A Summary of Techniques for FMEA & FTA

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Two good Techniques to examine possible failures are:

1. FMEA (Failure Mode and Effect Analysis)
2. FTA (Fault Tree Analysis).
Failure Mode Effects Analysis (FMEA)

An FMEA:
- Identifies the ways in which a product or process can fail (bottom up analysis)
- Estimates the risk associated with specific causes
- Prioritizes the actions that should be taken to reduce risk

FMEA is a team tool

There are two different types of FMEAs:
1. Design
2. Process
<table>
<thead>
<tr>
<th>Function</th>
<th>Failure Mode</th>
<th>Effects</th>
<th>Severity</th>
<th>Causes</th>
<th>Occurrence</th>
<th>Detection</th>
<th>Ease of detection</th>
<th>Risk Priority Number</th>
<th>Recommended Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medicare</td>
<td>Cannot see Doctor</td>
<td>Long wait time to see doctor</td>
<td>5</td>
<td>Claims Processing Times</td>
<td>5</td>
<td>None</td>
<td>5</td>
<td>125</td>
<td>Training</td>
</tr>
<tr>
<td>Eligibility</td>
<td>No Insurance</td>
<td>No/Little insurance opportunities</td>
<td>9</td>
<td>None</td>
<td>5</td>
<td>None</td>
<td>5</td>
<td>200</td>
<td>Creation of Additional Healthcare Options</td>
</tr>
<tr>
<td>Medicare</td>
<td>Not enough Doctors</td>
<td>Long wait times to see doctor</td>
<td>8</td>
<td>Doctors not willing to work with Medicare</td>
<td>5</td>
<td>None</td>
<td>6</td>
<td>200</td>
<td>Expand Medical Network</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mass enrollment</td>
<td>7</td>
<td>None</td>
<td>7</td>
<td>392</td>
<td>Limit Number of new enrollees, Phased approach</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Large Sick/Aging Population</td>
<td>6</td>
<td>Update Notice</td>
<td>7</td>
<td>336</td>
<td>Expand Medical Network</td>
</tr>
</tbody>
</table>
Fault Tree Analysis (FTA)

- A top down failure assessment technique for identifying safety concerns:
  - Identification of a single failure point and safety concerns
  - Evaluation of software, non-machine interfaces and design change impacts
  - Simplification of maintenance and trouble-shooting procedures
  - Assessment of modification or enhancements
<table>
<thead>
<tr>
<th>Process Step</th>
<th>Failure Mode</th>
<th>Severity 1-10</th>
<th>Occurrence 1-10</th>
<th>Detection 1-10</th>
<th>RPN(^1)</th>
<th>Improvement Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DHS identifies illegal immigrants</td>
<td>10</td>
<td>2</td>
<td>9</td>
<td>180</td>
<td>Trained officers and Improved checking</td>
</tr>
<tr>
<td>2</td>
<td>Incorrect Documentation and Data entry errors</td>
<td>7</td>
<td>3</td>
<td>6</td>
<td>126</td>
<td>Training Employees for Legal documentation</td>
</tr>
<tr>
<td>3</td>
<td>Determining Detention of Immigrants</td>
<td>9</td>
<td>6</td>
<td>7</td>
<td>162</td>
<td>Identify the legal and political flaws</td>
</tr>
<tr>
<td>4</td>
<td>Accommodate Detained Immigrants</td>
<td>5</td>
<td>8</td>
<td>2</td>
<td>80</td>
<td>Improve accommodation capacity</td>
</tr>
<tr>
<td>5</td>
<td>Escorting detainees back to their home country</td>
<td>9</td>
<td>3</td>
<td>5</td>
<td>135</td>
<td>Improving Political ties and arranging better transportation</td>
</tr>
</tbody>
</table>
Fault Tree Analysis

Immigrant entering the country

- AND
  - Failure to Identify
  - Escaping through Immigration Check
    - Failure to recognize false documentation
    - Less Effective officer
  - Patrolling Failure
  - Lack of security measures at the border

- OR
  - Failure after successful Identification
    - Legal Documentation Failure
    - Escaping from the escorting process
      - Escaping from detention facility
      - Failure in security of transportation
Failure Modes And Effects Analysis (FMEA)

- FMECA is a step by step approach for identifying all possible failures in a design, manufacturing or assembly process, or product or service.
- FMECA is one of the most important and most widely used tool of reliability analysis.
## Failure Modes And Effects Analysis (FMEA)

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>FAILURE MODE</th>
<th>EFFECTS</th>
<th>CAUSES</th>
<th>OCCURRENCE</th>
<th>SEVERITY</th>
<th>DETECTION</th>
<th>RPN</th>
<th>ACTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZIKA VIRUS SPREAD CONTROL</td>
<td>Pregnancy</td>
<td>Infant death</td>
<td>Body fluids</td>
<td>4</td>
<td>8</td>
<td>6</td>
<td>19 2</td>
<td>Medication</td>
</tr>
<tr>
<td></td>
<td>Mosquitos</td>
<td>Rapid Spread</td>
<td>Unhygienic</td>
<td>7</td>
<td>8</td>
<td>7</td>
<td>39 2</td>
<td>Use repellants</td>
</tr>
<tr>
<td></td>
<td>Travel</td>
<td>Transmission</td>
<td>Travel to affected areas</td>
<td>5</td>
<td>7</td>
<td>7</td>
<td>24 5</td>
<td>Avoid affected areas</td>
</tr>
<tr>
<td></td>
<td>Sex</td>
<td>Transmission</td>
<td>Semen</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>12 0</td>
<td>Use Condoms</td>
</tr>
</tbody>
</table>
Failure Modes And Effects Analysis (FMEA)

Criticality Analysis
A relative measure of the consequence.
Difficult to perform for a functional FMEA due to the lack of detailed failure data at this level.

Failure Mode Criticality Number = $\alpha \times \text{frequency} \times \text{hours of cycles} \times \beta$

$\alpha$ - the percent of occurrence of each failure mode.
Frequency – the rate of occurrence.
$\beta$ – Probability that the failure effect will occur.
FAULT TREE ANALYSIS (FTA)

- FTA is a top down failure consequence assessment technique to identify safety concerns.
- Will identify the causes of product failures which may then be eliminated.
- Updating the FTA to reflect design changes will assess whether previous problems have been eliminated, or new problems have been introduced.