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Questionnaire for estimating uncertainties in assurance cases

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Context

The objective of this assessment is to quantify the confidence in an assurance case or a safety case as it was studied at LAAS [2, 3, 4] . In this questionnaire, we ask an expert to provide her/his judgment regarding some specific situations. Her/his answers will be then integrated in a quantitative framework which is not presented here.

How to play

In order to assess confidence in an assurance case, an assessor needs to evaluate all goal that leads to the overall claim. We adopt an evaluation matrix (figure 1) to assess each goal by two criteria:

- *Decision*: In a scale of 5 equidistant items, it describes which side the expert leans towards, from the rejection of the claimed goal to its acceptance.
- *Confidence*: It reflects the amount of information an assessor possesses that can justify her/his decision. There are 6 equidistant levels of the confidence scale. From “Lack of confidence” to “For sure”.

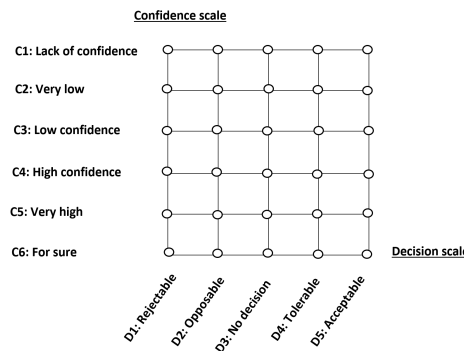


Figure 1: Evaluation Matrix

By analogy, this is comparable to the classical conference paper reviewing where reviewers have to provide a decision (strongly reject to strongly accept) and a level of confidence associated with it (low to expert).

Examples

In the first example (figure 2), the assessor accept the statement in goal (G1) with a very high level of confidence. This decision and its corresponding degree of confidence is based on the simulation report given as evidence (or reference in GSN nomination).

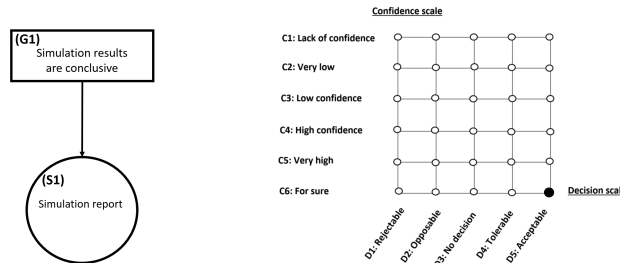


Figure 2: Example 1

In the second example (figure 3) the opinion about (G1) is conditioned by initial opinions on sub-goals (G2) and (G3). In this case, the assessor should give his or her decision and its corresponding level of confidence of (G1) according to the decision and confidence provided in the goals (G2) and (G3).

We can notice that the assessor is opposable to this statement with high level of confidence. This opinion could be explained by the fact that the sub-claim (G3) cannot support (G1) alone. To give a favorite opinion more information about the other sub-claim (G2) is needed.

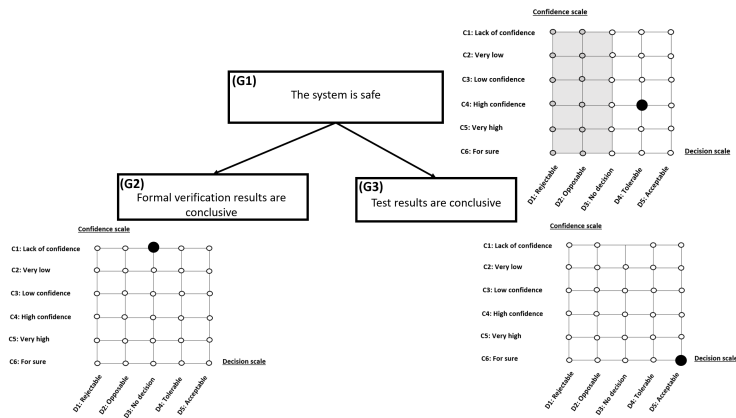


Figure 3: Example 2

The argument structure to assess

Figure 4 represent an extract of the assurance case form the paper [1], which aim to demonstrate that a Machine Learning (ML) based system meets its system and safety requirements. This extract shows through different pieces of evidence that the statement (G1) : “*The real world situations where the machine learning model (MLM) is not robust are identified and mitigated*” is achieved. This statement is supported by two pieces of evidence (G2) and (G3). Each of them is respectively supported by three (S1, S2 and S3) and one (S4) pieces of evidence.

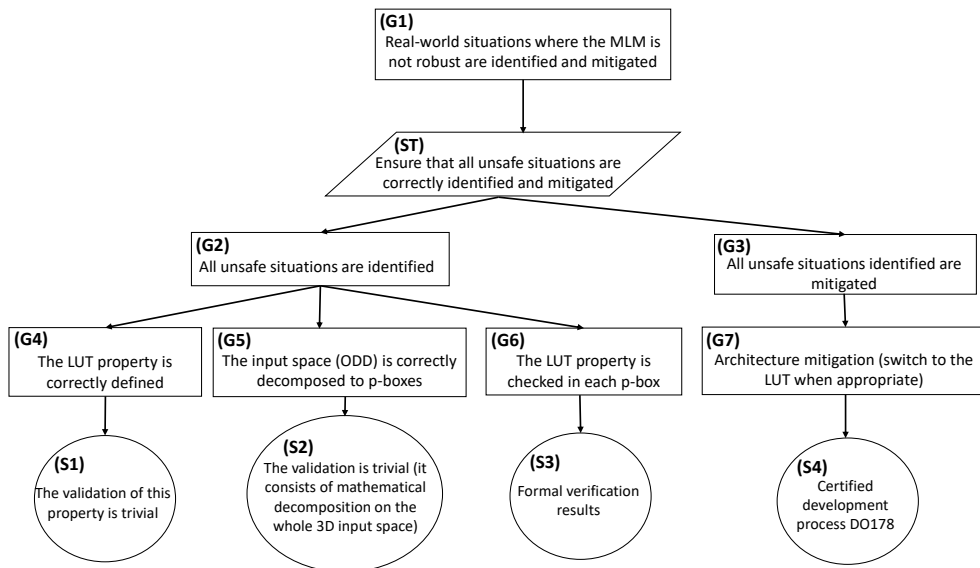
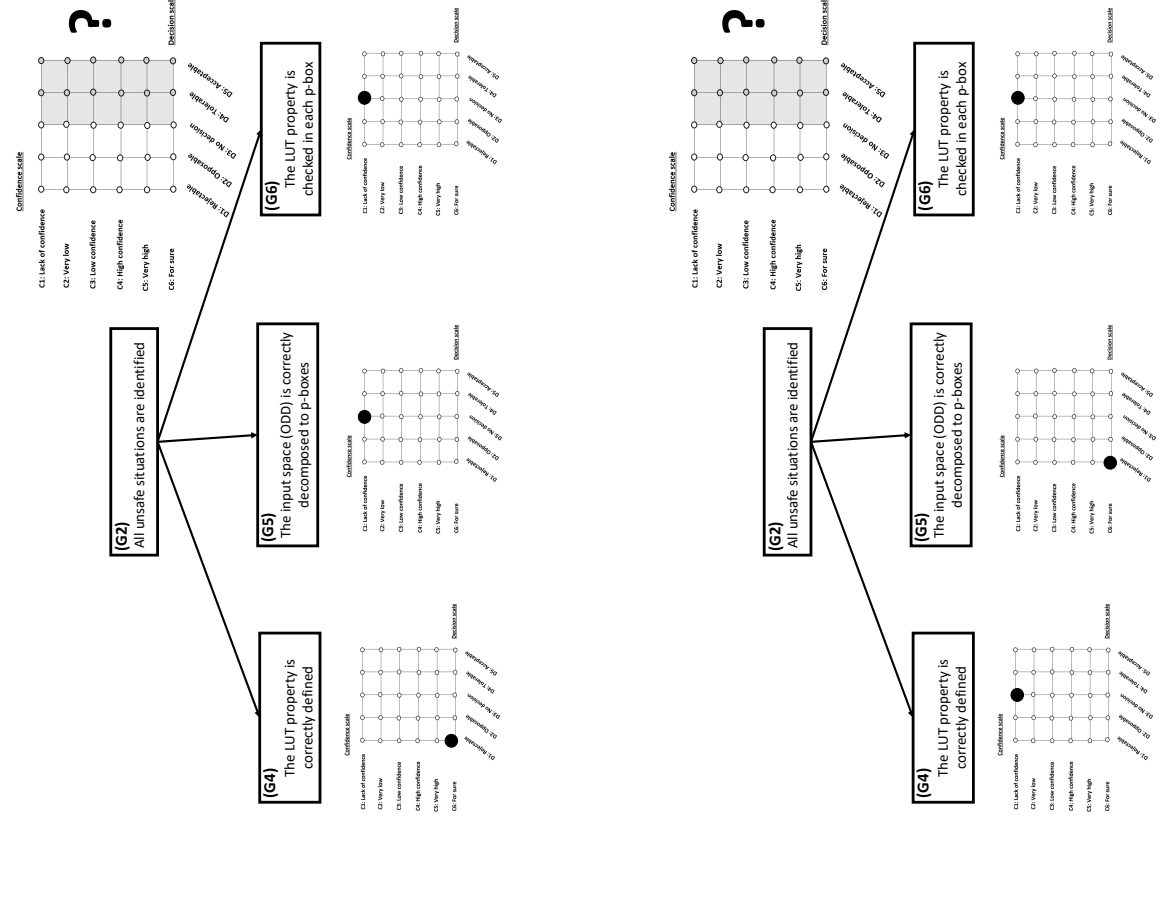
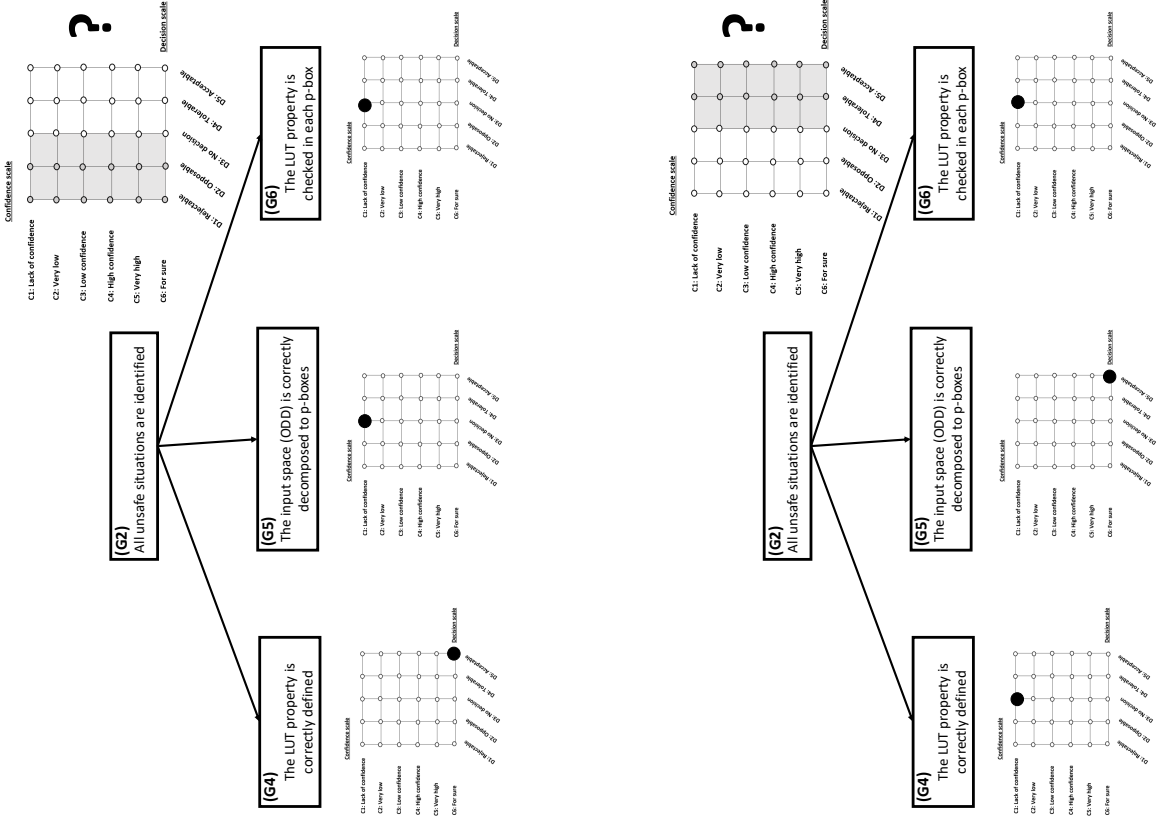
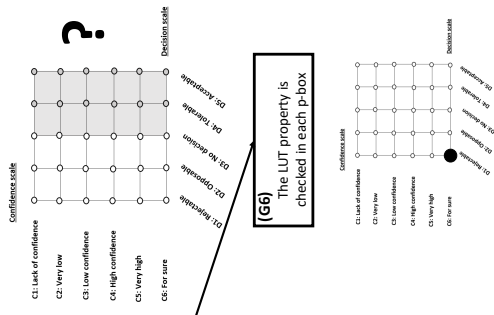


Figure 4: Assurance Case - ML subsystem robustness [1]

Part 1 : Elicitation of the opinions on G2

Please read the arguments bellow and give your opinion about the claim (G1) by taking into consideration the initial opinions for sub-goals (G4), (G5) and (G6). To do so, please select the couples (decision, confidence) in the goal (G2) evaluation matrix of each case. It is forbidden to choose couples in the grey area (couples situated in the median are not included).



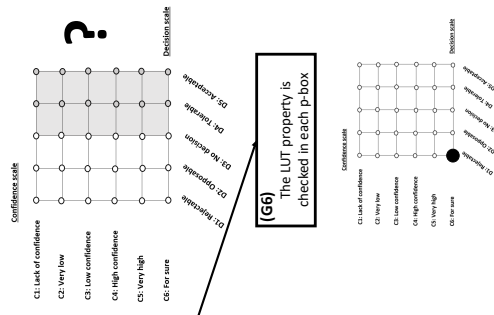
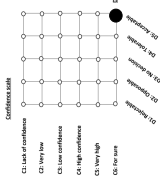
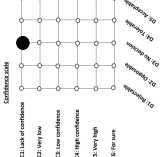
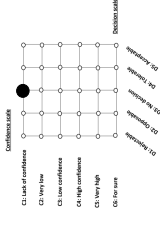
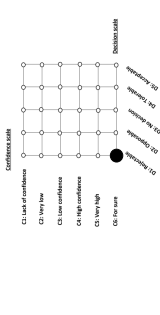


(G2) All unsafe situations are identified

(G5) The input space (ODD) is correctly decomposed to p-boxes

(G4) The LUT property is correctly defined

(G6) The LUT property is checked in each p-box

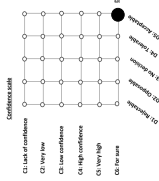
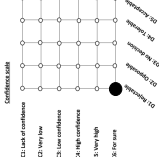
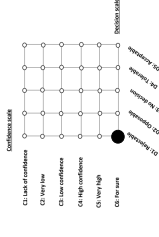
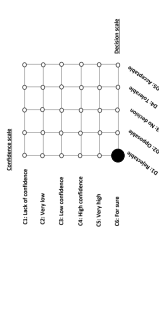


(G2) All unsafe situations are identified

(G5) The input space (ODD) is correctly decomposed to p-boxes

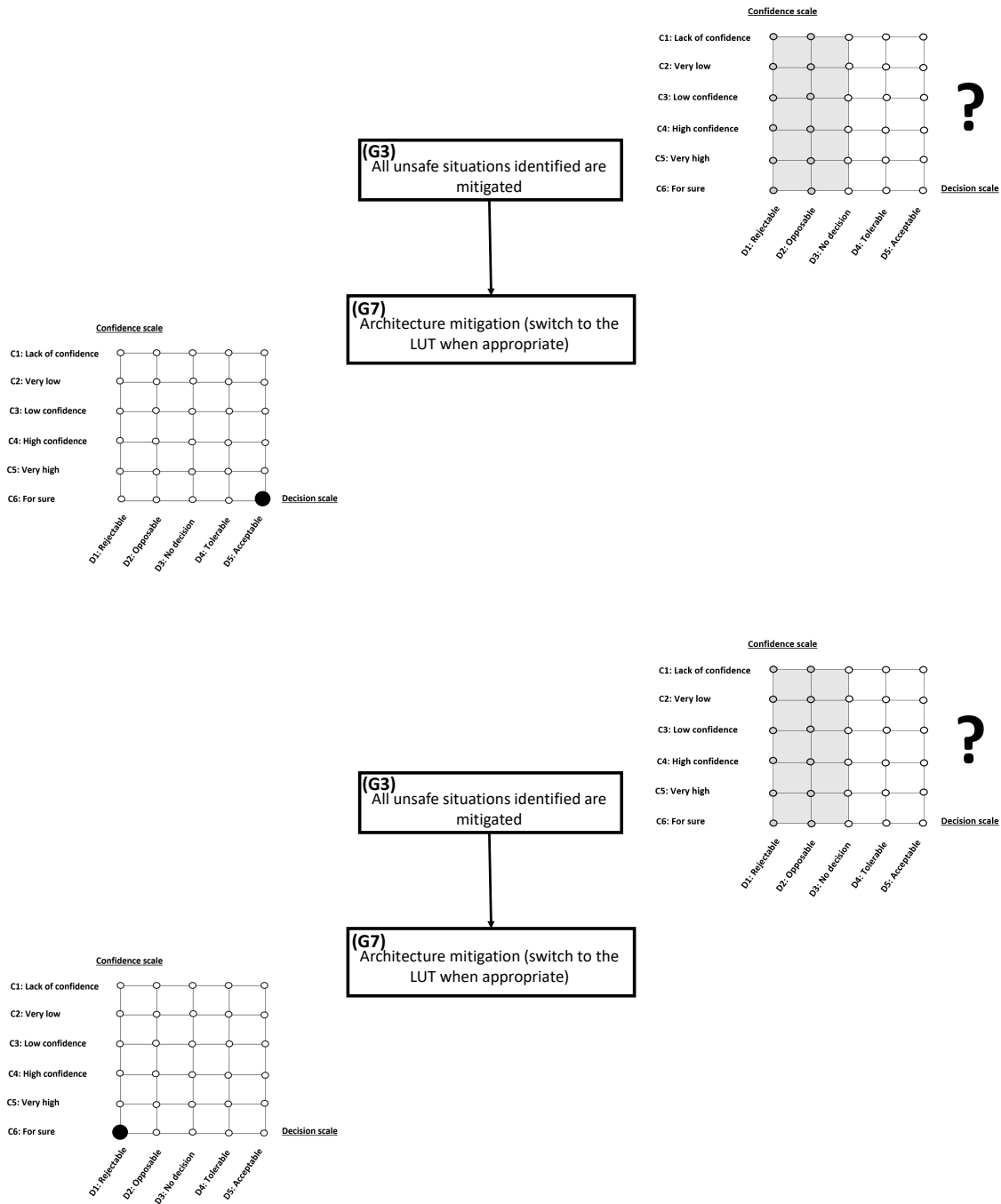
(G4) The LUT property is correctly defined

(G6) The LUT property is checked in each p-box



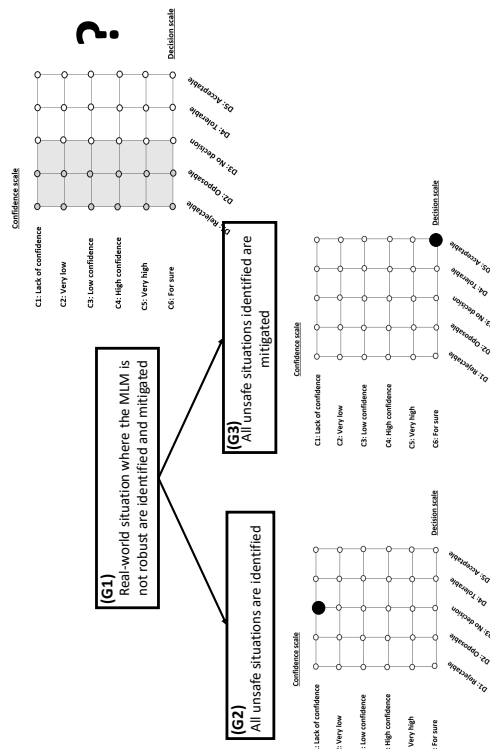
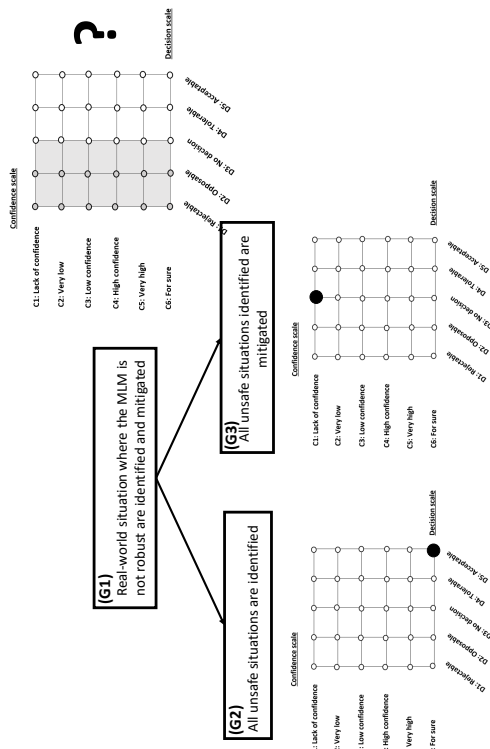
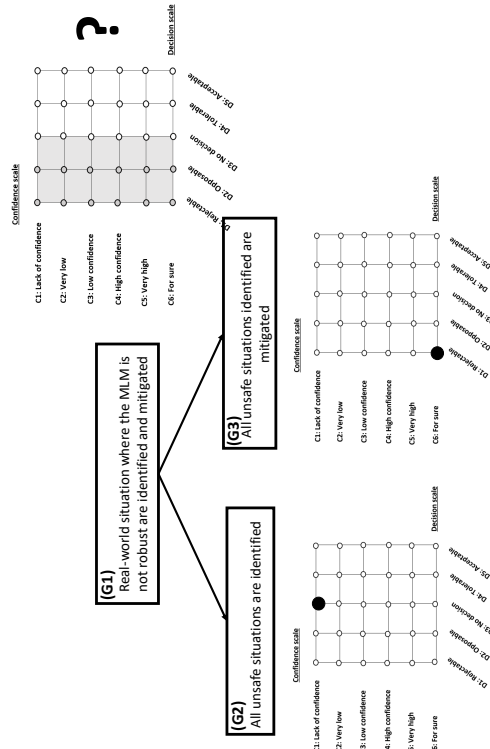
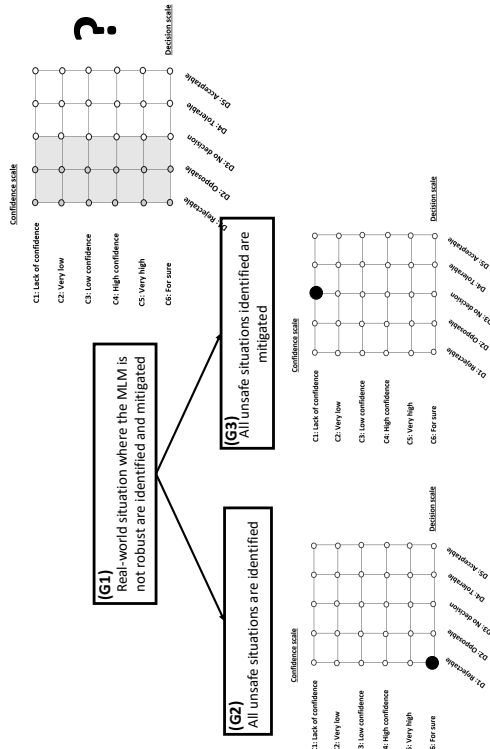
Part 2 : Elicitation of opinions on G3

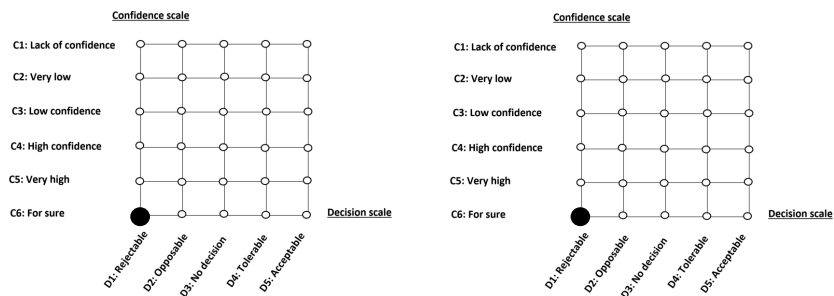
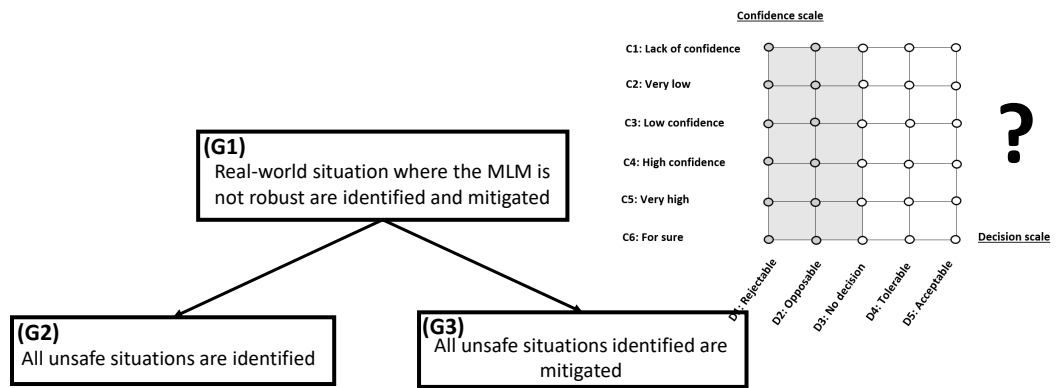
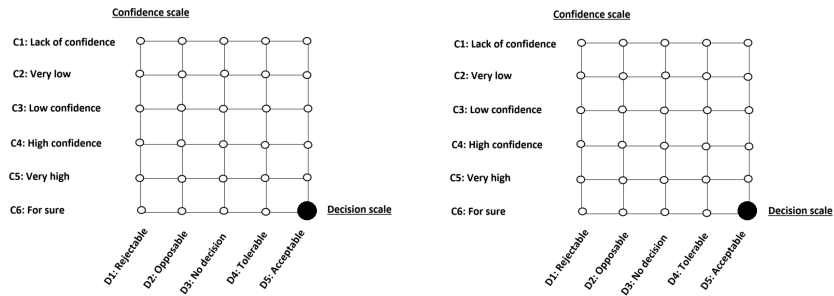
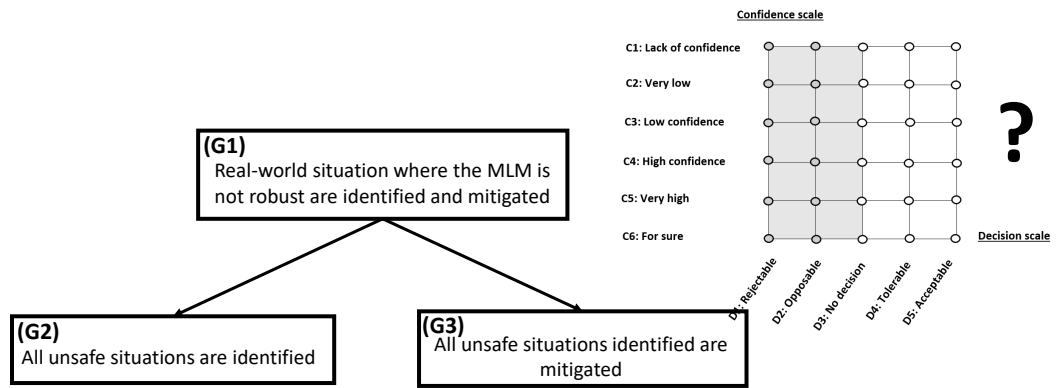
The confidence in (G3) can be deduced from the sub-goal (G7). Please read the arguments bellow and give your opinion about the goal (G3) by taking into consideration the initial opinions on the sub-goal (G7). To do so, please select the couples (decision, confidence) in the goal (G3) evaluation matrix in each case. It is forbidden to choose couples in the grey area (couples situated in the median are not included).



Part 3 : Elicitation of opinions on G1

The confidence in the top goal (G1) can be deduced from these premises. Please read the arguments bellow and give your opinion about the goal (G1) by taking into consideration the initial opinions for sub-goals (G2) and (G3). To do so, please select the couples (decision, confidence) in the goal (G1) evaluation matrix in each case. It is forbidden to choose couples in the grey area (couples situated in the median are not included).





Part 4 : Elicitation of confidence and decision about premises.

In this final section, you have to give your opinion about the premises directly from the evidence provided in each argument. To do so, please read the argument below and choose the appropriate couple (decision, confidence) in each case.

(G4)
The LUT property is correctly defined

(S1)
The validation of this property is trivial

Confidence scale

C1: Lack of confidence
C2: Very low
C3: Low confidence
C4: High confidence
C5: Very high
C6: For sure

Decision scale

D1: Not reasonable
D2: Opposable
D3: No decision
D4: Tolerable
D5: Acceptable

?

(G5)
The input space (ODD) is correctly decomposed to p-boxes

(S2)
The validation is trivial (it consists of mathematical decomposition on the whole 3D input space)

Confidence scale

C1: Lack of confidence
C2: Very low
C3: Low confidence
C4: High confidence
C5: Very high
C6: For sure

Decision scale

D1: Not reasonable
D2: Opposable
D3: No decision
D4: Tolerable
D5: Acceptable

?

(G6)
The LUT property is checked in each p-box

(S3)
Formal verification results

Confidence scale

C1: Lack of confidence
C2: Very low
C3: Low confidence
C4: High confidence
C5: Very high
C6: For sure

Decision scale

D1: Not reasonable
D2: Opposable
D3: No decision
D4: Tolerable
D5: Acceptable

?

(G6)
The LUT property is checked in each p-box

(S3)
Formal verification results

Confidence scale

C1: Lack of confidence
C2: Very low
C3: Low confidence
C4: High confidence
C5: Very high
C6: For sure

Decision scale

D1: Not reasonable
D2: Opposable
D3: No decision
D4: Tolerable
D5: Acceptable

?

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- [3] Idmessaoud, Y., Dubois, D., Guiochet, J.: Quantifying confidence of safety cases with belief functions. In: International Conference on Belief Functions. pp. 269–278. Springer (2021)
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