow Knowledge Display

- Derived from Leavitt’s 1965 model of organizational interactions.

- Multi-factor Plots parallel Leavitt’s model of Organizational Interactions. Human, Organizational, Environmental, and Accident are substituted for People, Organization, Tasks and Technology, respectively.

There is an average maximum relative decrease of 52.2% of Environmental Factors when applicable AvSP products are turned on.
## Research Project 1 \(\rightarrow\) Comparisons of KD's

<table>
<thead>
<tr>
<th>Knowledge Display</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
</table>
| Accident Case Display | Easy to use and utilize.  
                    | Compare many interactions.  
                    | May be used for any one metric.  
                    | Graphical.                                                      | Simplistic.  
                    | Compares only one metric.  
                    | Not easy to utilize again.                                      | |
| Haddon Matrices   | Displays a multitude of information.  
                    | Easy to cross-reference different metrics  
                    | Fairly easy to use.  
                    | Calculations may be performed.                                 | Numerous levels of information to analyze.  
                    | Moderate level of difficulty to understand.                     | |
| Multi-Factor Plots | Provides complex information in a small amount of space.  
                    | Compares different matrices.  
                    | Graphical.                                                      | High level of complexity.  
                    | Requires more knowledge to utilize effectively.                | |

### Additional Notes
- **Research:**
  - Problem Statement
  - Historical Accident Rate
  - Risk Mgmt.
  - Literature Survey
  - ASRM V1 DSS V2 EIS
  - Projects: #1 KD, #2 GAP, #3 SA, #4 Opt.
- **Further Remarks:**
Research Project 3 and 4 → Birnbaum’s Importance

\[ I_k^B (t) = \frac{\frac{\partial R_k(t)}{\partial t}}{\frac{\partial F_k(t)}{\partial t}} = \frac{\partial F_k(t)}{\partial F_k(t)} \]

\( I_k^B \) is reliability importance of the \( k^{th} \) component

\( R_k(t) \) and \( F_k(t) \) = system reliability and unreliability at time \( t \)

\( R_k(t) \) and \( F_k(t) \) = system reliability and unreliability of component \( k \) at time \( t \)

- Developed by Birnbaum in 1969

- Importance is how likely the component is to cause the system failure.

-- Also the system’s increase in reliability due to that component’s increase in reliability.


Research Project 3 and 4 → Importance of Product or Causal Factor

- Turn all Products off and then turn on 1 at a time.

- Turn one Causal Factor on at a time.
### Research Project 3 → Sensitivity Analysis

#### Construct a database measuring relative change of turning on and off a causal factor.

<table>
<thead>
<tr>
<th>Causal Factor</th>
<th>Changed Node</th>
<th>Percent Increase of Causal Factor</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air_Cause_VS</td>
<td>AFS</td>
<td>0.0347211</td>
<td>ASA, D29</td>
</tr>
<tr>
<td>Air_Cause_VS</td>
<td>AC_Veh</td>
<td>0.0820782</td>
<td>ASA, D29</td>
</tr>
<tr>
<td>Air_Cause_VS</td>
<td>Certificate_qualification</td>
<td>5.37E-05</td>
<td>ASA, D29</td>
</tr>
<tr>
<td>Air_Cause_VS</td>
<td>Fail_Overight</td>
<td>0.00590831</td>
<td>ASA, D29</td>
</tr>
<tr>
<td>Air_Cause_VS</td>
<td>Failure_Overight</td>
<td>1.1840413</td>
<td>ASA, D29</td>
</tr>
<tr>
<td>Air_Cause_VS</td>
<td>Improper_inspection</td>
<td>0.19571172</td>
<td>ASA, D29</td>
</tr>
<tr>
<td>Air_Cause_VS</td>
<td>Inadequate_design</td>
<td>0.0264918</td>
<td>ASA, D29</td>
</tr>
<tr>
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<td>Inadequate_documentation</td>
<td>0.01585604</td>
<td>ASA, D29</td>
</tr>
<tr>
<td>Air_Cause_VS</td>
<td>RTO</td>
<td>0.00208017</td>
<td>ASA, D29</td>
</tr>
<tr>
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<td>Inadequate_supervision</td>
<td>0.00719499</td>
<td>ASA, D29</td>
</tr>
<tr>
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<td>Inadequate_Uom</td>
<td>0.00704291</td>
<td>ASA, D29</td>
</tr>
<tr>
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<td>Inadequate_Processes</td>
<td>1.06521111</td>
<td>ASA, D29</td>
</tr>
<tr>
<td>Air_Cause_VS</td>
<td>NTSB</td>
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<td>ASA, D29</td>
</tr>
<tr>
<td>Air_Cause_VS</td>
<td>Knowledge_rate_test</td>
<td>0.00250618</td>
<td>ASA, D29</td>
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<tr>
<td>Air_Cause_VS</td>
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<td>4.08E-05</td>
<td>ASA, D29</td>
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<tr>
<td>Air_Cause_VS</td>
<td>SBE</td>
<td>1.2025694</td>
<td>ASA, D29</td>
</tr>
<tr>
<td>Aircraft_VS</td>
<td>Traceability</td>
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<td>ASA, D29</td>
</tr>
<tr>
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<td>ASA, D29</td>
</tr>
<tr>
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<td>ASA, D29</td>
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<td>ASA, D29</td>
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<tr>
<td>Aircraft_VS</td>
<td>Absence</td>
<td>0.00208017</td>
<td>ASA, D29</td>
</tr>
</tbody>
</table>

### Research Project 3 → Sensitivity Analysis

#### Create “What-If” tool for accident investigation and to determine which causal factors need more investigation.

**CFIT**
- Causal Factor: SBE, Difficulty: 2.237433664
- Causal Factor: AMS, Difficulty: 1.5231043937
- Causal Factor: DE, Difficulty: 0.3376581892
- Causal Factor: Design_Tech_Environment, Difficulty: 0.2122874956

**EF**
- Causal Factor: Turbulence, Difficulty: 1.745484307
- Causal Factor: Improper Inspection, Difficulty: 6.630152108
- Causal Factor: SBE, Difficulty: 6.2009406918

**LOC**
- Causal Factor: Hardware_Failure, Difficulty: 1.4530243396
- Causal Factor: DE, Difficulty: 4.6899929523
- Causal Factor: Fail_Cor_Known_Problem, Difficulty: 3.0050180067
- Causal Factor: Routine_Violation, Difficulty: 2.0857254403

**MAIN**
- Causal Factor: AIT_Mem, Difficulty: 1.796420812
- Causal Factor: Routine_Violation, Difficulty: 6.630152108
- Causal Factor: Infract, Difficulty: 6.630152108
- Causal Factor: Knowledge_rule_base, Difficulty: 0.425998211
Algorithm 1 Explanation
- Turn all Products off and then turn on 1 at a time. Add another product and check previous set of products.
  Calculations = Checks (# of products)! x (# of nodes)

Algorithm 2 Explanation
- Same as Algorithm 1, except take off all products originally where P(1) < alpha.
  Calculations = (# of products | P(1) > alpha)! x (# of nodes)

Research Project 4 \(\rightarrow\) Comparison A1 and A2

<table>
<thead>
<tr>
<th>ALPHA</th>
<th>Number of Records Efficiency</th>
<th>Time of Algorithm Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(N(A2) / N(A1))</td>
<td>(T(A2) / T(A1))</td>
</tr>
<tr>
<td>0.00%</td>
<td>92%</td>
<td>68%</td>
</tr>
<tr>
<td>0.10%</td>
<td>89%</td>
<td>46%</td>
</tr>
<tr>
<td>0.20%</td>
<td>89%</td>
<td>47%</td>
</tr>
<tr>
<td>0.30%</td>
<td>87%</td>
<td>32%</td>
</tr>
<tr>
<td>0.40%</td>
<td>88%</td>
<td>26%</td>
</tr>
<tr>
<td>0.50%</td>
<td>87%</td>
<td>20%</td>
</tr>
<tr>
<td>0.60%</td>
<td>88%</td>
<td>19%</td>
</tr>
<tr>
<td>0.70%</td>
<td>84%</td>
<td>18%</td>
</tr>
<tr>
<td>0.80%</td>
<td>87%</td>
<td>15%</td>
</tr>
<tr>
<td>0.90%</td>
<td>87%</td>
<td>15%</td>
</tr>
<tr>
<td>1.00%</td>
<td>88%</td>
<td>13%</td>
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<td>88%</td>
<td>12%</td>
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<td>88%</td>
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<td>1.60%</td>
<td>90%</td>
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<td>1.70%</td>
<td>93%</td>
<td>8%</td>
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<td>1.80%</td>
<td>91%</td>
<td>6%</td>
</tr>
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<td>1.90%</td>
<td>97%</td>
<td>6%</td>
</tr>
<tr>
<td>2.00%</td>
<td>90%</td>
<td>5%</td>
</tr>
<tr>
<td>2.10%</td>
<td>91%</td>
<td>5%</td>
</tr>
<tr>
<td>2.20%</td>
<td>92%</td>
<td>5%</td>
</tr>
</tbody>
</table>

LOC – US405 Case Study for comparison
An LP where the variables are restricted to be integers is called an all-integer linear program (ILP).

Binary variables whose values are restricted to be 0 or 1. If all the variables in a Mathematical Program are restricted to be 0 or 1, then the problem is called a binary integer linear program.
Research Project 4 → Genetic Algorithm Overview

- A programming technique that “mimics” biological evolution as a problem-solving strategy.
- Evaluates candidate solutions and then tries to randomly generate a new solution based upon other ones to improve solution.
- Promising candidates are kept and “reproduce”. These candidates are reproduced with random changes.
- A next generation is made and the process is repeated with these candidates.

http://www.talkorigins.org/faqs/genalg/genalg.html#what
**Program Trees**

GAs have **multiple offspring**, they can explore the solution space in **multiple directions** at once. If one path turns out to be a dead end, they can easily eliminate it and continue work on **more promising avenues**, giving them a greater chance each run of **finding the better solution**.

**Research Project 4 → OptWorks Flexibility**

- May use a number of heuristics.
- Integrates into Excel.
### Research Project 4 → OptWorks Search

<table>
<thead>
<tr>
<th><strong>Decision Variables</strong></th>
<th><strong>ASMM_2</strong></th>
<th><strong>ASMM_1</strong></th>
<th><strong>SWAP_8</strong></th>
<th><strong>SWAP_7</strong></th>
<th><strong>SWAP_6</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>{1 is on, 0 is off}</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>Cost Per Tech</strong></td>
<td>$800,000.00</td>
<td>$800,000.00</td>
<td>$1,200,000.00</td>
<td>$1,600,000.00</td>
<td>$1,400,000.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Node</strong></th>
<th><strong>Max Percent Change w/ Best Tech Set</strong></th>
<th><strong>Row Number in Main</strong></th>
<th><strong>Cost of Node</strong></th>
<th><strong>Cost of Node After Products</strong></th>
<th><strong>Best Total Cost Case for Model</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Consequence</td>
<td>41.3%</td>
<td>64</td>
<td>$10,000,000.00</td>
<td>$5,870,033.50</td>
<td><strong>$13,643,934.92</strong></td>
</tr>
<tr>
<td>Infraction</td>
<td>11.4%</td>
<td>86</td>
<td>$20,000.00</td>
<td>$17,719.39</td>
<td><strong>Savings Per Similar Accident:</strong> $2,334,065.08</td>
</tr>
<tr>
<td>Routine_violation</td>
<td>2.2%</td>
<td>102</td>
<td>$800,000.00</td>
<td>$782,438.58</td>
<td></td>
</tr>
<tr>
<td>Attention_Memory</td>
<td>61.7%</td>
<td>128</td>
<td>$40,000.00</td>
<td>$15,333.74</td>
<td></td>
</tr>
<tr>
<td>Inad_Adapt_Flex</td>
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<td>150</td>
<td>$800,000.00</td>
<td>$761,646.26</td>
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<tr>
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<td>0</td>
<td>$500,000.00</td>
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<tr>
<td>Qualification</td>
<td>5.9%</td>
<td>170</td>
<td>$60,000.00</td>
<td>$56,470.59</td>
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<tr>
<td>Inad_Communication</td>
<td>9.0%</td>
<td>186</td>
<td>$750,000.00</td>
<td>$682,774.54</td>
<td></td>
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<tr>
<td>Uncorrected_Problem</td>
<td>9.3%</td>
<td>202</td>
<td>$800,000.00</td>
<td>$725,311.32</td>
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</tr>
<tr>
<td>Inap_PI_Op</td>
<td>0.0%</td>
<td>0</td>
<td>$900,000.00</td>
<td>$900,000.00</td>
<td></td>
</tr>
<tr>
<td>Inad_Super</td>
<td>55.2%</td>
<td>222</td>
<td>$750,000.00</td>
<td>$336,206.99</td>
<td></td>
</tr>
<tr>
<td>Inad_Res</td>
<td>0.0%</td>
<td>0</td>
<td>$234,000.00</td>
<td>$234,000.00</td>
<td></td>
</tr>
<tr>
<td>Inappropriate_Processes</td>
<td>50.0%</td>
<td>242</td>
<td>$324,000.00</td>
<td>$162,000.01</td>
<td></td>
</tr>
</tbody>
</table>

*** All Costs are Synthetic. This is an Example to illustrate how to put BBN into Genetic Algorithm that gets the optimal solution ***
## Research Projects Status

### Research Project 1 → Knowledge Displays
- **Initial**: Case Displays, All Case Haddon & Multi-Factor
- **Final Result**: Model & Case Suite Haddon & Multi-Factor

### Research Project 2 → Gap Analysis
- **Initial**: All Case Gap Analysis
- **Final Result**: Model & Case Suite Gap Analysis, Pareto Chart

### Research Project 3 → Sensitivity Analysis
- **Initial**: Database Design and Opening Screen
- **Final Result**: Drill-down from case type to causal factor

### Research Project 4 → Optimization
- **Initial**: Compare A1 and A2 for LOC 405
- **Final Result**: Compare A1 and A2 for LOC 405, Any Model Optimization

***Result → EIS Prototype***
EIS Prototype

Executive Information System

- Executive Displays
- Sensitivity Analysis
- Gap Analysis
- ASRM

Multi-Factor and Case Displays
IF Tool and Pareto
Haddon Matrices
Link to ASRM

Nathan Greenhut
Joseph Irgon
EIS Prototype – Multi-Factor

Click for Case Suite
Case Displays – Multiple EIS Views
EIS Prototype – Gap Analysis

Problem Statement

Historical Accident Rate

Risk Mgmt.

Literature Survey

ASRM V1 DSS V2 EIS

Projects #1 KD #2 GAP #3 SA #4 Opt.

Research

Further Remarks

Click for Case Suite
EIS Prototype – Pareto Causal Factors

Number of Analyses for Causal Factors

Causal Factors

Number of Analyses
Number of Analyses for Products

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Contributions from Thesis Research

- Developed methodology to compare numerous case studies in an EIS.
- Meetings with technical monitor and NASA managers to develop and refine. Exposure to top-level management at public companies and government agencies.
- 5 Papers and Presentations
- Produced deliverables for NASA contract.
- Optimization, Sensitivity Analysis, Gap Analysis, Graphical Displays and Graphical User Interface for NASA managers and executives to utilize.
- Bayesian Belief Network → Genetic Algorithm
Future Research

Extensions to EIS

- Extension of Tools ("IF", "What-If" and Sensitivity Programs → C. Bareither)
- Enterprise Information System
- Optimization Techniques and Budgetary Linkages
- Integration of EIS into other areas at NASA and FAA
EIS Review

- Numerous FAA Technical Centers
- Aircraft Owners and Pilots Association
- Chief System Engineer, FAA National Airspace Architecture and Systems Engineering
- FAA Washington ARTCC
- MITRE
- Embry-Riddle Aeronautical University
- NASA
- Pratt & Whitney

→ Gained feedback on relevance, effectiveness and meaningfulness of EIS from NASA managers and executives.

**RESULT** = Development of EIS Prototype with 20 ASRM models
Present Papers and Presentations


Papers and Presentations

Questions?