A Dynamic Safety Risk Assessment Model

Suggested by:

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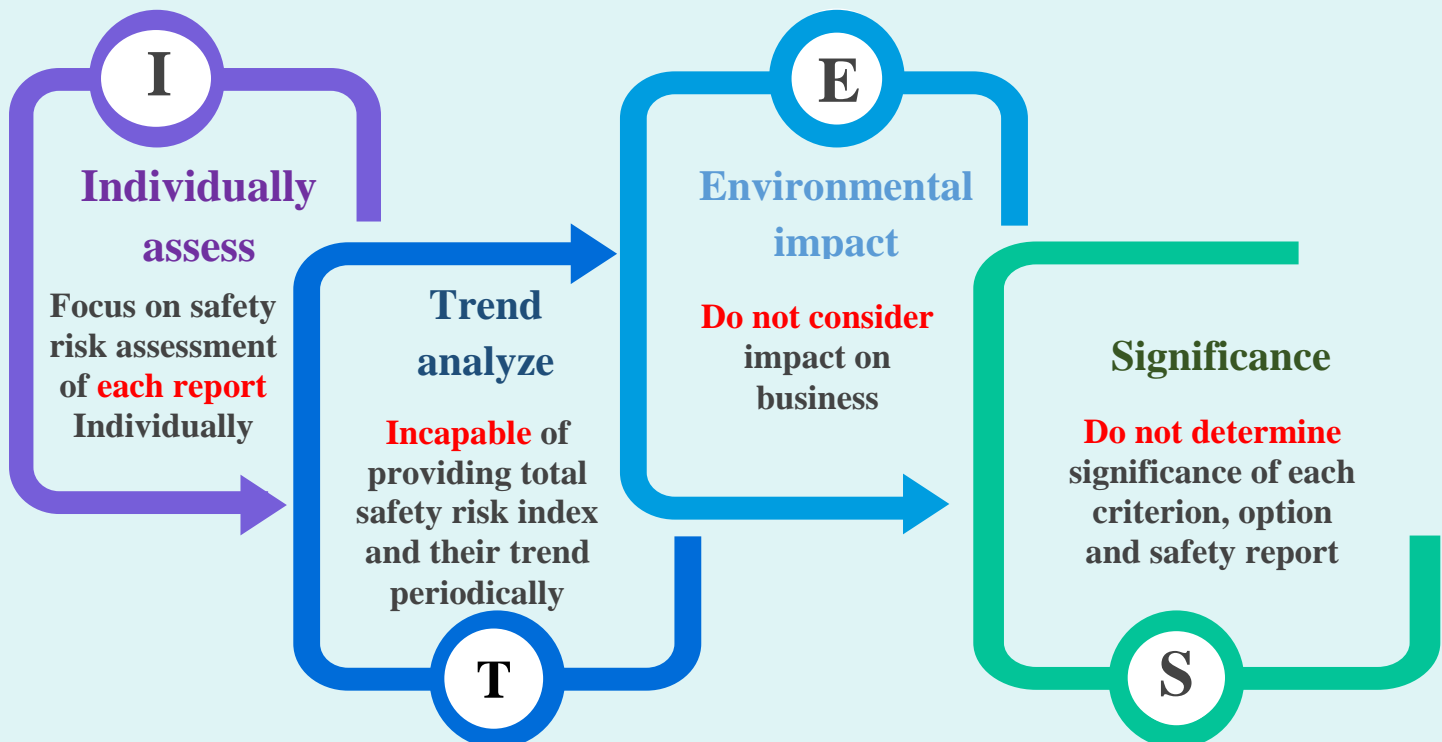
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Current Safety Risk Assessment Model (Doc.9859)

Safety risk tolerability:

The safety risk index rating is created by combining the result of probability and severity scores.

Current Gaps in safety risk assessment

I
Individually assess
Focus on safety risk assessment of **each report** Individually

T
Trend analyze
Incapable of providing total safety risk index and their trend periodically

E
Environmental impact
Do not consider impact on business

S
Significance
Do not determine significance of each criterion, option and safety report
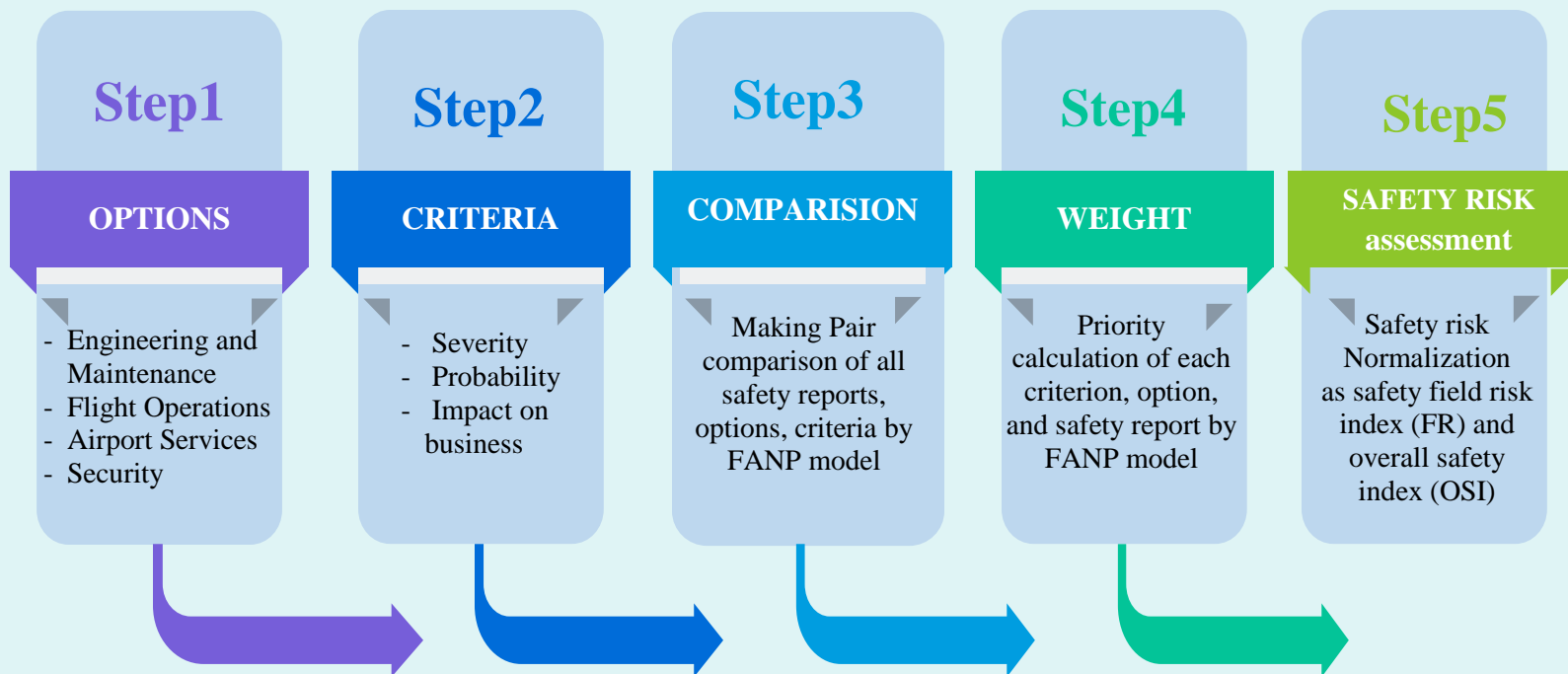
The 3D – Dynamic Safety Risk Assessment introduction

Three dimensional exponential (nonlinear) model introduction for overall safety risk index measurement by:

➢ Using Multi Attribute Decision Making (MCDM) to determine significance for each criterion, option and safety report.

➢ The importance (weight) of each criterion and option are measured in line with operational safety strategies by expert judgment.

➢ Taking into account impact on business criterion (environmental, economic ….) to cover the latent aftermath of safety reports even if there are no accidents or incidents as safety risks with financial or fatal consequences.

➢ Consisting of three distinct criteria to measure safety risk:

- Severity of occurrence
- Probability of occurrence
- Impact on business of occurrence

➢ Appraising safety reports one by one in each field, integrating different criteria mathematically into one safety risk index (RI).

➢ Providing safety risk index (RI) for each operational scopes to measure safety field risk (FR) and overall safety index (OSI).

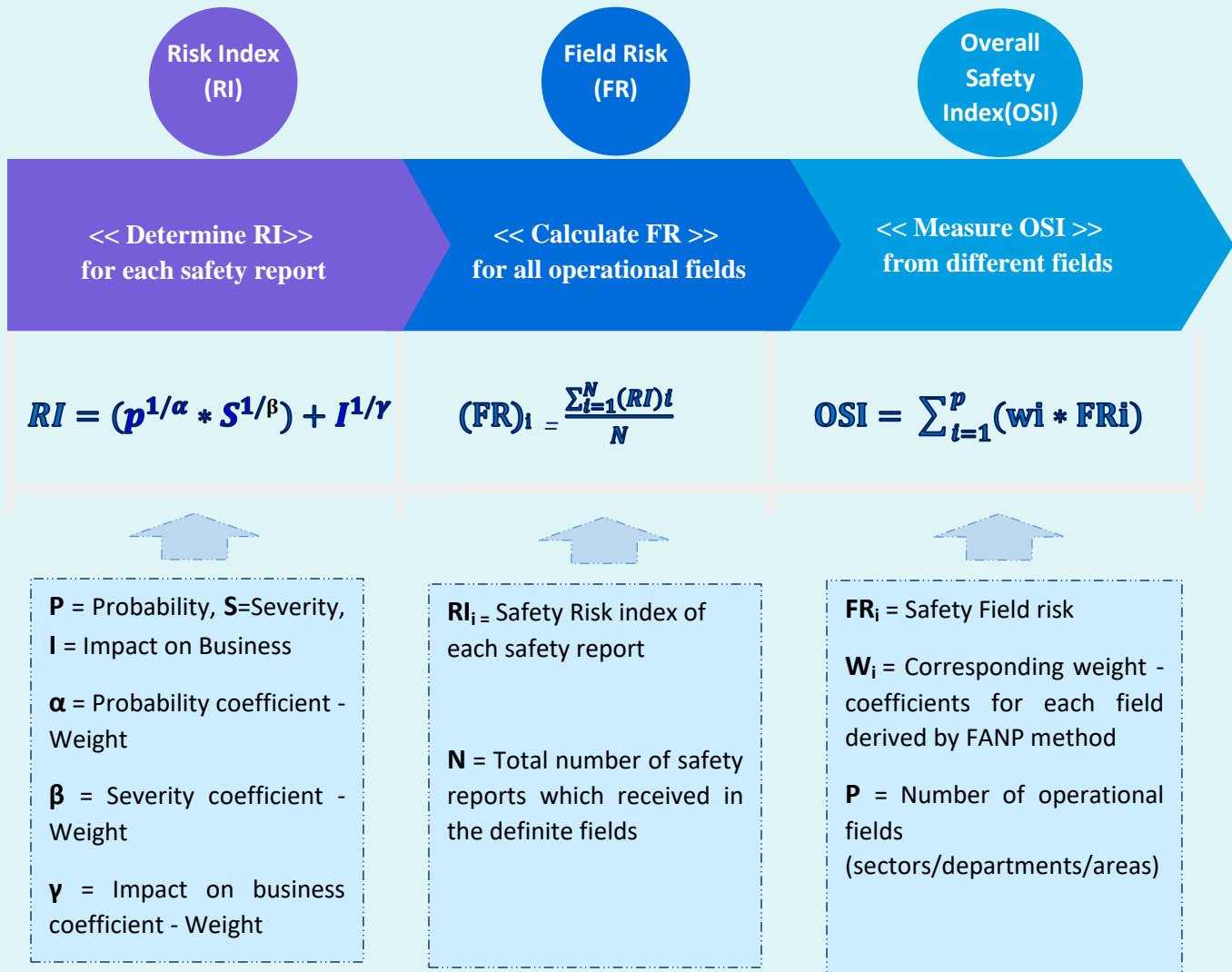# 3D – Dynamic Safety Risk Assessment implementation plan

Step1
OPTIONS
- Engineering and Maintenance
- Flight Operations
- Airport Services
- Security

Step2
CRITERIA
- Severity
- Probability
- Impact on business

Step3
COMPARISION
Making Pair comparison of all safety reports, options, criteria by FANP model

Step4
WEIGHT
Priority calculation of each criterion, option, and safety report by FANP model

Step5
SAFETY RISK assessment
Safety risk Normalization as safety field risk index (FR) and overall safety index (OSI)

Fuzzy Analytical Network Process (FANP)[1]

➢ *Determine the best choice among all possible options.*

➢ *Using a number of evaluation criteria and formulated as decision matrix.*

➢ *Consensus about viewpoints regarding indicators, and criteria and options order on the basis of collective experts' judgment.*

➢ *Modeling relations between different levels of decisions about criteria or options.*

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[1] *The attached software will have calculated all proposed formulas (As FANP process)*

3D-Model safety risk assessment calculation[1]

Risk Index (RI) → **Field Risk (FR)** → **Overall Safety Index(OSI)**

<< Determine RI>>
for each safety report

<< Calculate FR >>
for all operational fields

<< Measure OSI >>
from different fields

$$RI = (p^{1/\alpha} * S^{1/\beta}) + I^{1/\gamma}$$

$$(FR)_i = \frac{\sum_{i=1}^{N}(RI)i}{N}$$

$$OSI = \sum_{i=1}^{p}(wi * FRi)$$

P = Probability, **S**=Severity, **I** = Impact on Business

α = Probability coefficient - Weight

β = Severity coefficient - Weight

γ = Impact on business coefficient - Weight

RI_i = Safety Risk index of each safety report

N = Total number of safety reports which received in the definite fields

FR_i = Safety Field risk

W_i = Corresponding weight - coefficients for each field derived by FANP method

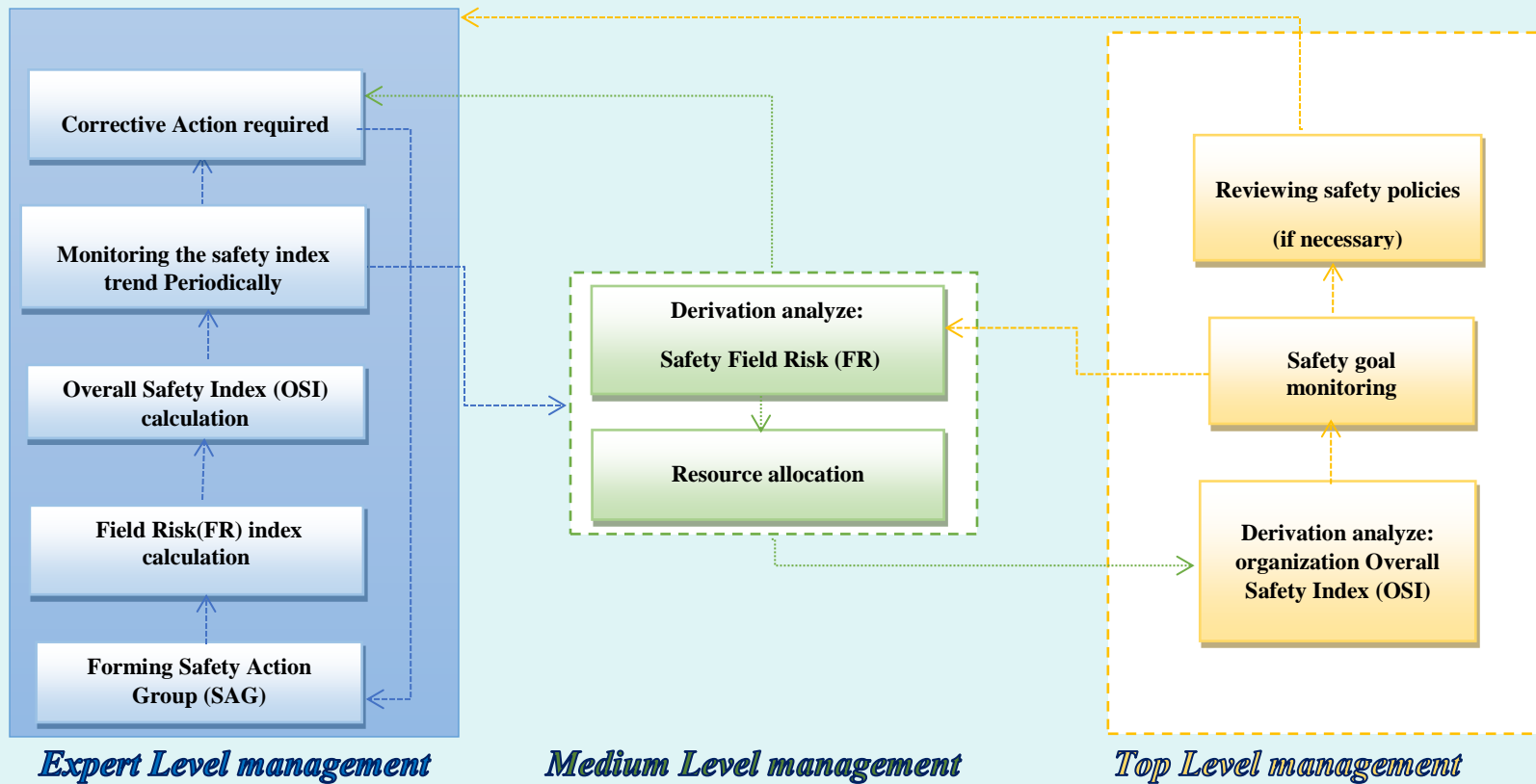**P** = Number of operational fields (sectors/departments/areas)

By OSI measurement:

➢ *The overall safety risk index of the whole operational fields is achieved.*

➢ *Organization can monitor the safety trend over time and set safety goals.*
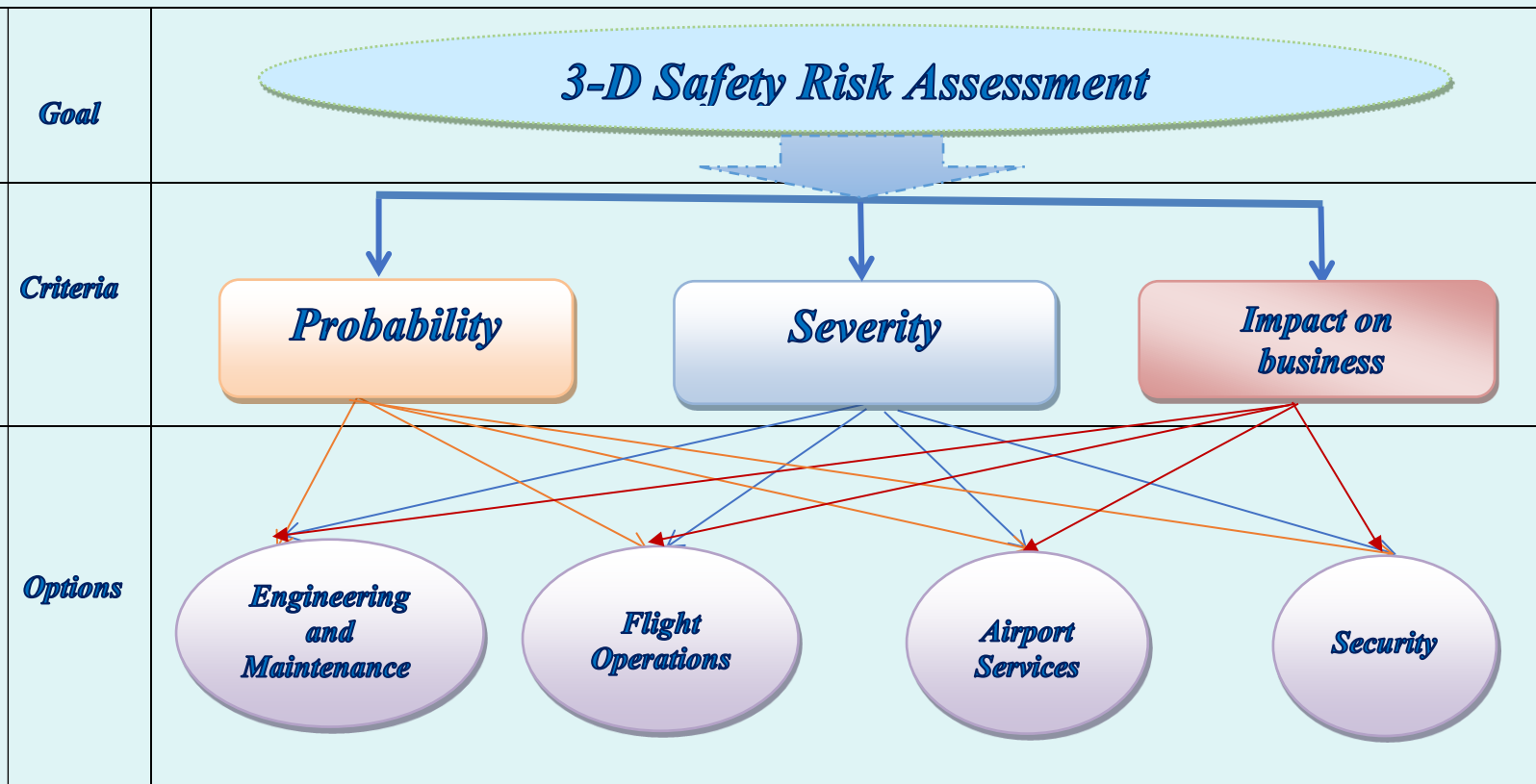
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[1]*The attached software will have calculated all proposed formulas (As RI, FR, OSI)*

3D-Model Implementation Roadmap:

Expert Level management — **Medium Level management** — **Top Level management**

Expert Level management (blue column, top to bottom):
- Corrective Action required
- Monitoring the safety index trend Periodically
- Overall Safety Index (OSI) calculation
- Field Risk(FR) index calculation
- Forming Safety Action Group (SAG)

Medium Level management (green column):
- Derivation analyze: Safety Field Risk (FR)
- Resource allocation

Top Level management (yellow column):
- Reviewing safety policies (if necessary)
- Safety goal monitoring
- Derivation analyze: organization Overall Safety Index (OSI)

- ➢ By calculating safety field index (FI) for each field or safety sections, the normalized safety risk index of all departments are yielded.

- ➢ Each department can depict its safety field risk (FR) index periodically and monitor its safety trend or define the safety goal by specifying a threshold for the safety target to be reached.

- ➢ Top-level managers are able to monitor safety field index (FR) and recognize the most critical field from the safety point of view and focus on high priority corrective or preventive actions.

- ➢ Defining the safety goal via monitoring overall safety index (OSI) is achievable.
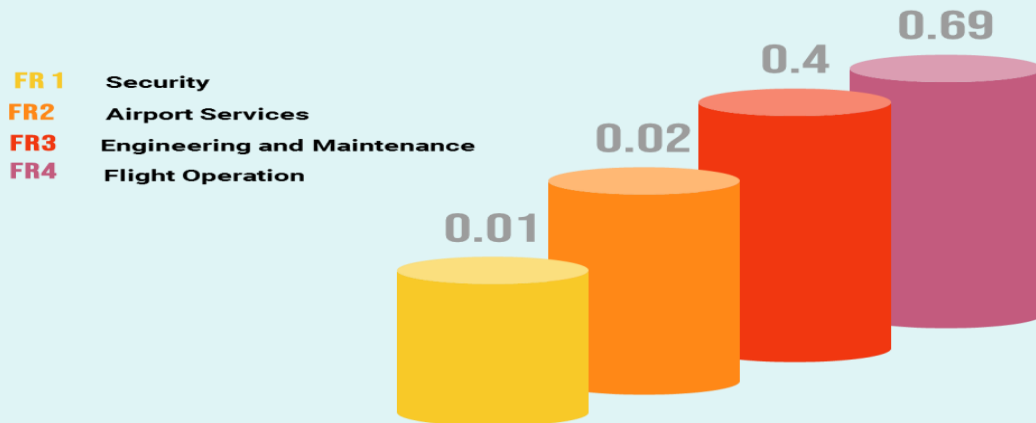
Decision tree "3-D Safety risk assessment"

Goal	**3-D Safety Risk Assessment**
Criteria	**Probability** **Severity** **Impact on business**
Options	**Engineering and Maintenance** **Flight Operations** **Airport Services** **Security**

The decision tree of safety goal delineates:

➢ *Goal is 3-D safety risk assessment.*

➢ *The goal defines based on three criteria: probability, severity and impact on business.*

➢ *Four options are considered for prioritizing of requirements in different fields of operation including engineering and maintenance, flight operations, airport services and security.*

The 3-D model outputs:

All proposed formulas in 3-D model are designed as attached software. Numerical examples are used in mentioned software to show the output of model. Safety risk indexes results also are demonstrated as below figures by numerical example usage:

Field Risk (FR) Calculation (As numerical example)

FR 1 — Security
FR2 — Airport Services
FR3 — Engineering and Maintenance
FR4 — Flight Operation

0.01   0.02   0.4   0.69

Overall Safety Index (OSI) Calculation (As numerical example)

- JAN
- FEB
- MAR
- APR
- MAY

1.13   1.7   1.8   1.9   2

Safety risk index (RI)based on each report
(As numerical example)

Overall Safety Index (OSI) Rate
(As numerical example)