

#### FRAM — FIRST STEPS How to Use FRAM and the FMV

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- Define the purpose of modelling and describe the situation being analysed. A typical activity, an event that has occurred, a possible future scenario.
- Identify and describe the essential functions in the activity/event using the FMV; characterise each function by means of the basic aspects. The FMV will indicate when the model is finished (consistent).



Characterise the typical / potential variability of 'foreground' functions using the FMV. Consider both everyday and excessive cases of variability.



Go through a number of instantiations of the model to look for cases of functional resonance based on potential / actual dependencies (couplings) among functions.



Propose ways to monitor and manage performance variability (indicators, barriers, design / modification, etc.)



PURPOSE: A FRAM analysis aims to identify how the system functions (or should function) for everything to succeed (i.e., everyday performance), and to understand the variability which alone or in combination may prevent that from happening.

MODEL: A FRAM model describes a system's functions and the potential couplings among functions. The model does not describe or depict an actual sequence of events, such as an accident or a future scenario.

INSTANTIATION: A concrete scenario is the result of an instantiation of the model. The instantiation is a "map" of how functions are coupled, or may become coupled, under given – favourable or unfavourable - conditions.

The meaning of the connectors





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### The meaning of the connectors





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### Describing a FRAM function





## Getting cash from an ATM





Describe what you do to get money from an ATM.

Write it as you would explain it to someone else.

Describe what you do – and what the ATM-asa-system does – <u>when everything works as it</u> <u>should</u>. In other words, describe the typical case. Do not yet include possible ways in which it could go wrong. That will come later.

Go through the description and mark all functions. Rewrite them in the infinitive form ("to xxx").



Step 1. Insert your card into the ATM machine (with the side that has the arrow going in first.)

Step 2. Enter your pin when prompted by the machine then press proceed button.

Step 3. Select the "withdrawal" option by pressing the button next to it when prompted by the machine.

Step 4. Select your type of account "Current or Savings" option by pressing the button next to it when prompted by the machine.

Step 5. Select the amount you want by pressing the button next to it when prompted by the machine.

Step 6. The machine will request if you want a receipt for the transaction? Proceed with the desired by pressing either the Yes or No button.

Step 7. Once the transaction is completed, the machine will;

Dispense the amount to you.

Dispense the receipt on the amount (If you had selected the Yes button in Step 6). Release your ATM Card.

See also: m.wikihow.com/Use-an-ATM



Begin to describe the functions using the FMV. Build the model using a breadthbefore-depth principle.

#### Depth-before-breadth

The usual way to carry out an analysis is depth-before breadth. In accident investigations this is illustrated by the search for the root cause. In decision making this is illustrated by exploring all the consequences of each alternative.'In depth-before-breadth each possible path is explored exhaustively before other paths are considered.

#### Breadth-before-depth

When building a FRAM model, try to describe the activity as a whole, before going into detail with specific functions. Try to understand the "big picture" – the activity in its context – before getting lost in details.

# Describing the aspects



FRAM Model Visualiser	
Open 🔄 Save 🔤 Report	Image
Function	Visualiser - new
Name	
Description	The aspects of a function are described using
	the FRAM Model Visualiser (FMV).
Function Type 🔹 More ≫	The FMV provides a structured way of defining,
Aspect Description of aspect	editina, and revisina functions.
Input	
Output 📮	
Precondition	
Resource	
Control	
Time 👍	
Function Colour	
Model Rendering 💌	
Show Aspect Labels	









All inputs must have an origin or source, which means that an input to one function must be the output from another function.

Designated foreground functions must have defined inputs, while designated background functions need not have.

If the function does not have en Input, it will never be carried out!







The result of the function, or what is produced or manufactured by the function. The output can represent matter, energy, or information, for instance, a decision, a command issued, or the result of some kind of deliberation. The output represents a change of state – of the system or of one or more output parameters.

The output makes clear how variability can propagate through a system. If a function varies then it is also likely to vary in some way. Since the output from an upstream function will be the input to a downstream function, variability of the output may lead to variability in the (downstream) function, and so on.

All functions, except a designated drain (or sink) must have an Output.

The system conditions that must be satisfied before a function is carried out. The preconditions must be the output from one or more other functions. Preconditions provide demonstrate how functions can be coupled.

# FRAM: Characterisation of precondition

 
 I
 Activity/ Function

 Precondition

A precondition is a state that must be true before a function is carried out, but it is not itself the signal that starts the function. An input, on the other hand, can start the activation of a function.







Something that is needed when a function is carried out - matter, energy, information, competence, software, tools, manpower, etc. A resource is consumed while the function is carried out. Execution conditions must be present for the function to be carried out, but are not diminished because of that, e.g., data, competence, or skills.

Resources must be produced by one or more functions. Execution conditions are assumed to be stable for the duration of the event (output from 'dummy' functions).





Something that supervises or regulates the function to ensure that it produces the desired output - plans, schedules, procedures, guidelines or instructions, etc. Control can also be the conditions that constrain the sequencing of sub-steps. Explicit control is provided by another function (procedures, instructions). Social control is the expectations of others (company, management, colleagues) or of the agent itself.

Control must be the output from an upstream function. If it is stable, then it is reasonable to assign it to a background function. If it is active and adaptive, then it should be assigned to a foreground function.



## FRAM: Characterisation of time

This aspect represents the various ways in which time can affect performance.

Time as control: relative or absolute sequencing conditions.

- Earliest Starting Time (EST),
- Latest Starting Time (LST),
- Earliest Finishing Time (EFT), and
- Latest Finishing Time (LFT).

Time as a resource: time available, deadline, etc.

Time as a precondition: clock-time or relative to other functions.



### More about the aspects



There is no requirement to define all six aspects for every function.

In practice, you should only describe aspects if it seems to be relevant or necessary, based on knowledge about the activity.

For each type of aspect there can be more than one entry.

A function may, for instance have a single Output that used by several downstream functions.

A function may also have two – or more Outputs.

A function may also have two – or more – upstream couplings to its Input, Precondition, Resource, Control, or Time aspects.



#### Data collection



#### "Work-as-imagined"

The various sources, descriptions or specifications, for the type of work being studied.

Policies, strategies, guidelines, instructions, checklists

Documented experiences (cases, events, statistics)

Workplace layout and organisation, equipment, facilities.

#### "Work-as-done"

The various ways in which information about actual work practices can be obtained.

Interviews – open and appreciative questions

Checklists to guide interviewers

Information about attitudes, habits, assumptions, tacit knowledge

Typical adjustments (variability)

Dependencies among functions, conditions that affect performance

#### Interviews



Interviews should be conducted at the place of work (on-site), although not necessarily where the specific work or activity is carried out.

Interviews should be conducted in small groups, e.g., two from the staff and two from the analysis group.

Having more than one interviewee can help to get more information about daily practices and to show both shared assumptions and individual work patterns.

Having more than one interviewer means that one can focus on asking questions and listen for answers, while the other can focus on taking notes.

Checklists should be used to keep interviews on track and to ensure no questions have been missed.

Duration is typically 1-2 hours.





The purpose of the data collection is to find out what team members do every day to get the task done successfully, how this may vary, and how this understanding may improve how they do their work (in terms of safety, productivity, etc.)

As such the researcher/observer should observe the team undertaking tasks and ask questions according to the spirit of the FRAM.

Notes will be made from observations and discussions with team members

The observations/questions may be conducted over a number of weeks asking slightly different questions each week.

The goal is not to question whether work is being done correctly (work-as-imagined) but to understand what was being done and why (work-as-done).

Use pre-defined questionnaires carefully. During an interview it is more important to listen to what people say, than prepare the next question (from a list).

# Sample questions



How well is the activity described? (simple, detailed) What are the key functions? Are preconditions always identified and/or fulfilled? Is guidance provided on the variability associated with key functions? Are controls identified and described? Are resources available when they are required?

What's the best way to do it?

Is that like training?

Do you or your colleagues ever change it around?

Does anything unexpected ever happen? Tell me about it.

Is there anything that could be better, anything you feel you have to put up with? Do you need any special tools to in your work?

So how do you know the quality is okay?

If you need a team leader or manager, do you stop and call them or do you keep working until you see them?

What do you do if the task is running behind?

### Identifying Functions: Details



A FRAM analysis can in principle begin with any function. The analysis Where to will show the need for other functions to be included, i.e., functions begin that are coupled or linked through various relations. FRAM defines six types of relations. There is no single, correct level of description. A FRAM model will Level of typically comprise functions described on different levels. description Foreground Functions are pragmatically labelled as being either foreground or background background functions. Level of If there can be significant variability in a foreground function, then it is possible to go deeper into the analysis of that function, and detail possibly break it down into subfunctions. System The analysis may go beyond the boundaries of the system as initially boundary defined. If some background function can vary and thereby affect (stop rule) foreground functions "inside" the system, then it should be considered a foreground function.



FRAM uses a distinction between foreground and background functions, which may all affect performance variability.

Foreground functions are directly associated with the activity being modelled and may vary

significantly during a scenario.

Background functions refer to common conditions that may vary more slowly.

The distinction between foreground and background functions is relative rather than absolute.

A 'background' function may be analysed further, and thereby becomes a 'foreground' function.

Both sets of functions should be calibrated as far as possible using information extracted from accident databases.

#### Upstream and downstream





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