



Black & Veatch Consulting

Value Management!

The Risk of Change

Presentation to CSVA October 2004

by

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Black & Veatch



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building a world of difference™

Aim

The aim of the presentation is to provide a brief introduction to some of the risk management techniques that are in use and how they can interact with Value Engineering



Presentation


- Basis for Synergy
- Definitions & Terminologies
- Interaction
- Examples






Some Basic Thoughts!

Some Basic Thoughts

- 
- For the purposes of this presentation VE or Value Engineering is generic for all forms of Value Management, e.g. Engineering, Management, Assessment, etc,
 - A scheme can relate to,
 - Construction project
 - Technical review
 - System Review
 - Operations
 - ,etc



Synergy

- 
- In Value Engineering we strive to achieve the most cost effective solutions for both immediate capital expenditure, along with probable life cycle costs.

- In other words the Value Engineer performs a Cost Benefit Analysis*

- In Risk & Reliability Engineering we seek to provide a solution based on ALARP (As Low As Reasonably Practicable).

- In other words the Risk Engineer performs a Cost Benefit Analysis*



Synergy

- **The Higher Order Function (Scheme Intent) provides the basis for determining Success Criteria**
- **Both the Value Engineer and The Risk Engineer review the functionality of the scheme**
- **Each function is reviewed for its criticality**
- **An assessment of benefit is established for each proposed change**
- **The scheme Life Cycle is taken into Account**



Value Management

Value Management (VM) provides a systematic approach by which the most cost effective method can be assessed in order to achieve a desired aim, without any detriment to Reliability & Quality

However VM can lead to change, which in turn, can lead to a change in RISK levels. Risk & Reliability Management actively seeks to QUANTIFY this potential change and its impact on Reliability & Quality.





Therefore!

Whilst seeking to achieve this the VM team **MUST TAKE** into account the potential impact on risk that the VM study can have on the Reliability & Quality of the Higher Order Function



Definition of Risk

Risk can be defined as the likelihood of an event happening compared the potential consequences of such an event should it occur.



Terminologies

When we refer to assessment of risk there are three methods for quantifying risk



Types of Risk Assessment

Quantitative (QRA) - This can be a detailed mathematical assessment of the probability of failure (Success).

It utilises hard Data as for example

Failure Rates

Consequence

Repair Times

Capital Cost

Criticality

Performance

Life Cycle

Regulatory

It provides the user with both probability and likely outcome as a numerical consequence e.g. 10^{-6} fatalities equivalents



Types of Risk Assessment

Qualitative-

This is a highly subjective/judgemental approach generally utilising a Risk Matrix.

High, Low, Medium, 1:10, 90%, etc

Semi-Quantitative-

This is a mixture of hard and subjective data. Can also include various risk management techniques such as HAZOP, HAZAN, etc. As with Qualitative it generally uses a Risk Matrix, but with a more mathematical assessment.

Quantification of Risk (Consequence x Probability)



Terminologies

- *RBC – Reliability Centred Maintenance*
- *RAM – Reliability, Availability, Maintainability*
- *FME(C)A - Failure Modes Effects (Criticality) Analysis*
- *RBD – Reliability Block Diagram*
- *RBA – Risk Based Asset Management*
- *Fault & Event Trees*
- *Monte Carlo Simulation*
- *Live Risk Register*
- *HAZOP – HAZard & OPerability Study*

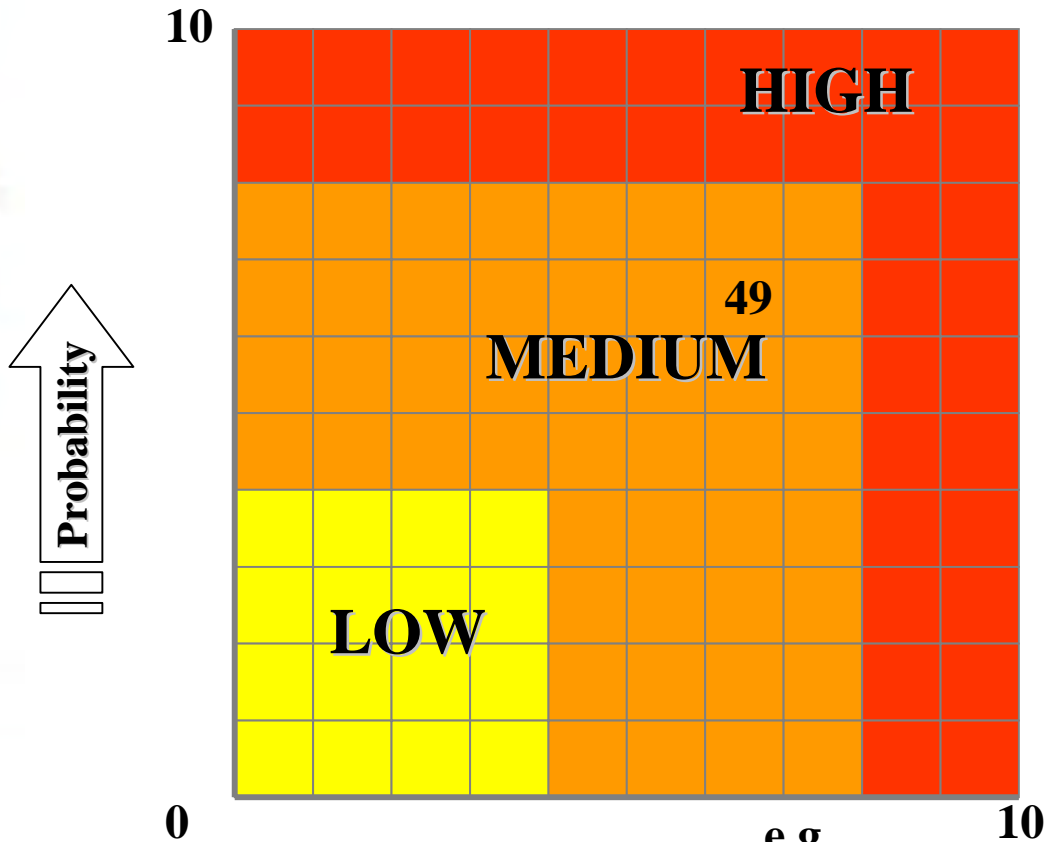


Risk Matrix

A risk matrix is a means of providing both a qualitative & semi-quantitative assessment of risk



Qualitative Risk Matrix



Severity

e.g.
 High/High
 Medium/High
 Low/High
 $7 \times 7 = 49$

=
 =
 =
 =

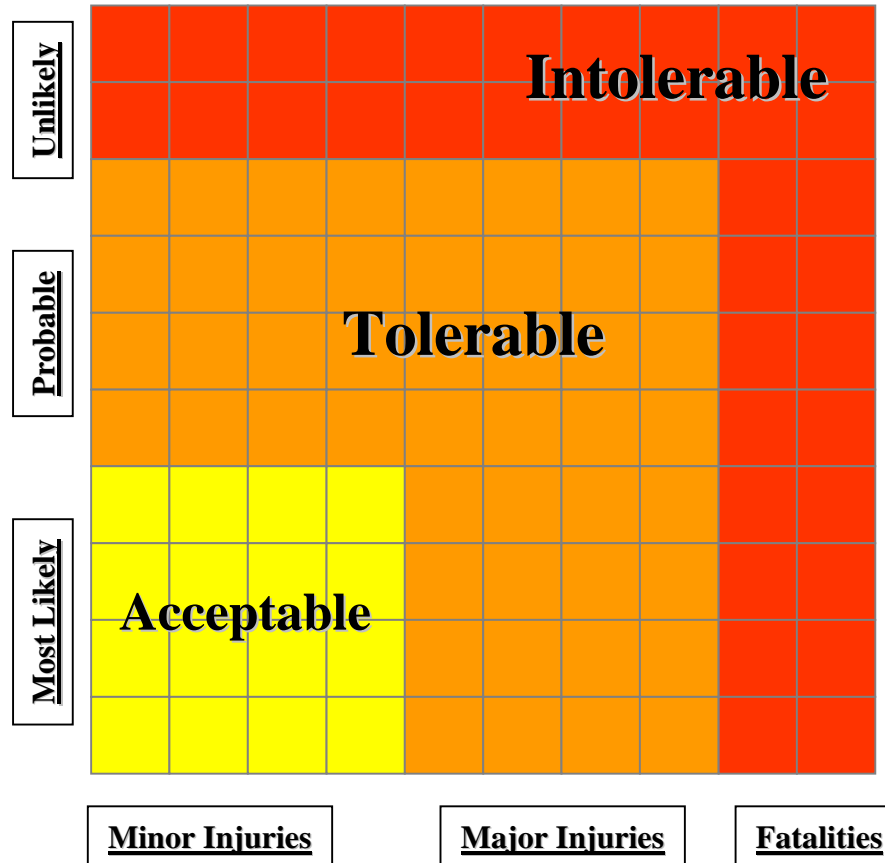
High
 High
 Medium
 Medium



Semi Quantitative Risk Matrix



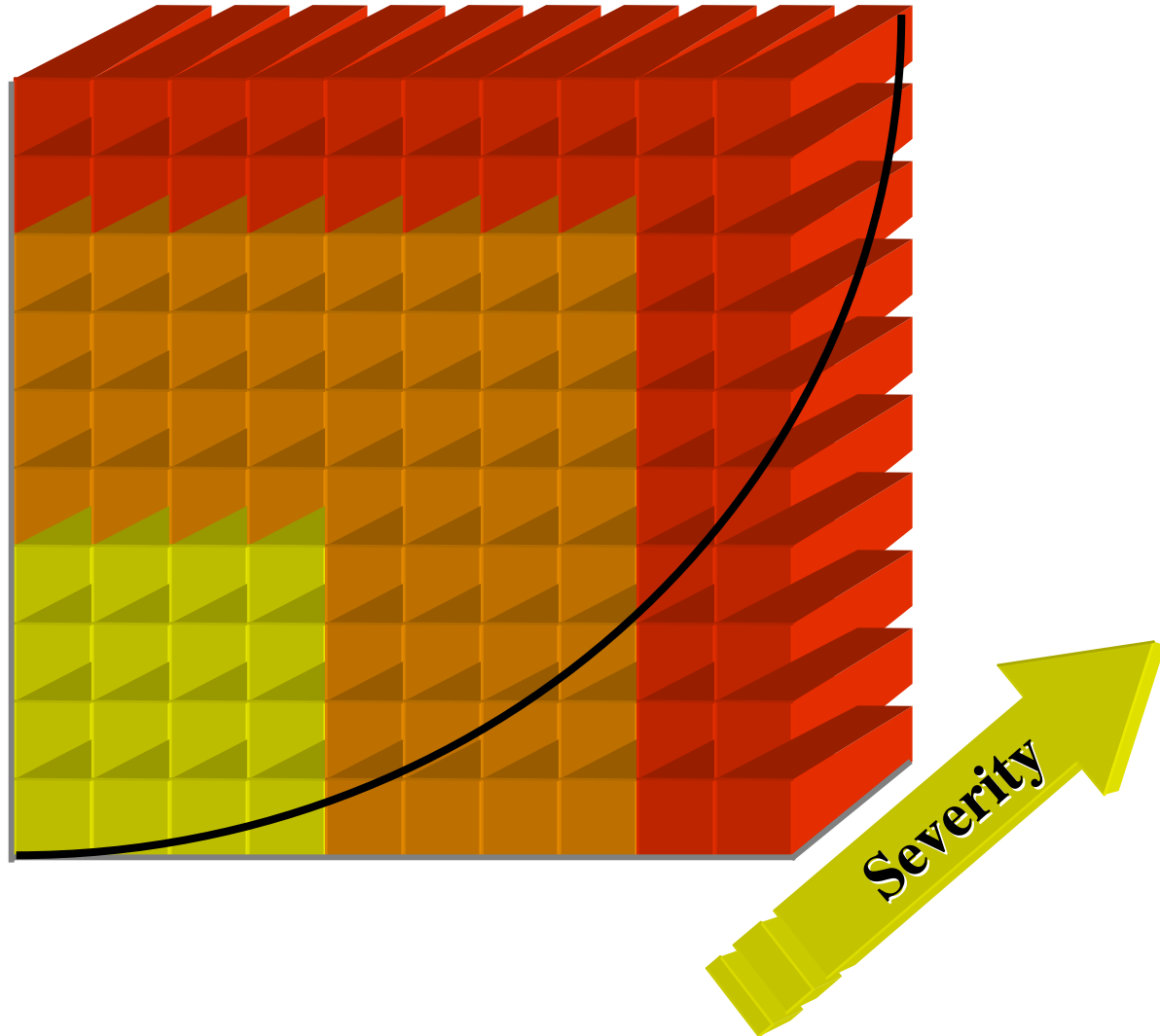
↑
Probability



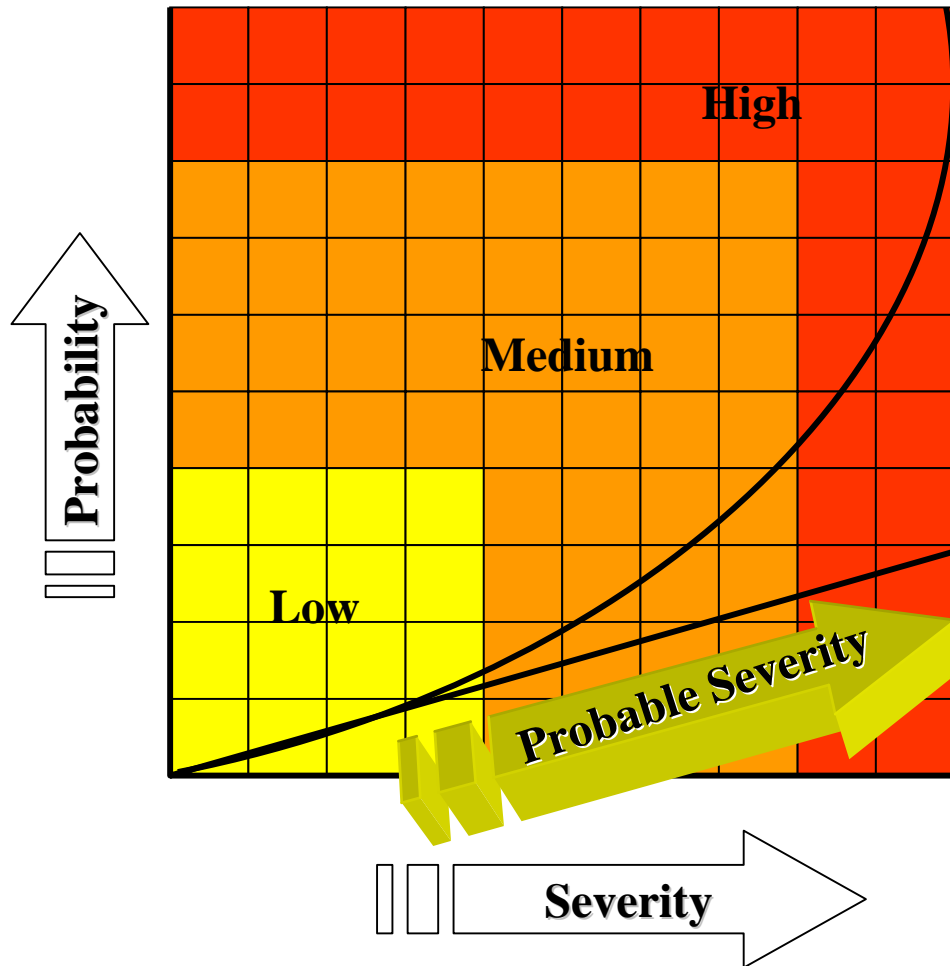
→
Severity



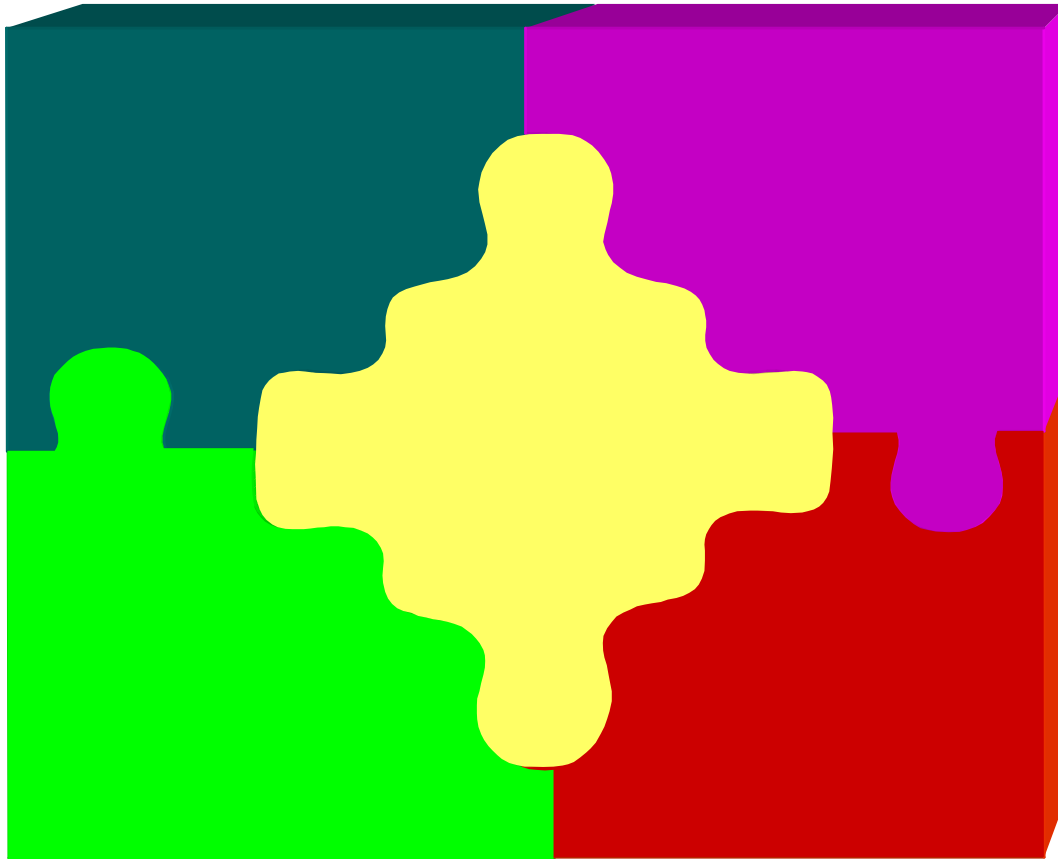
3 Dimensional Risk Matrix



3 Dimensional Risk Matrix



How can Risk & VM be incorporated?



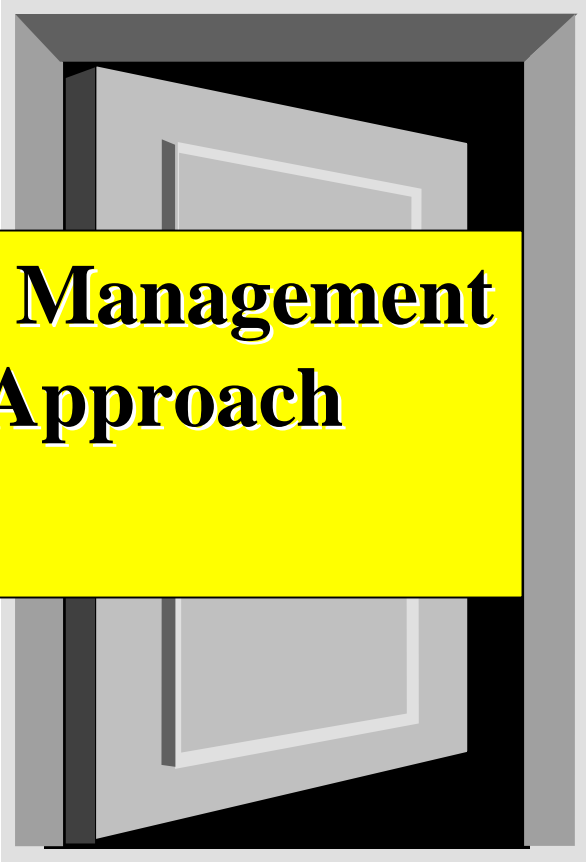
Value Management

Time Given Approach

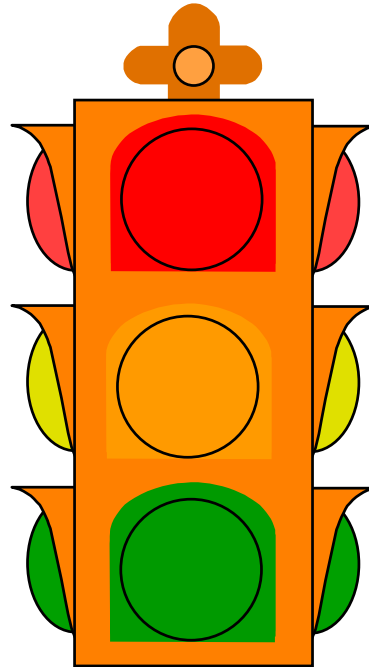




Risk Management Approach



Starting Point



F.A.S.T Diagram

HOW

WHY

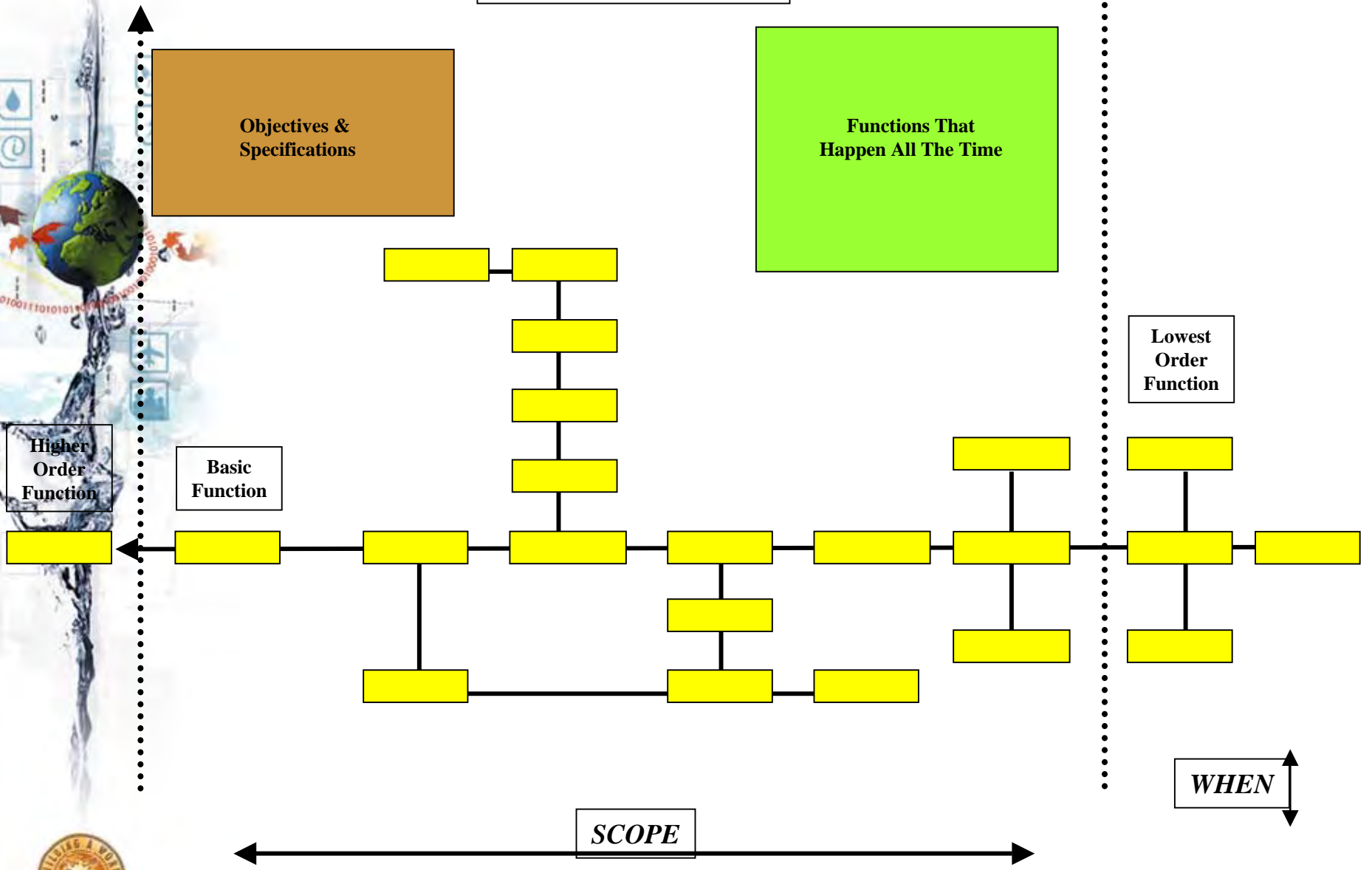
Objectives & Specifications

Functions That Happen All The Time

Higher Order Function

Basic Function

Lowest Order Function

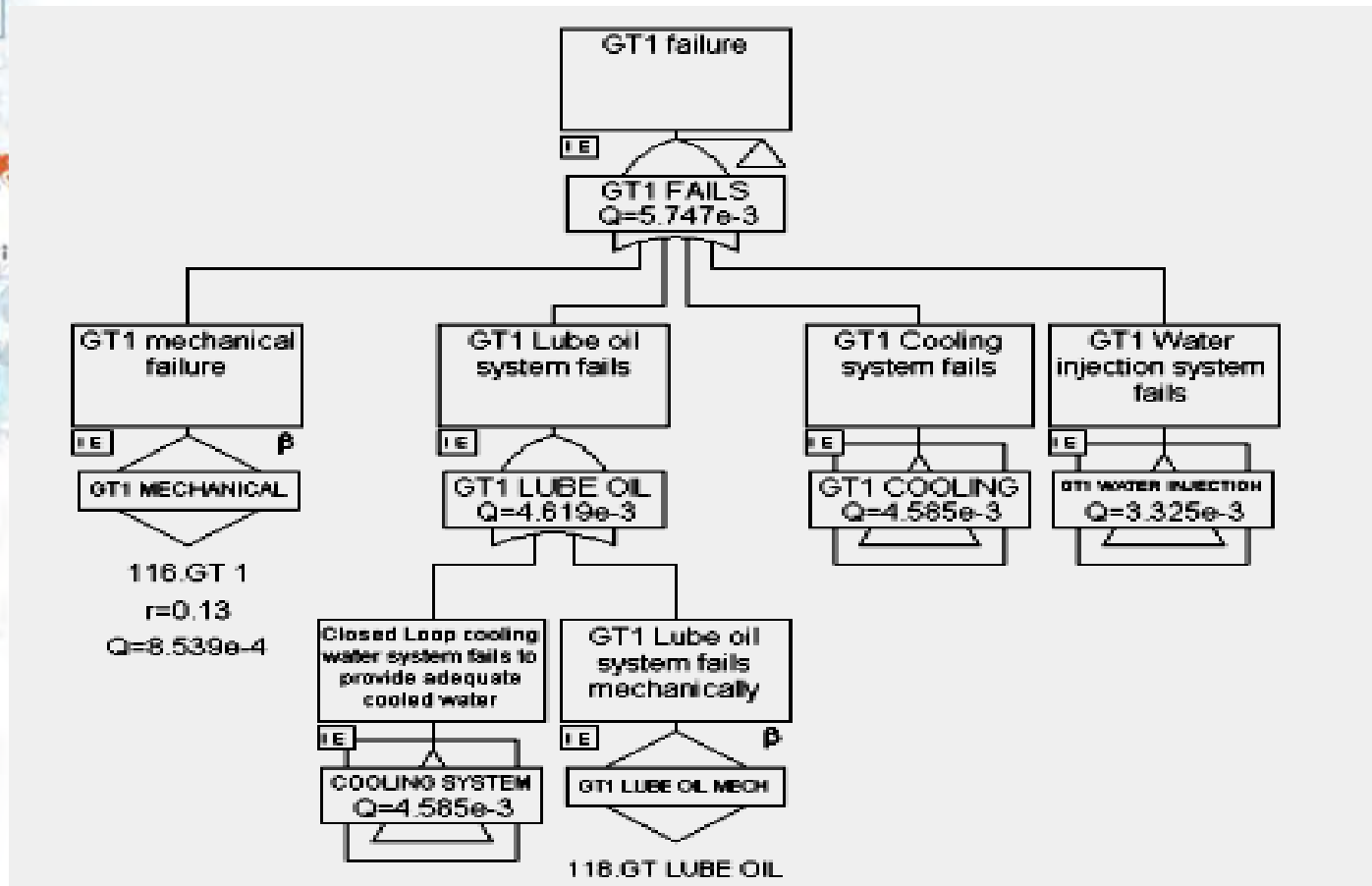


SCOPE

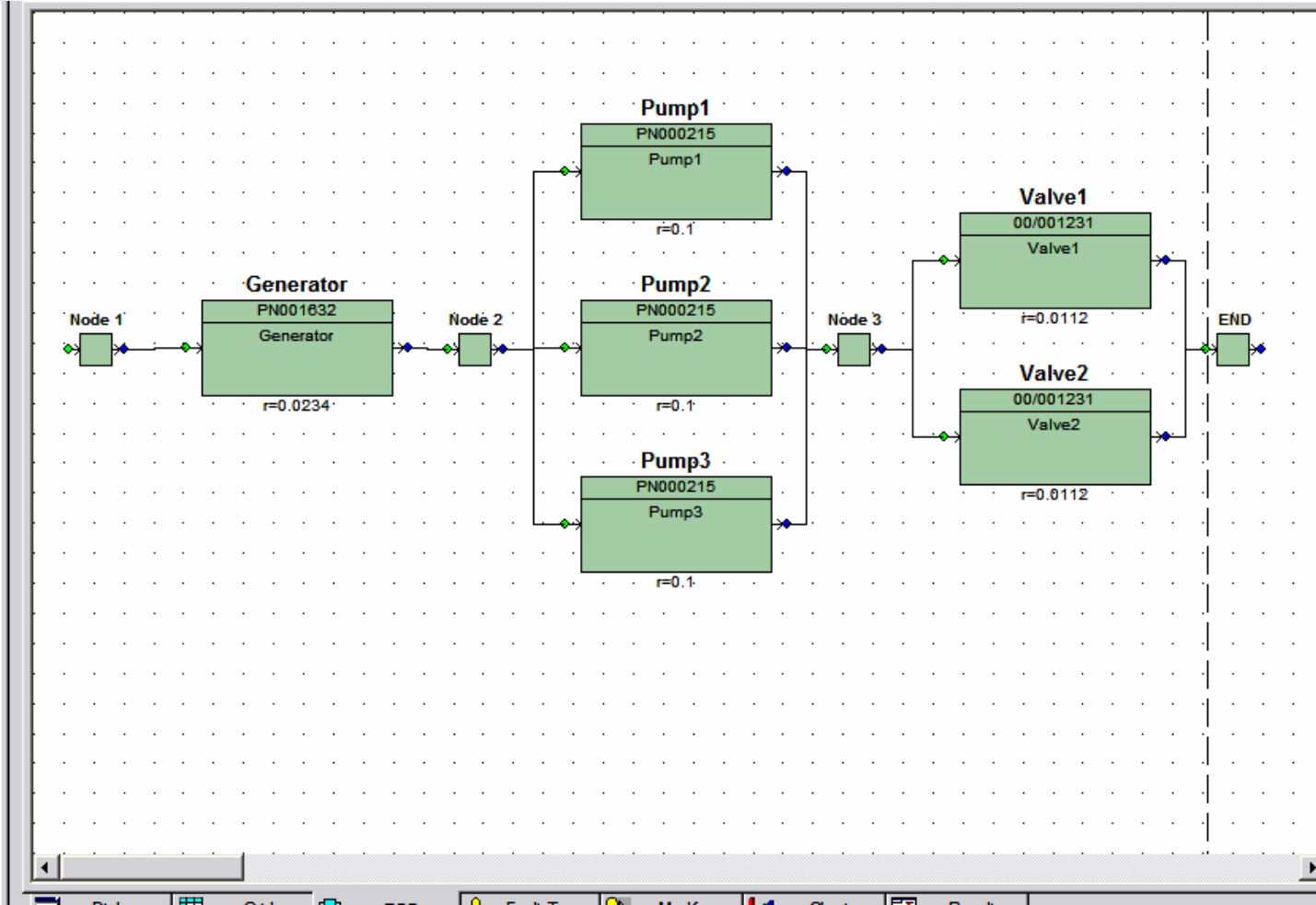
WHEN



Atypical Fault Tree



Reliability Block Diagram (RBD)

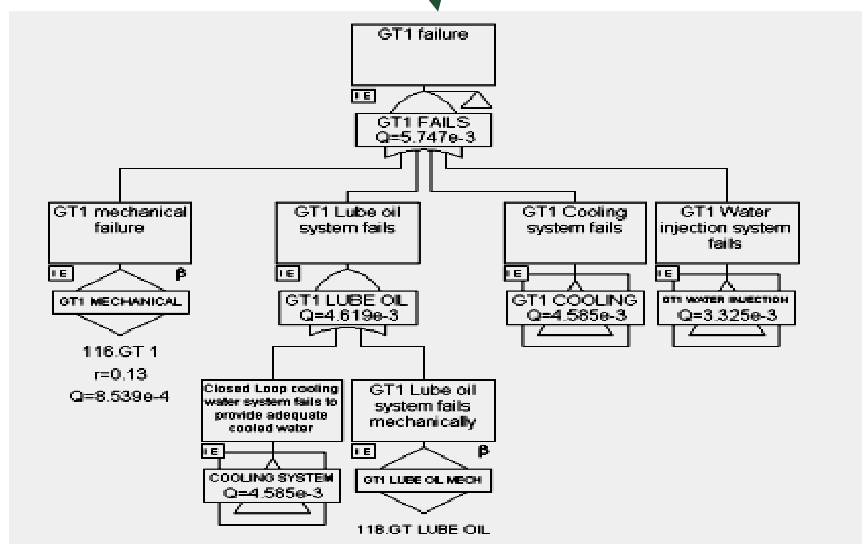
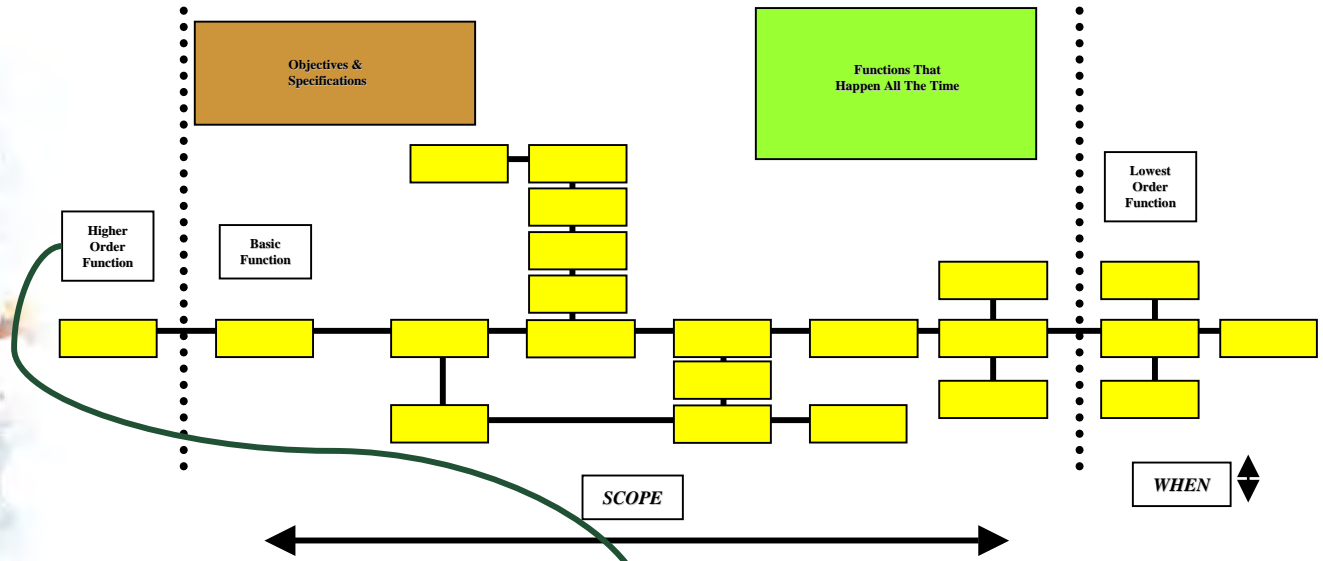


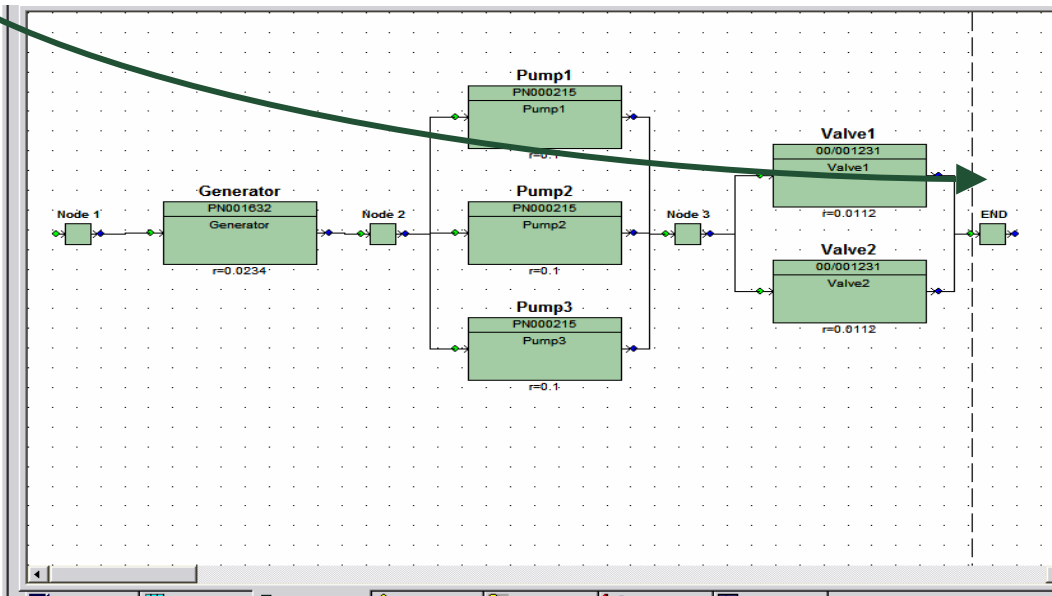
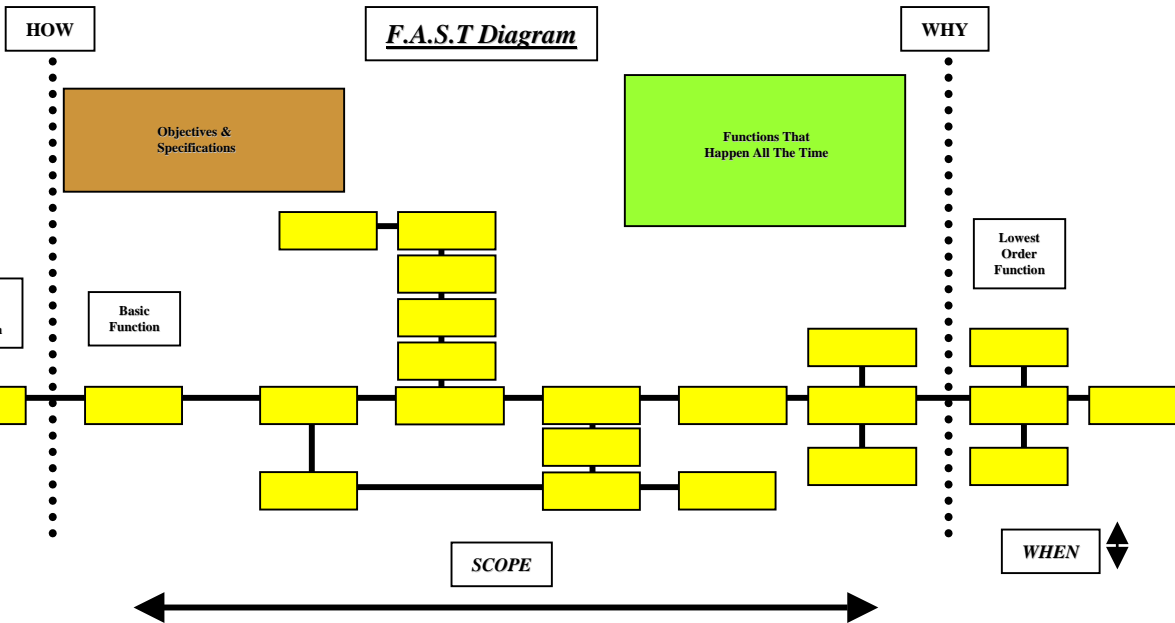


HOW

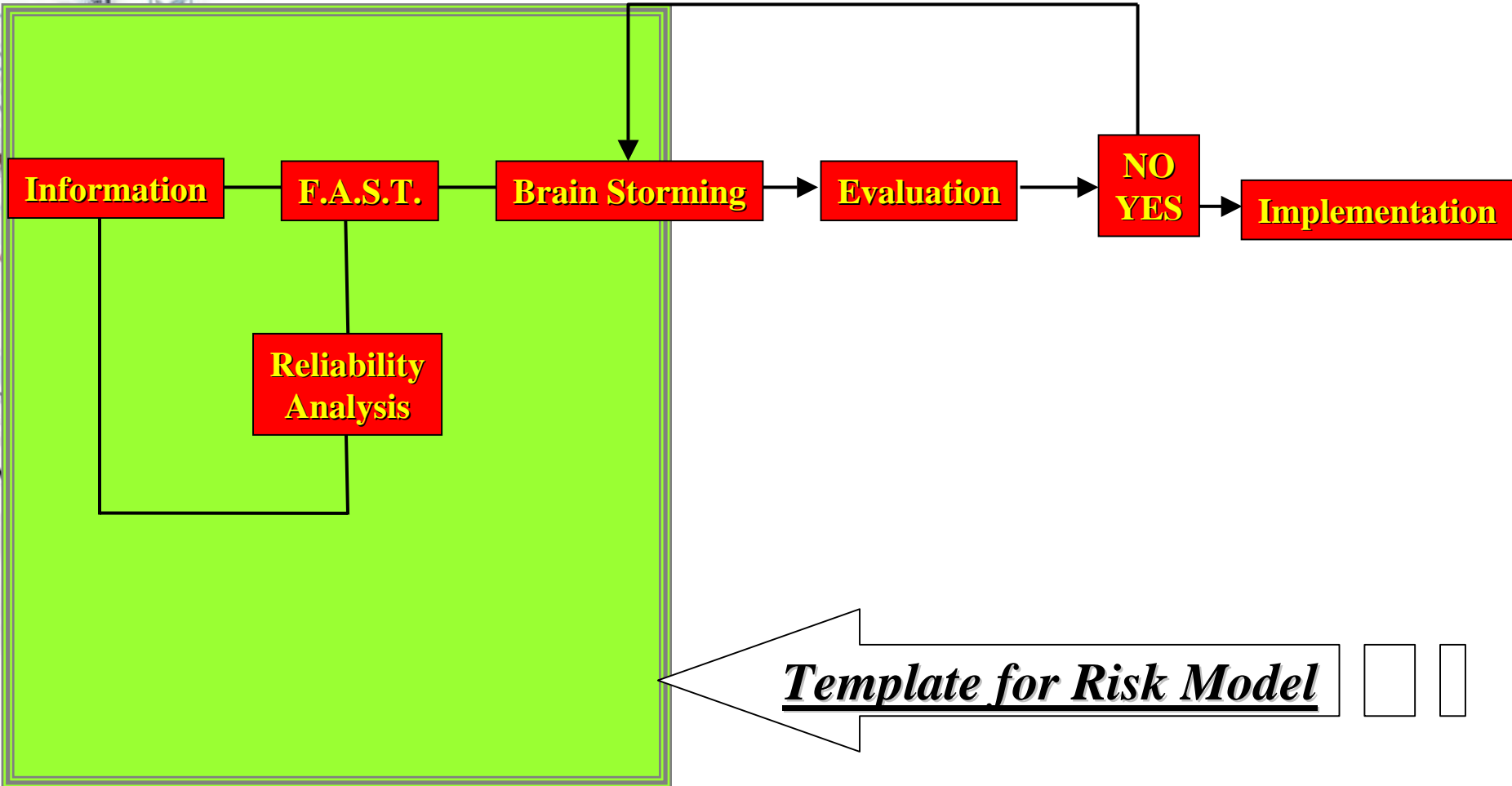
F.A.S.T Diagram

WHY





Template Stage



EVALUATION CIRCLE

Information

F.A.S.T.

Brain Storming

Evaluation

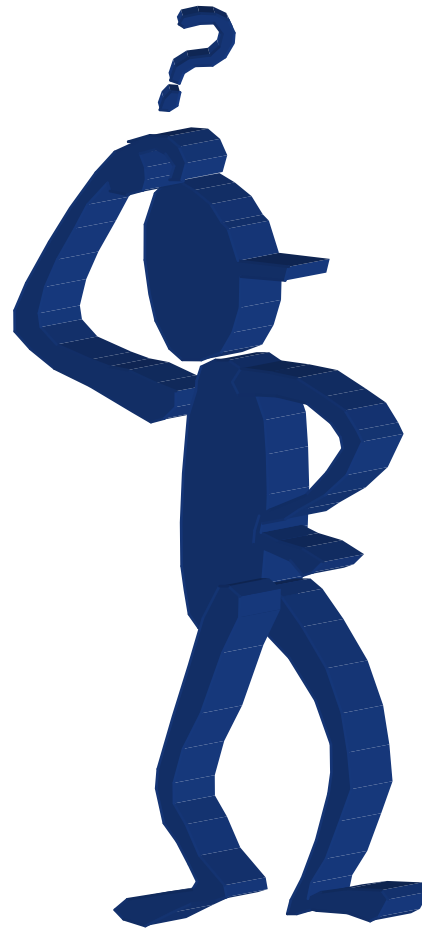
NO
YES

Implementation

Reliability
Analysis



Where Does it Fit In?



**Overall Systems
Effectiveness**

Design

QRA

RBI

RCM

LCA

RAMS

Asset
Management

HAZAN

VM
Study



Example of Risk Generating a VE Study

A system is designed to have an availability level of 100% based upon a reliability of 1 major systems failure per 10 years.

RAM analysis has determined that the systems current reliability is more towards 1 major system failure per 3 years giving an availability of 90% .

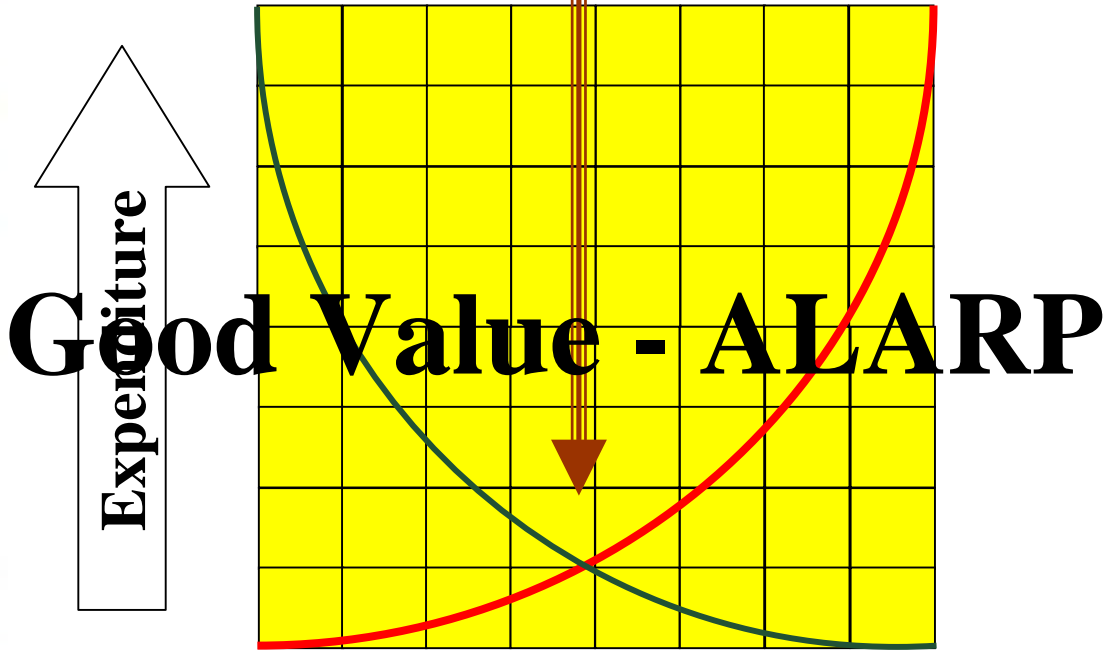
This has resulted in system overloads and unscheduled failures.

A VE study is required to assess the most cost effective means of increasing availability.





Best Value Fit



Reliability

Bridge Construction Project

The following is based upon a real project and how a more detailed use of Reliability Modelling can be used.

Some of the Issues,

- Novel Design of Bridge
- Materials of Construction
- In country capacity for technical skills
- Capacity to supply materials in country
- Contractual Conditions to be met
- Geotechnical requirements



Bridge Construction Project

Due to the time constraint for the study, a semi quantitative assessment was carried out.

The aim of the assessment was to provide a confidence factor for the study and avoid technical prejudices

Each identified issue was allotted a criteria for success and a value based upon its ability to meet that criteria

The probable consequences for failure were identified on a generic basis

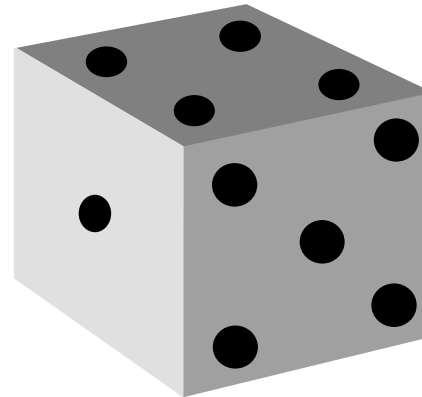
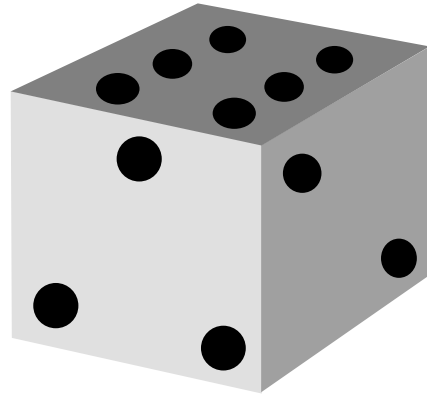
A basic fault tree was drawn up with decision gates and supportive events.

From this area of criticality were defined

The result indicated that a high degree of confidence could be achieved for a successful outcome. But most importantly it identified the areas providing the greater degree of risk.



Monte Carlo Simulation



Monte Carlo - Description

This is a mathematical model of the results of the various techniques used in Risk Analysis. First developed for use in the “Atomic” industry.

The basis for the technique is the roll of the dice (Hence Monte Carlo).

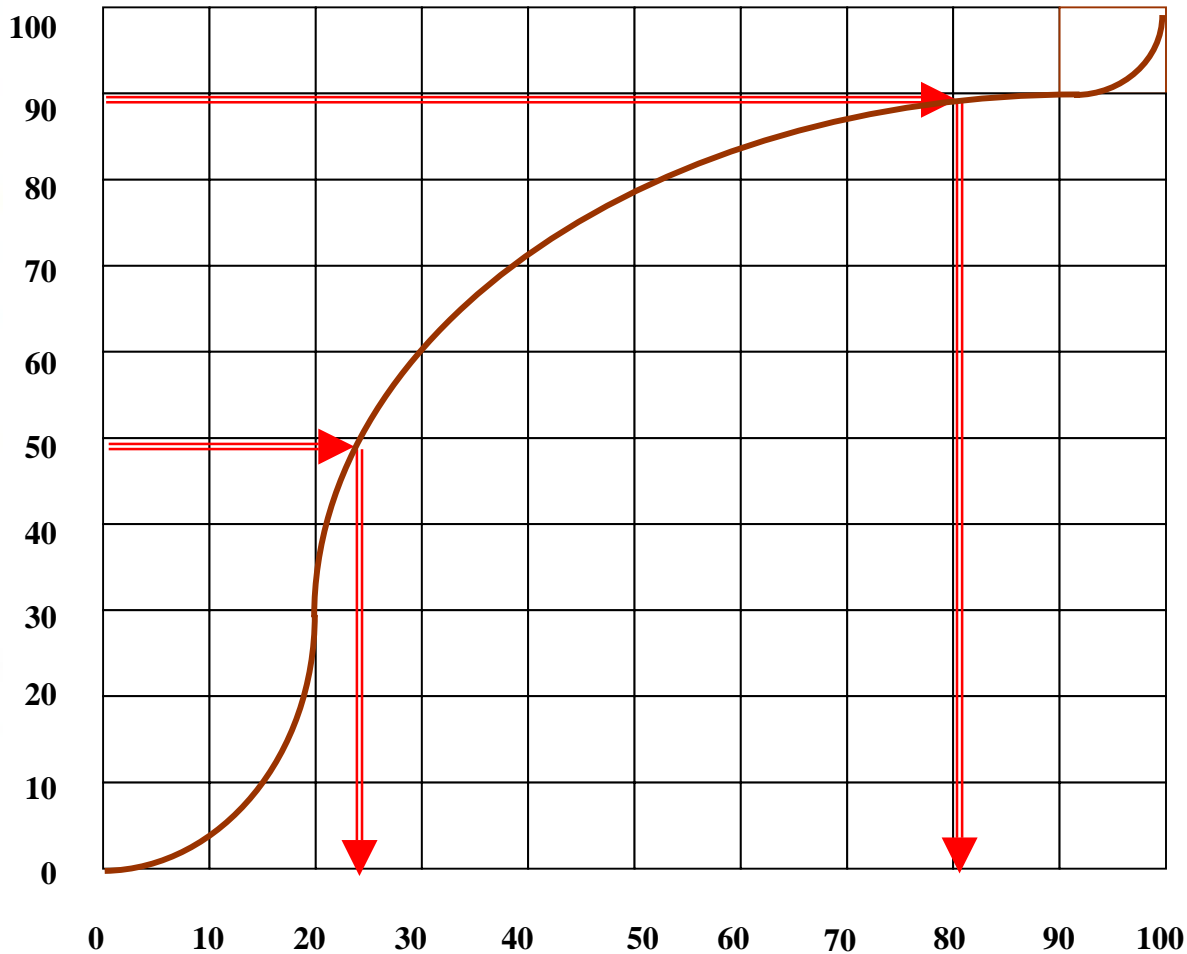
It takes into account that whilst based upon certain criteria being met, the probability of an event occurring can be taken as predicted, the resulting consequences however may change.

The tighter the criteria for success the greater degree of uncertainty in the outcome. E.g. with 2 dice roll a value of 12.

The less stringent the criteria the more predictable e.g. ODDS or EVENS.

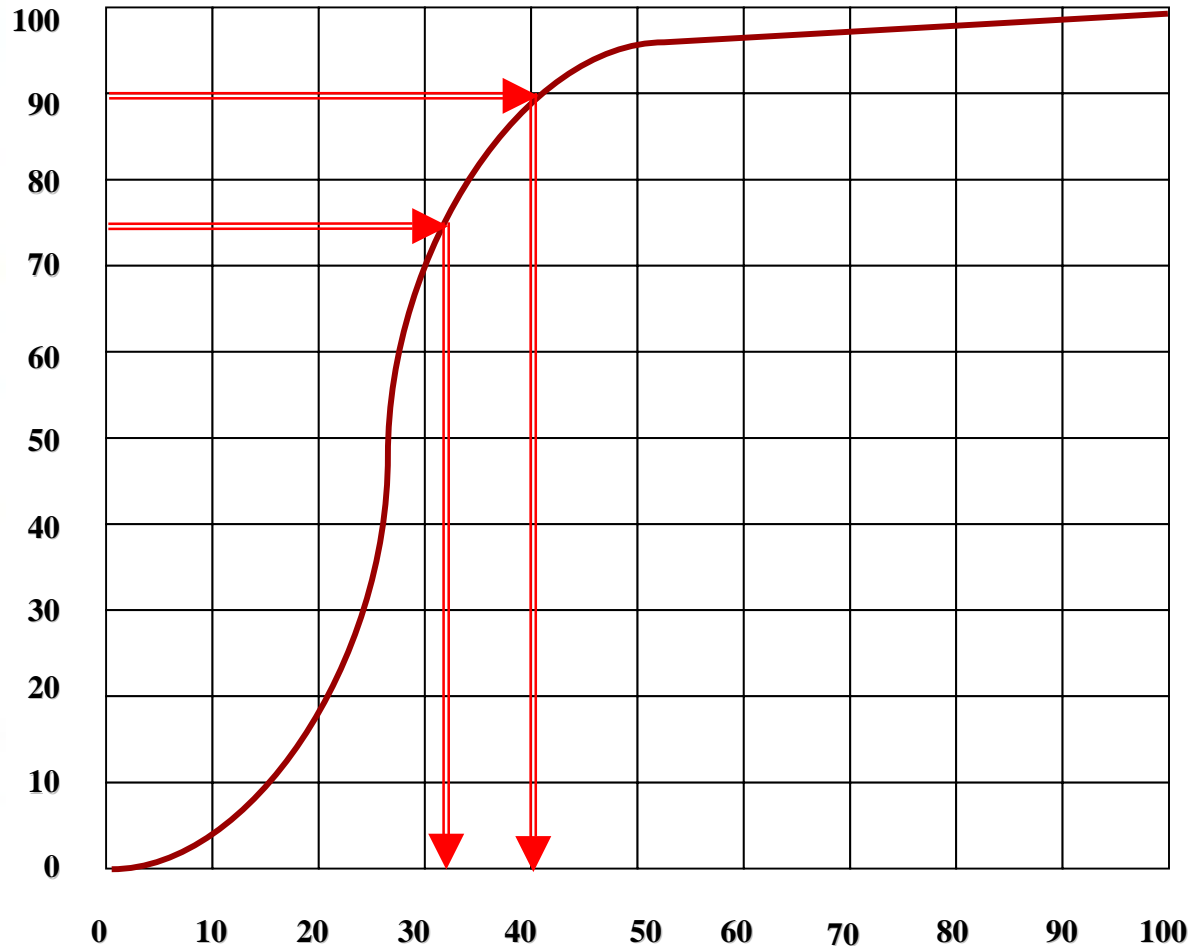


Low Degree of Confidence



Impact

High Degree of Confidence



% Probability

Impact



Reliability Modelling

In general terms, the Monte Carlo simulation looks at the randomness on potential outcome of an event.

The more accurate the data the less random the potential outcome.



Reliability Modelling

Reliability modelling examines how a “system” is constructed (Functionality) and determines potential “failure” modes, including topics such as

- frequencies
- recovery times
- criticality
- availability
- maintainability



Reliability Modelling

It can be used to predict,

- Schedule, including contingency
- Cost Benefit Analysis
- Risk Based Asset Management
- Life Cycle Analysis
- Construction techniques & materials
- Capital Expenditure, including Contingency
- Future Availability
- Quality



EVALUATION CIRCLE

Information

F.A.S.T.

Brain Storming

Evaluation

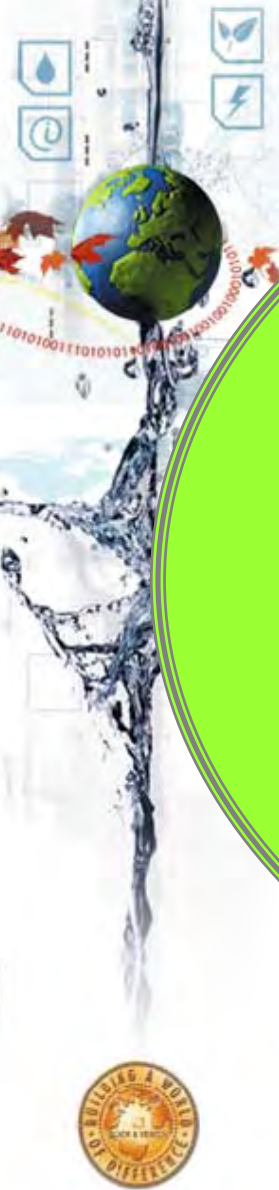
NO
YES

Implementation

Reliability
Analysis



Overall Systems Management



Value Management

Risk/Reliability Management



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