

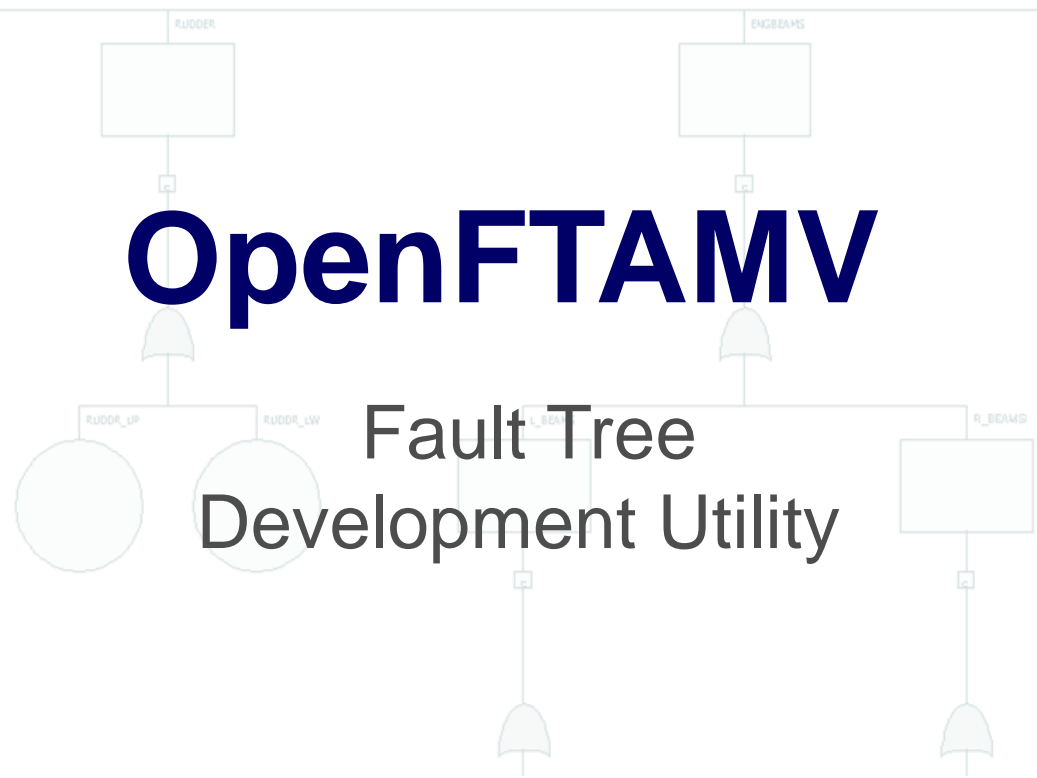
OpenFTAMV

Fault Tree Development Utility

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In This Presentation

- Fault Tree Utility Selection Process
- OpenFTAMV Development
- Overview of MV Specific Features
- Future Plans
- Demonstration

The screenshot displays the OpenFTA_MV software interface. The top window shows a tree view for 'MVEexample.fta' with various components like MKILL 1 through MKILL 15. Below this, a fault tree diagram is visible, showing a top event 'ENGBEAMS' connected to a gate labeled 'L_BEAMS'. A detailed component list is overlaid on the right side of the interface, listing various components and their associated parameters.

```

MVKILL mv
GRPMULT ENGINES 1
ENGINES L_ENG R_ENG 2 2 ENGINES
SYSMUL L_ENG 1 3 L_ENG
L_ENG L_COMP L_TURB 1 L_EN_FAN L_COMP
SYSMUL L_COMP 1 5 L_COMP
L_COMP L_E_LPC1R_E_HPC1R_E_HPC2R_E_HPC3R_E_CASE L_TURB 1 4 L_TURB
L_TURB L_E_HPT1R_E_LPT1R_E_LPT2R_E_LPT3 SYSMUL R_ENG 1 3 R_ENG
SYSMUL R_ENG 1 3 R_ENG
R_ENG R_COMP R_TURB R_EN_FAN R_COMP
SYSMUL R_COMP 1 5 R_COMP
R_COMP R_E_LPC1R_E_HPC1R_E_HPC2R_E_HPC3R_E_CASE SYSMUL R_TURB 1 4 R_TURB
R_TURB R_E_HPT1R_E_LPT1R_E_LPT2R_E_LPT3
ENDNAME
ENDGROUP
MVKILL 1
GRPMULT ELEVATOR 1 2 ELEVATOR
ELEVATOR ELEVCONTEVEVTRIM
ENDNAME
ENDGROUP
MVKILL RUDDER 1 2 RUDDER
RUDDER RUDDR_UPRUDDR_LW
ENDNAME
ENDGROUP
MVKILL ENGBEAMS 1 2 ENGBEAMS
GRPMULT ENGBEAMS 1 2 ENGBEAMS
ENGBEAMS L_BEAMS R_BEAMS L_BEAMS
SYSMUL L_BEAMS 1 2 L_BEAMS
L_BEAMS L_F_BEAML_A_BEAM SYSMUL R_BEAMS 1 2 R_BEAMS
R_BEAMS R_F_BEAMR_A_BEAM
ENDNAME
ENDGROUP
MVKILL STRUCTRE 1 8 STRUCTRE
GRPMULT STRUCTRE 1 8 STRUCTRE
STRUCTRE STRUCT_1 STRUCT_2 STRUCT_3 STRUCT_4 STRUCT_5 STRUCT_6 STRUCT_7 STRUCT_8 STRUCT_1
SYSMUL STRUCT_1 5 8 STRUCT_1
STRUCT_1 STRING_1 STRING_2 STRING_3 STRING_4 STRING_5 STRING_6 STRING_7 STRING_8 STRUCT_2
SYSMUL STRUCT_2 5 8 STRUCT_2
STRUCT_2 STRING_9 STRING_10 STRING_11 STRING_12 STRING_13 STRING_14 STRING_15 STRING_16 STRUCT_3
SYSMUL STRUCT_3 5 8 STRUCT_3
STRUCT_3 STRING_17 STRING_18 STRING_19 STRING_20 STRING_21 STRING_22 STRING_23 STRING_24 STRUCT_4
SYSMUL STRUCT_4 5 8 STRUCT_4
STRUCT_4 STRING_25 STRING_26 STRING_27 STRING_28 STRING_29 STRING_30 STRING_31 STRING_32 STRUCT_5
SYSMUL STRUCT_5 5 8 STRUCT_5
STRUCT_5 ASTRING_29 ASTRING_30 ASTRING_31 ASTRING_32 ASTRING_1 ASTRING_2 ASTRING_3 ASTRING_4 STRUCT_6
SYSMUL STRUCT_6 5 8 STRUCT_6
STRUCT_6 ASTRING_5 ASTRING_6 ASTRING_7 ASTRING_8 ASTRING_9 ASTRING_10 ASTRING_11 ASTRING_12 STRUCT_7
SYSMUL STRUCT_7 5 8 STRUCT_7
STRUCT_7 ASTRING_13 ASTRING_14 ASTRING_15 ASTRING_16 ASTRING_17 ASTRING_18 ASTRING_19 ASTRING_20 STRUCT_8
SYSMUL STRUCT_8 5 8 STRUCT_8
STRUCT_8 ASTRING_21 ASTRING_22 ASTRING_23 ASTRING_24 ASTRING_25 ASTRING_26 ASTRING_27 ASTRING_28
ENDNAME
ENDGROUP
ENDDATA
  
```

Evaluated Multiple Fault-Tree Programs

Item Software

Diagram-1 - [IT - Item Toolkit - C:\Program Files\Item\Toolkit\Examples\W-708-Example.ITP::Fault Tree]

General dialog box:

- Type: BASIC
- Name: SPARK
- Part Number:
- Logic Mode: Basic
- Circuit Ref:
- Failure Model:
- Adjustment Factor: Q: 1 w: 1
- Description: Spark

Tremor

SystemA: Single Point

Components: SystemA

- A
- B
- C
- D
- E
- F
- G
- H
- I
- J
- W
- X
- Y
- Z

Systems: SystemA, SystemAA, SystemB, SystemC, SystemCC, SystemD, SystemE

User Killed List:

- SystemF
- I
- SystemA
- SystemBB

Relex

Garage Door Opener, System: Garage Door Opener

Fault Tree Table:

Identifier	Gate/Event Type	Description	Logical Condition	Input Type	Failure Rate Type
1	LOG Failure	Garage door will not auto-open or auto-close	Normal		
2	AND Gate	Power outage	Normal	Constant Probability	
3	OR Gate	Undeveloped Event	Normal		
4	AND Gate	Communications failure (includes items that would send signal to receiver)	Normal		
5	OR Gate	Undeveloped Event	Normal	Failure with Repair	Failure Rate
6	OR Gate	Undeveloped Event	Normal	Failure with Repair	Failure Rate
7	Inhibit Gate	Person/object crushed by auto-closing door	Normal		
8	OR Gate	Garage Door Opener Motor Failure	Normal		

Fault Tree Diagram:

Garage door will not auto-open or auto-close

Power outage (F: 0.001 Q: 0.001)

Communications failure (F: 2.06224e-011 Q: 0.25705e-02)

Motor and drive failure (F: 0.0040377 Q: 0)

Receiver circuit failure (F: 0.00279517 Q: 0.11397e-008)

WS1534X (Wall switch failure) (F: 2.00781e-005 Q: 3.65102e-006)

EK1534X (Entry keypad failure) (F: 0.00174847 Q: 2.01667e-007)

RC1534X (Remote control failure) (F: 0.000815317 Q: 8.15640e-008)

OpenFTA

Tree Overview

Formal PED (Database: lift.ped)

Lift door fails

Lift door opens when lift in motion

Door refuses to open when lift stopped

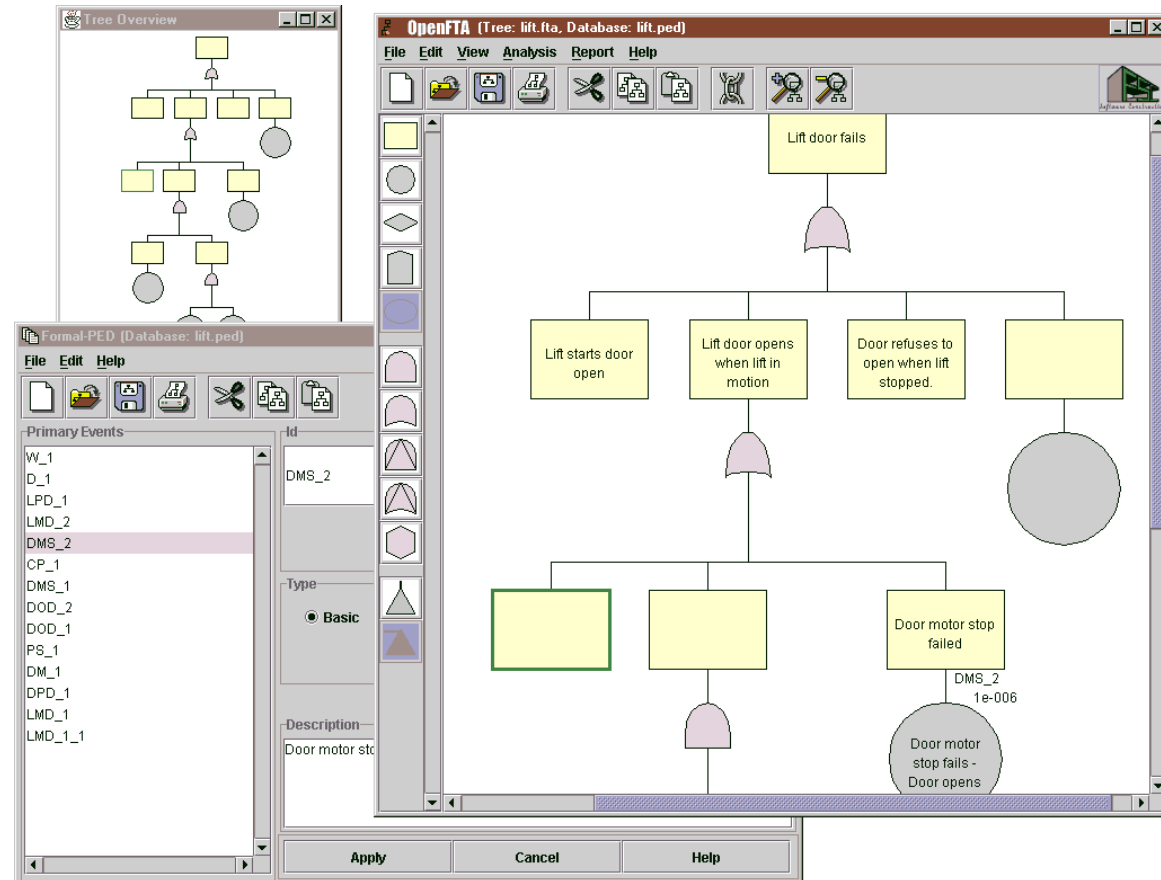
Door motor stop failed

Door motor stop fails - Door opens

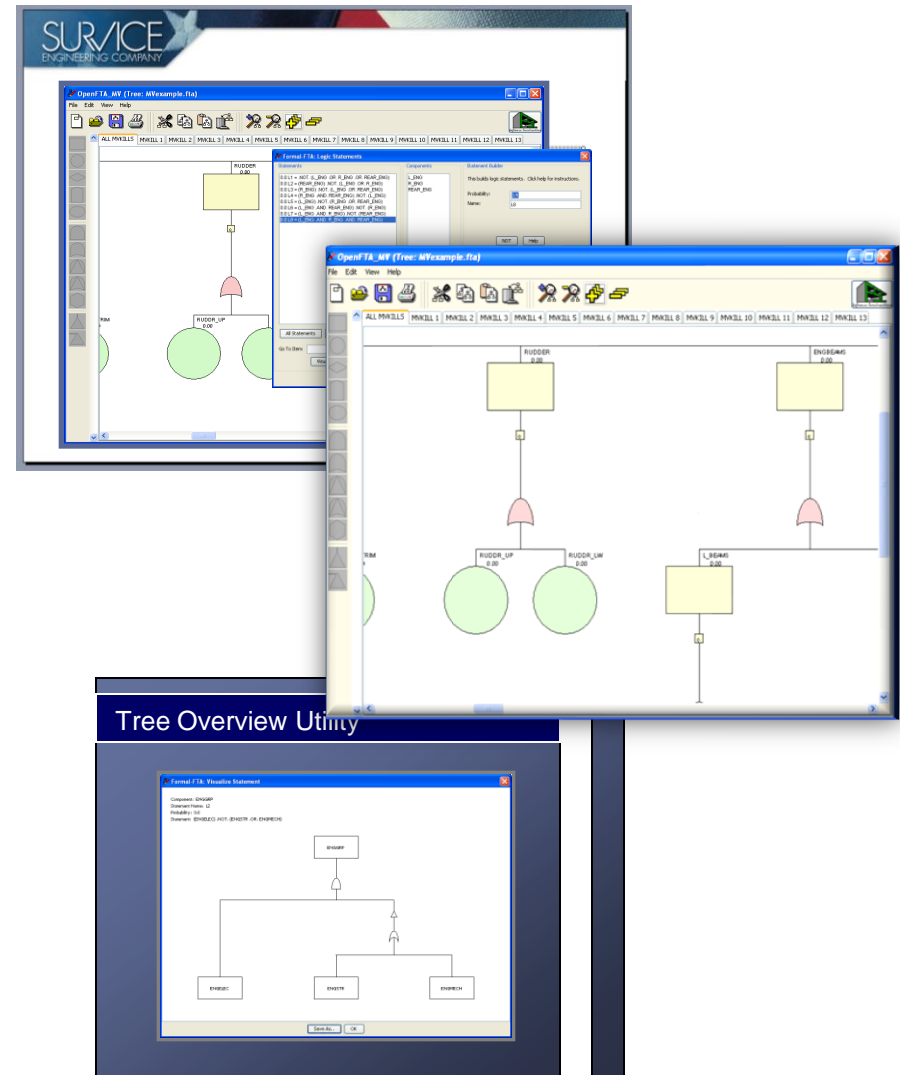
Primary Events:

- W_1
- D_1
- LPD_1
- LMD_2
- DMS_2
- CP_1
- DMS_1
- DOD_2
- DOD_1
- PS_1
- DM_1
- DPD_1
- LMD_1
- LMD_1_1

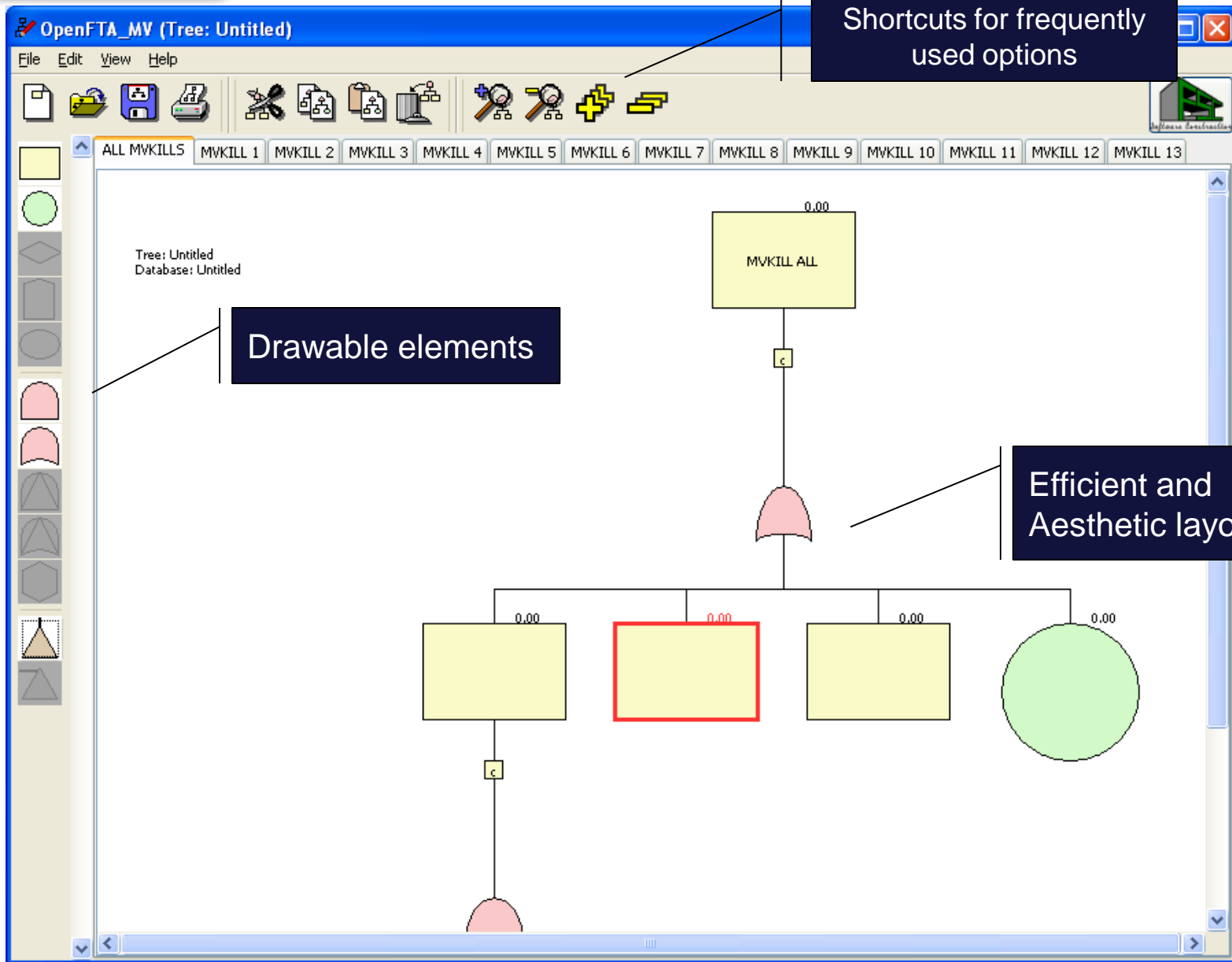
- Open source software developed by Auvation
 - <http://www.openfta.com>
- Intuitive user interface
- Runs on multiple platforms
- Ability to convert to text
- Free!



- A modification of OpenFTA which directly supports the creation of MV files
- Ensures COVART/UEDDAM compatible input files



Easy To Use Interface



Importing/Exporting MV Files

Files can be opened in fault tree (.fta) or MV (.txt) format

Information is easily exported but selecting *File* → *Export to MV*

MV files are saved in an .txt format

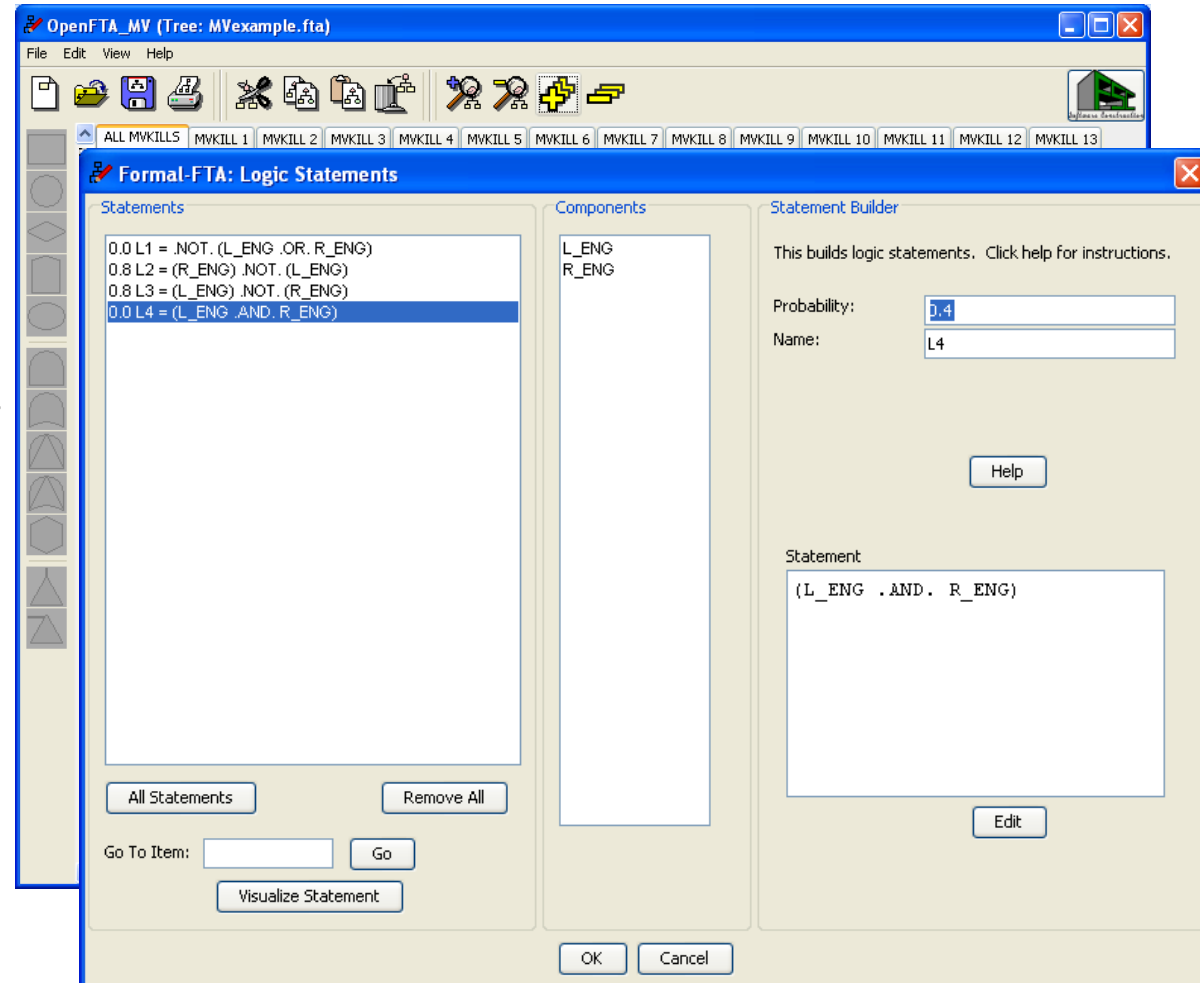
The image illustrates the process of exporting an MV file from a fault tree. It is divided into three main sections:

- File Selection:** A Windows Explorer window shows a folder named 'MW example' containing two files: 'MWexample.fta' and 'MWexample.txt'. The 'Files of type' dropdown is set to 'FTA Files and MV(txt) Files (.txt, .fta)'. The 'File name' field contains 'MWexample.txt'.
- Export Action:** A screenshot of the software interface shows the 'File' menu with 'Export to MV File' selected. The main window displays a fault tree diagram with a top event and several intermediate events.
- Exported Data:** A screenshot of the resulting text file content, which is a structured list of components and their relationships. The text is as follows:


```
AVCD MV
MVKILL ENGINES 1 2 2 ENGINES
GRMULT ENGINES R_ENG 2 2 L_ENG
ENGINES L_ENG R_ENG 1 3 L_ENG
SYMULT L_ENG 1 3 R_ENG
L_COMP L_E_LPC3LE_HPC3LE_HPC3LE_CASE L_COMP
SYMULT L_TURB 1 4 L_TURB
L_TURB L_E_HPT3LE_LPT3LE_LPT3LE_LPT3 SYMULT R_ENG 1 3 R_ENG
R_ENG R_COMP R_TURB R_ENG_FAN R_COMP
SYMULT R_COMP 1 5 R_COMP
R_COMP R_E_LPC3R_E_HPC3R_E_HPC3R_E_CASE R_TURB 1 4 R_TURB
R_TURB R_E_HPT3R_E_LPT3R_E_LPT3R_E_LPT3 ENDDATA
ENDGROUP
MVKILL ELEVATOR 1 2 ELEVATOR
GRMULT ELEVATOR 1 2 ELEVATOR
ELEVATOR ELEVCONTEVEUETRIM ENDDATA
ENDGROUP
MVKILL RUDDER 1 2 RUDDER
GRMULT RUDDER 1 2 RUDDER
RUDDER RUDDER_UFRUDDER_LW ENDDATA
ENDGROUP
MVKILL ENGBEAMS 1 2 ENGBEAMS
GRMULT ENGBEAMS 1 2 ENGBEAMS
ENGBEAMS L_BEAMS 1 2 L_BEAMS
SYMULT L_BEAMS 1 2 L_BEAMS
L_BEAMS L_F_BEAMS_A_BEAM SYMULT R_BEAMS 1 2 R_BEAMS
SYMULT R_BEAMS 1 2 R_BEAMS
R_BEAMS R_F_BEAMS_A_BEAM ENDDATA
ENDGROUP
MVKILL STRUCTRE 1 STRUCTRE
GRMULT STRUCTRE 1 8 STRUCTRE
STRUCTRE STRUCTRE_1 STRUCTRE_2 STRUCTRE_3 STRUCTRE_4 STRUCTRE_5 STRUCTRE_6 STRUCTRE_7 STRUCTRE_8 STRUCTRE
SYMULT STRUCTRE_1 1 8 STRUCTRE_1
STRUCTRE_1 STRING1 STRING2 STRING3 STRING4 STRING5 STRING6 STRING7 STRING8 STRUCTRE_2
SYMULT STRUCTRE_2 1 8 STRUCTRE_2
STRUCTRE_2 STRING9 STRING10 STRING11 STRING12 STRING13 STRING14 STRING15 STRING16 STRUCTRE_3
SYMULT STRUCTRE_3 1 8 STRUCTRE_3
STRUCTRE_3 STRING17 STRING18 STRING19 STRING20 STRING21 STRING22 STRING23 STRING24 STRUCTRE_4
SYMULT STRUCTRE_4 1 8 STRUCTRE_4
STRUCTRE_4 STRING25 STRING26 STRING27 STRING28 STRING29 STRING30 STRING31 STRING32 STRUCTRE_5
SYMULT STRUCTRE_5 1 8 STRUCTRE_5
STRUCTRE_5 STRING33 STRING34 STRING35 STRING36 STRING37 STRING38 STRING39 STRING40 STRUCTRE_6
SYMULT STRUCTRE_6 1 8 STRUCTRE_6
STRUCTRE_6 STRING41 STRING42 STRING43 STRING44 STRING45 STRING46 STRING47 STRING48 STRUCTRE_7
SYMULT STRUCTRE_7 1 8 STRUCTRE_7
STRUCTRE_7 STRING49 STRING50 STRING51 STRING52 STRING53 STRING54 STRING55 STRING56 STRUCTRE_8
SYMULT STRUCTRE_8 1 8 STRUCTRE_8
STRUCTRE_8 STRING57 STRING58 STRING59 STRING60 STRING61 STRING62 STRING63 STRING64 ENDDATA
ENDGROUP
ENDGROUP
```

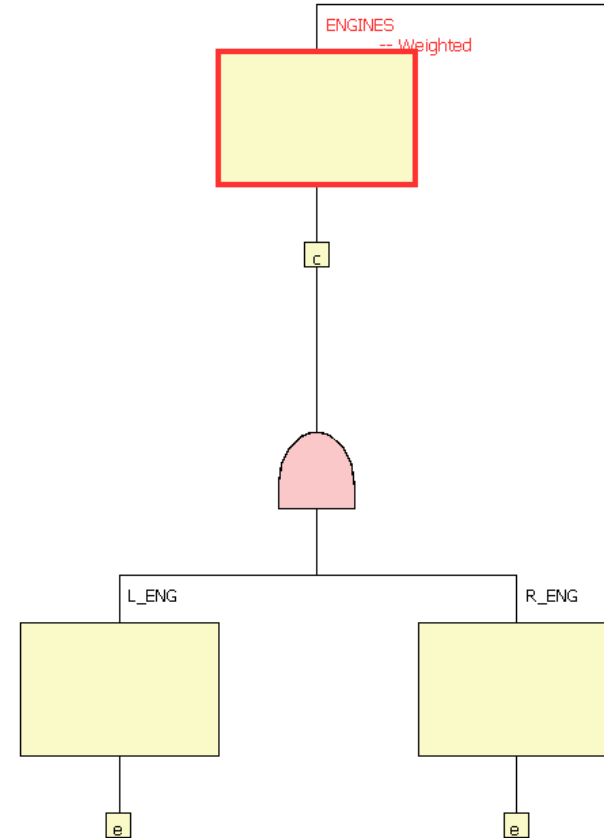
Weighting Factors

- Weighting factors are applied in the Logic Statement Builder
- All possible combinations of components the selected system are automatically generated
- Values are applied in the **Probability:** field



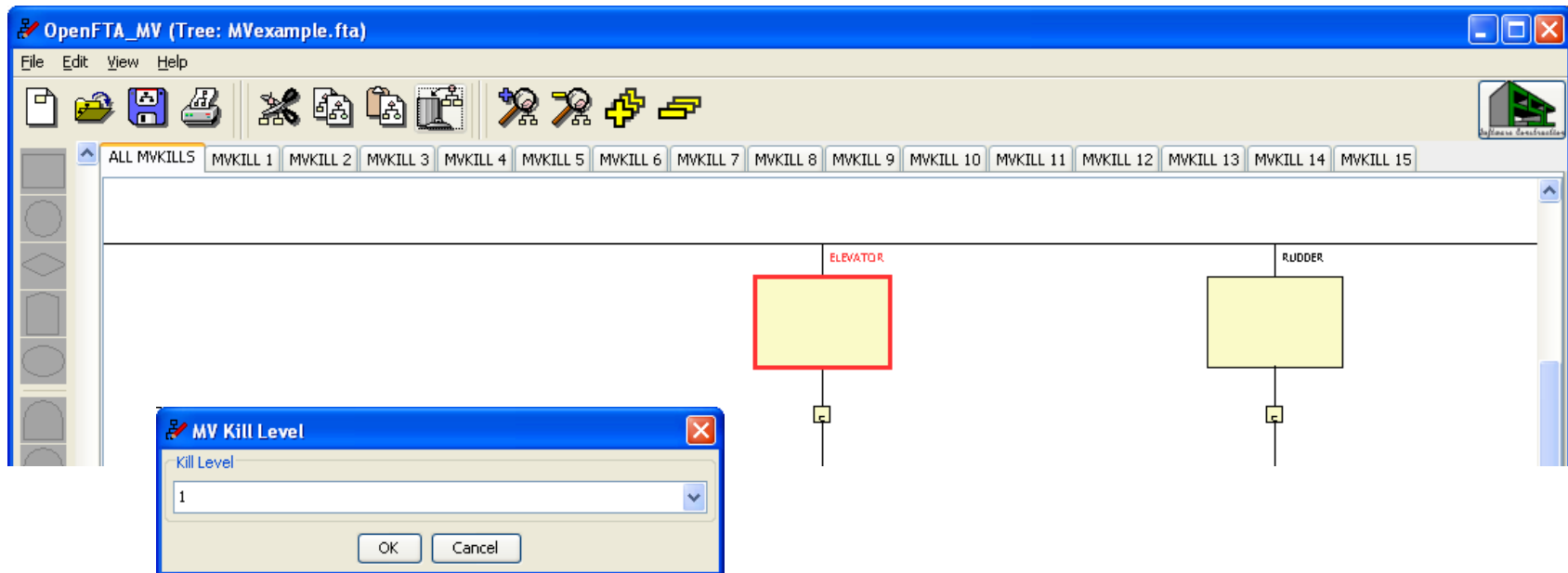
Weighting Factors

- Weighting factors are applied in the Logic Statement Builder
- All possible combinations of components the selected system are automatically generated
- Values are applied in the **Probability:** field



Kill Levels

- Kill levels are assigned through the event dialog
- Up to 15 different kill levels can be defined
- Individual kill levels can be viewed under respective tabs



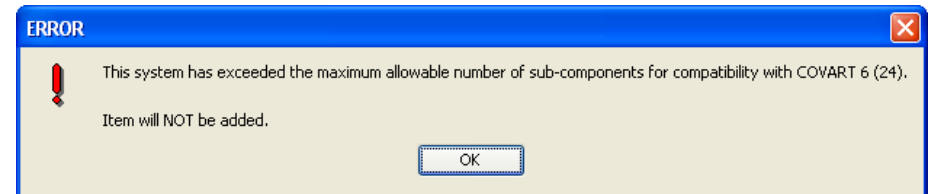
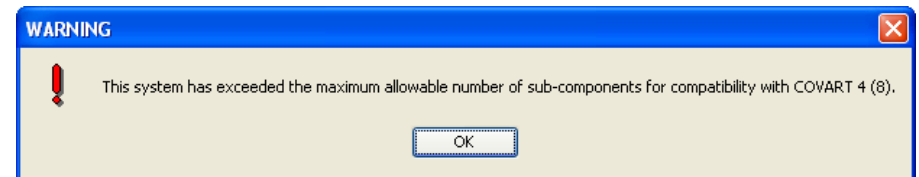
Incorporating Sub-Trees

The image displays two windows of the OpenFTA_MV software. The left window shows a partial fault tree for 'ENGINES' with a 'Formal-FTA: Transfer Tree' dialog box open. The dialog box has an 'ID' field containing 'LeftEngel' and 'OK', 'Cancel', and 'Help' buttons. The right window shows the same fault tree after the sub-tree has been incorporated. The 'ENGINES' node is connected to an AND gate, which is connected to three sub-trees: 'LeftEngine.Fa', 'Right Engine', and 'Rear Engine'. Each sub-tree is a fault tree with its own AND gate and two leaf nodes (green circles).

Use the transfer-in function to incorporate multiple trees

Maintains Compatibility

- Only offers supported symbols
 - GRPMULT / NAN Events
 - AND / OR Gates
- Identification
 - 8 character limit
 - Multiple Occurrences
- Subsystems Limit
 - Warning at 8 for COVART 4 users
 - Error at 24 for COVART 6 users

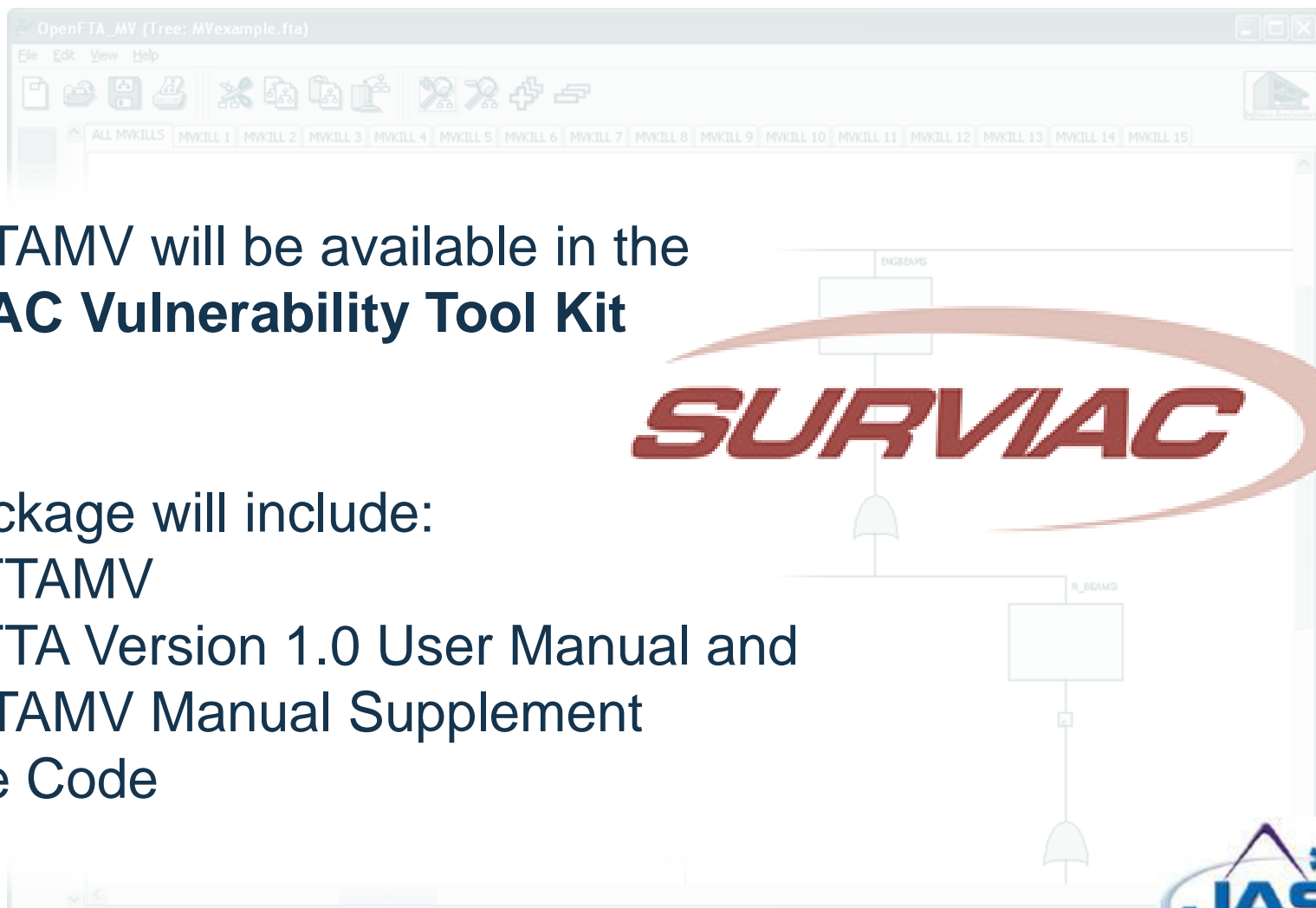


Plans for Distribution

OpenFTAMV will be available in the **SURVIAC Vulnerability Tool Kit**

The package will include:

- OpenFTAMV
- OpenFTA Version 1.0 User Manual and OpenFTAMV Manual Supplement
- Source Code



Demonstration

```

MVCD mv
MVKILL 1
GRPMULT ENGINES 1 2 2
ENGINES L_ENG R_ENG L_ENG
SYSMULT L_ENG 1 3
L_ENG L_COMP L_TURB L_EN_FAN
SYSMULT L_COMP 1 5
L_COMP L_E_LPC1L_E_HPC1L_E_HPC2L_E_HPC3L_E_CASE
SYSMULT L_TURB 1 4
L_TURB L_E_HPT1L_E_LPT1L_E_LPT2L_E_LPT3
SYSMULT R_ENG 1 3
R_ENG R_COMP R_TURB R_EN_FAN
SYSMULT R_COMP 1 5
R_COMP R_E_LPC1R_E_HPC1R_E_HPC2R_E_HPC3R_E_CASE
SYSMULT R_TURB 1 4
R_TURB R_E_HPT1R_E_LPT1R_E_LPT2R_E_LPT3
ENDNAME
ENDGROUP
MVKILL 1
GRPMULT ELEVATOR 1 2
ELEVATORELEVCONTEVEVTRIM
ENDNAME
ENDGROUP
MVKILL 1
GRPMULT RUDDER 1 2
RUDDER RUDDR_UPRUDDR_LW
ENDNAME
ENDGROUP
MVKILL 1
GRPMULT ENGBEAMS 1 2
ENGBEAMS L_BEAMS R_BEAMS
SYSMULT L_BEAMS 1 2
L_BEAMS L_F_BEAML_A_BEAM
SYSMULT R_BEAMS 1 2
R_BEAMS R_F_BEAMR_A_BEAM
ENDNAME
ENDGROUP
MVKILL 1
GRPMULT STRUCTRE 1 8
STRUCTRESTRUCT_1STRUCT_2STRUCT_3STRUCT_4STRUCT_5STRUCT_6STR
SYSMULT STRUCT_1 5 8
STRUCT_1STRING_1STRING_2STRING_3STRING_4STRING_5STRING_6STR
SYSMULT STRUCT_2 5 8
STRUCT_2STRING_9STRING_10STRING_11STRING_12STRING_13STRING_14STR
SYSMULT STRUCT_3 5 8
STRUCT_3STRING_17STRING_18STRING_19STRING_20STRING_21STRING_22STR
SYSMULT STRUCT_4 5 8
STRUCT_4STRING_25STRING_26STRING_27STRING_28STRING_29STRING_30STR
SYSMULT STRUCT_5 5 8
STRUCT_5ASTRING_29ASTRING_30ASTRING_31ASTRING_32ASTRING_1 ASTRING_2 AST
SYSMULT STRUCT_6 5 8
STRUCT_6ASTRING_5 ASTRING_6 ASTRING_7 ASTRING_8 ASTRING_9 ASTRING_10AST
SYSMULT STRUCT_7 5 8
STRUCT_7ASTRING_13ASTRING_14ASTRING_15ASTRING_16ASTRING_17ASTRING_18AST
SYSMULT STRUCT_8 5 8
STRUCT_8ASTRING_21ASTRING_22ASTRING_23ASTRING_24ASTRING_25ASTRING_26AST
ENDNAME
ENDGROUP
ENDDATA
    
```

