

AEROSPACE TECHNOLOGY CONGRESS

Human Decision-Making Model for a Single Pilot Operation

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Summary

1. Motivation
2. Goal
3. Theoretical background
4. Model Development Process
5. Results and Discussion



1. Motivation

- Analyze human factors that directly or indirectly influence flight quality;
- Promote safety improvements;
 - How?
 - Measuring several previously disregarded human factors as a basis for creating pilot-specific procedures and training.

2. Goal

- Develop a decision making model in pilotage operation that merges the abrangency of the Endsley's model and the assertiveness of the Rasmussen's model.

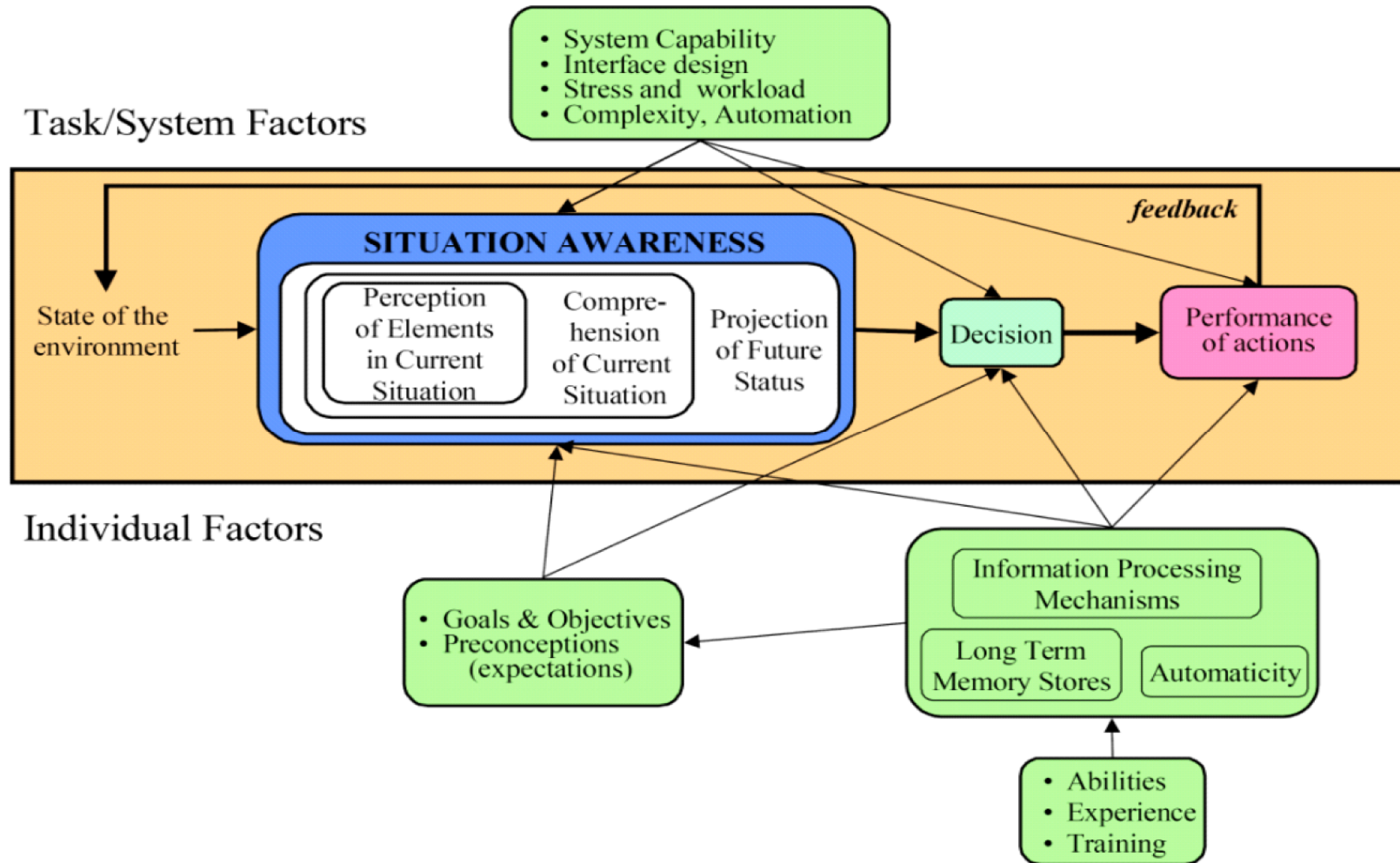
3. Theoretical background

- The design of human decision models is a complex and continuous trend;
- In pilotage, about 30% of incidents and accidents are related to human factors (CENIPA, 2018);
 - Therefore, human factors can affect the pilot performance
 - Under some circumstances, lack of attention, lapses of memory or retard response can be fatal.
- Currently most applied and renown decision-making models:
 - Cognitive Model of Dynamic Decision Making (Mica R. Endsley);
 - Human Behavior Model (Jens Rasmussen).

3. Theoretical background

- Cognitive Model of Dynamic Decision Making (Endsley, 1995):
 - The human process of capturing, understanding and applying response actions is called situation awareness and can be divided in 3 different levels:
 - **Level 1:** Perception of elements in the environment;
 - **Level 2:** Understanding the current situation;
 - **Level 3:** Future status projection.

3. Theoretical background



Cognitive Model of Dynamic Decision Making (Endsley, 1995)

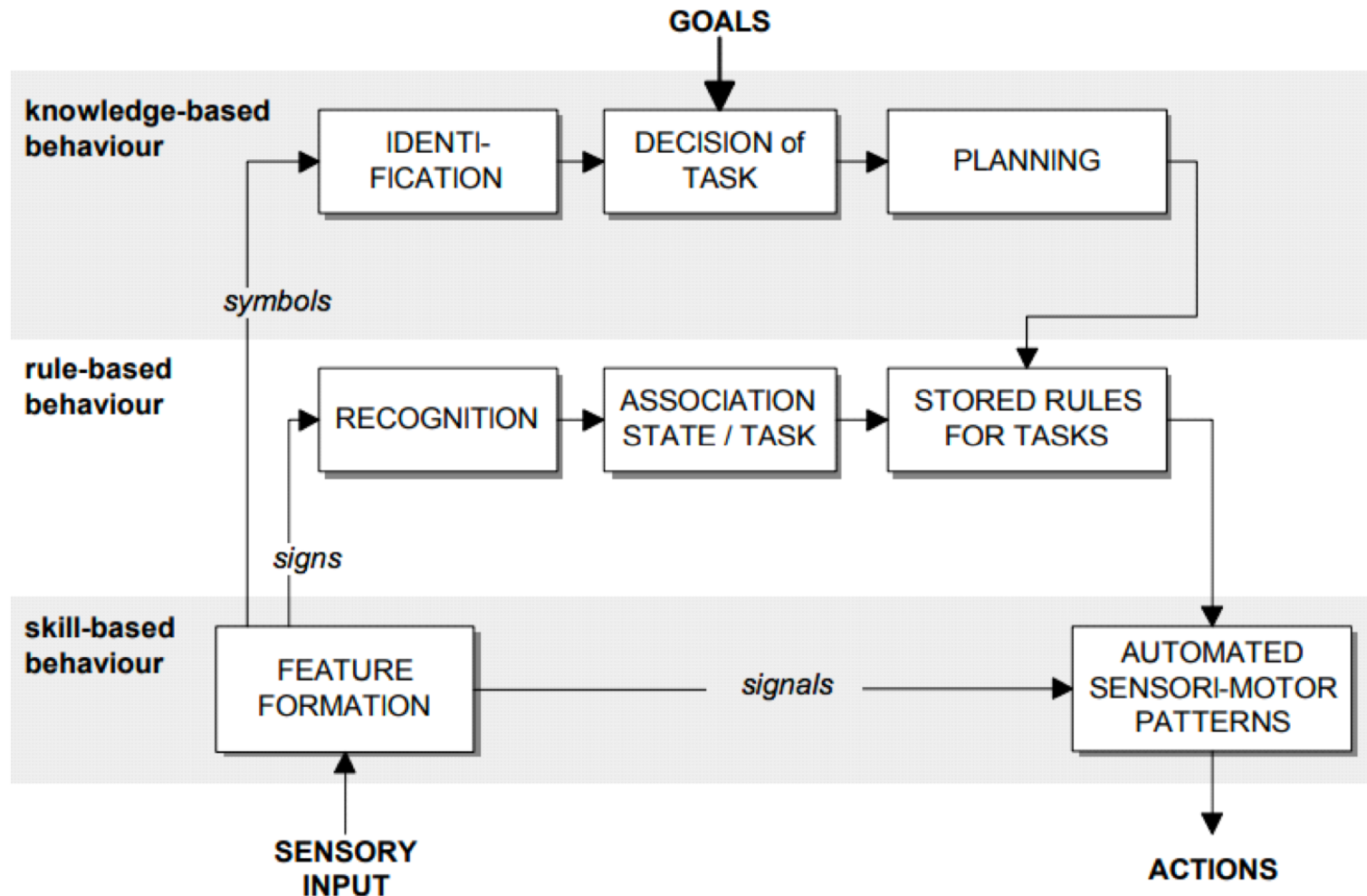
3. Theoretical background

■ **Human Behavior Model (Rasmussen, 1983):**

- Rasmussen model consists of 3 levels of decision:
 - **Level 1 - Skill-based behavior:** Performance is guided by the skill set, patterns and instructions learned over time and stored;
 - **Level 2 - Ruled-based behavior:** Actions or decisions based on established rules e.g. a very well detailed cake recipe.
 - **Level 3 - Knowledge-based behavior:** The unknown. The tasks / challenges a person faces are not part of his/her acquired knowledge. There is no set of known rules and standards. Analytical processes must be applied, which requires time and attention to solve the problems.

Human Decision-Making Model for a Single Pilot Operation

3. Theoretical background



Human Behavior Model (Rasmussen, 1983)

3. Theoretical background

■ **Gap to develop a new decision-making model:**

- Although many authors are researching the influence of human factors in pilot's performance, none of them provide guidelines to replicate their models and verify them experimentally.

■ **Contribution of the Human Decision-Making Model for a Single Pilot:**

It

- captures the most important factors that may affect the pilot performance;
- prescribes guidelines to perform experiments to verify the model;
- presents guidelines to measure each factor of the model.

3. Model Development Process:

■ Methods used:

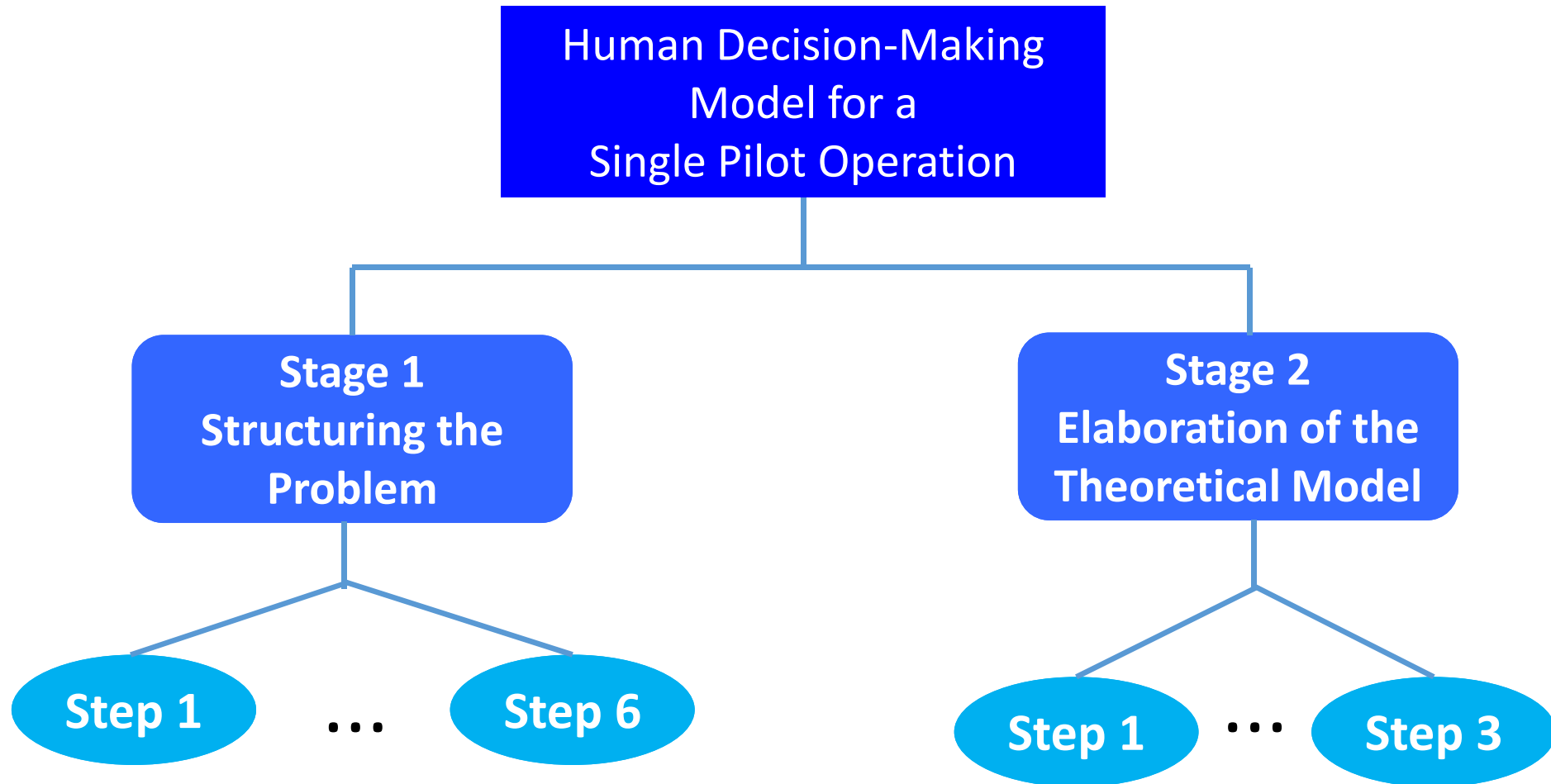
- Analysis and Problem Solving Method - *Método de Análise e Solução de Problemas* (MASP):
 - The method proposes the following order in dealing with problems:
 - **1. Problem:** identify the problem;
 - **2. Note:** analyze the characteristics of the problem;
 - **3. Analysis:** determine the root causes;
 - **4. Action plan:** design a plan to eliminate the causes;
 - **5. Action:** act to eliminate the causes;
 - **6. Verification:** confirm the effectiveness of the action;
 - **7. Standardization:** definitively eliminate the causes;
 - **8. Conclusion:** recapture the activities developed and plan for the future.

3. Model Development Process:

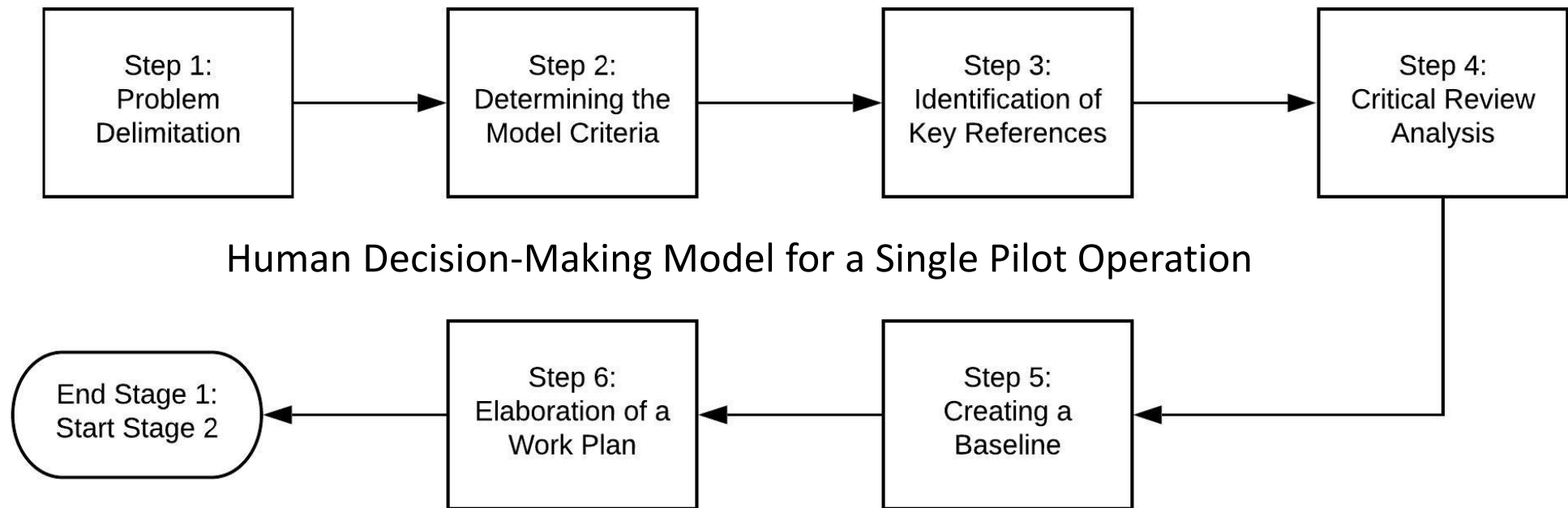
■ Methods used:

- ❑ **Systematic Research:** Analysis of the applicability and continuity of the use of the ideas of these authors even though some are older publications demonstrating that although old are still one of the most commented and their published theories have not been broken.
- ❑ **Bibliometric Research:** Analysis by the number of publications of the authors and the number of citations of authors.
- ❑ **Bibliographic Research:** The study from the papers and works pointed as important by the systematic a bibliometric research.
- ❑ **Consensus:** The group must agree to support a decision in the best interest of the common goal.
- ❑ **Brainstorming:** Technic used to gather a list of spontaneously ideas from the members of the group.
- ❑ **Trade-off analysis:** Situation that involves losing one quality or aspect in return of gaining another.

4. Model Development Process:

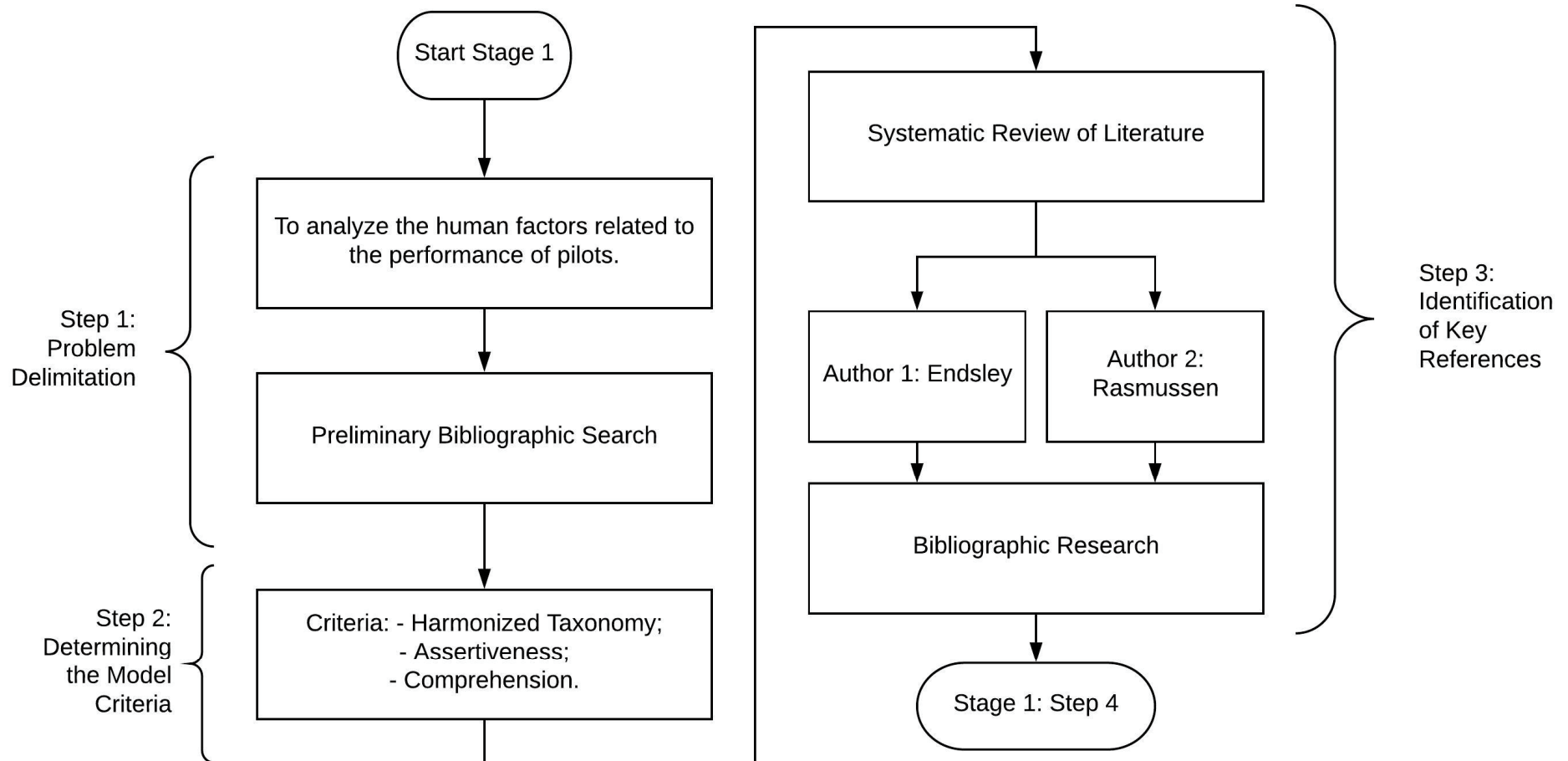


4. Model Development Process:



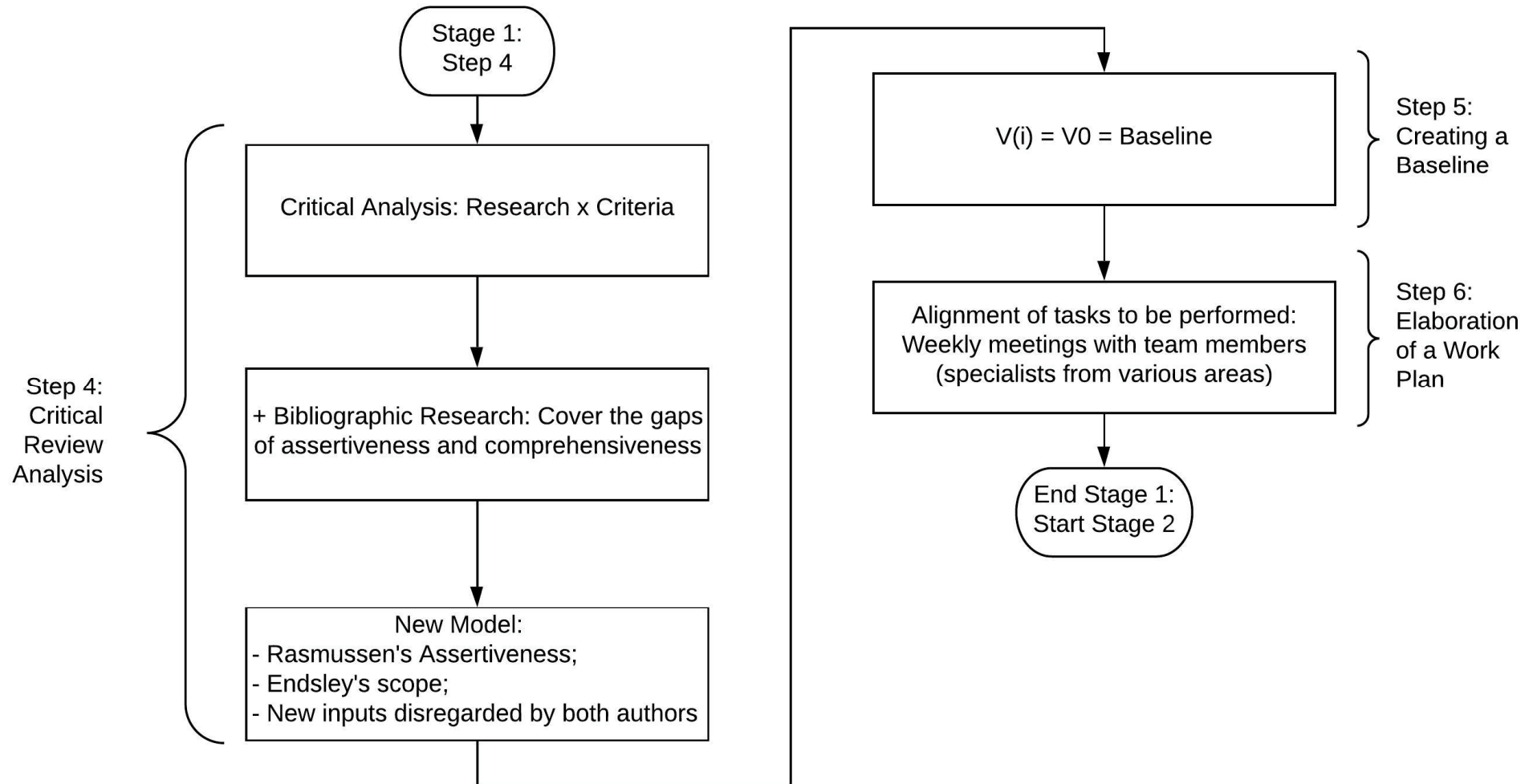
Stage 1 Summary: Structuring the Problem

4. Model Development Process:



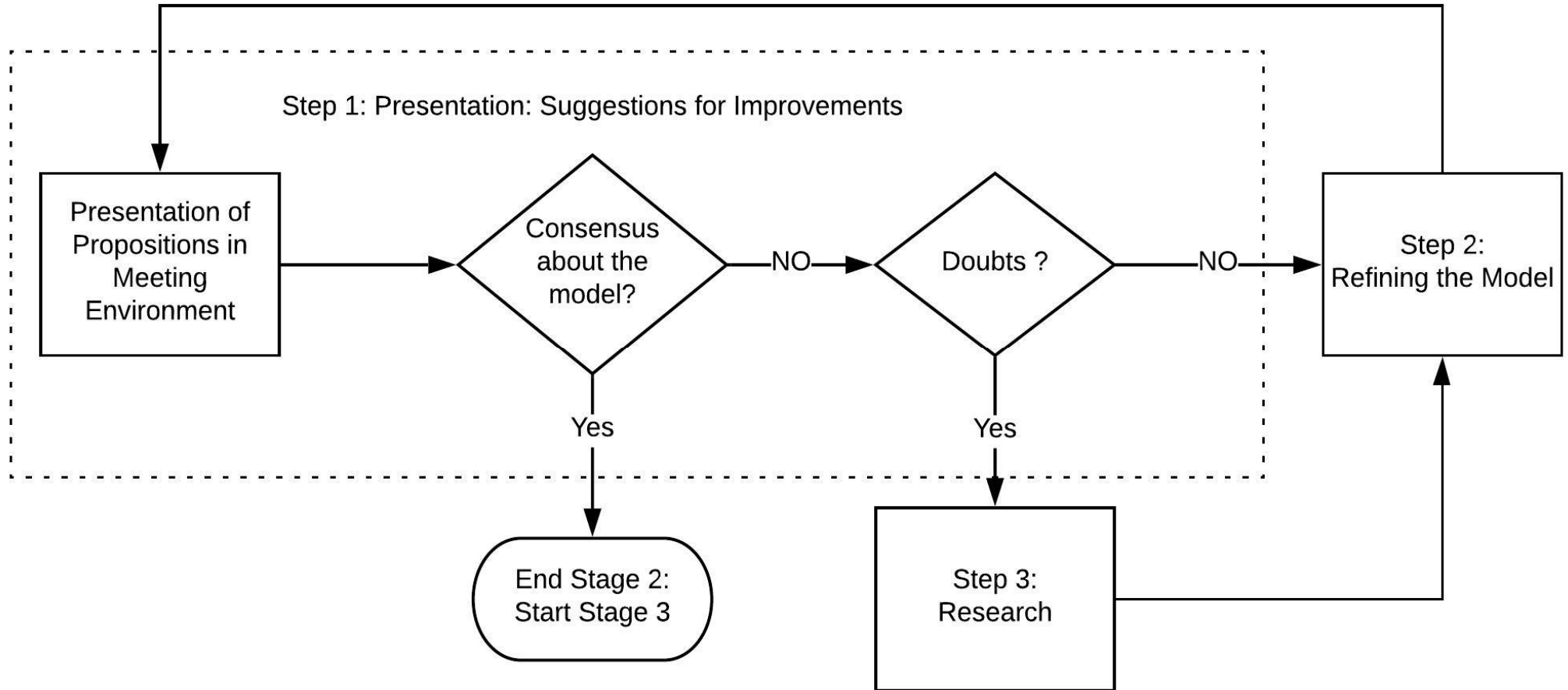
Stage 1: Structuring the Problem - Part I

4. Model Development Process:



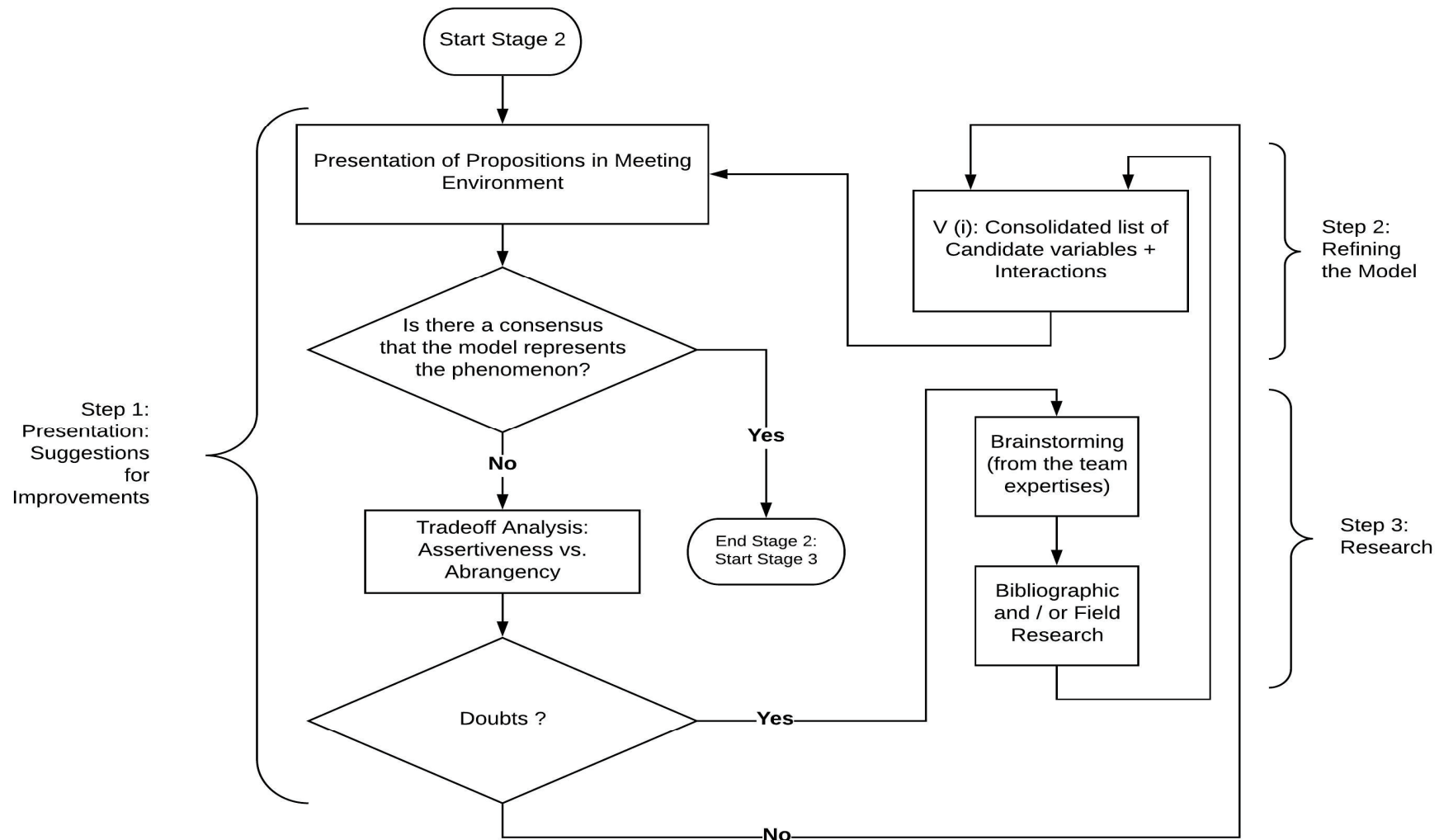
Stage 1: Structuring the Problem - Part II

4. Model Development Process:



Stage 2 Summary: Elaboration of the Theoretical Model

4. Model Development Process:



Stage 2 Summary: Elaboration of the Theoretical Model

5. Results and Discussion

- After 7 months of weekly meetings, the development of a Human Decision-Making Model for a Single Pilot identified 34 variables with 79 causal relations, based upon the contribution of:
 - **Endsley's Model** - Cognitive Model of Dynamic Decision Making;
 - **Rasmussen's Model** - Human Behavior Model;
 - **Multidisciplinary evaluation group:** military pilot, one commercial aircraft pilot, two psychologists, two members of the Brazilian Certification Authority, three professors, four post graduates students and one aircraft manufacturer engineer.

5. Result and Discussion

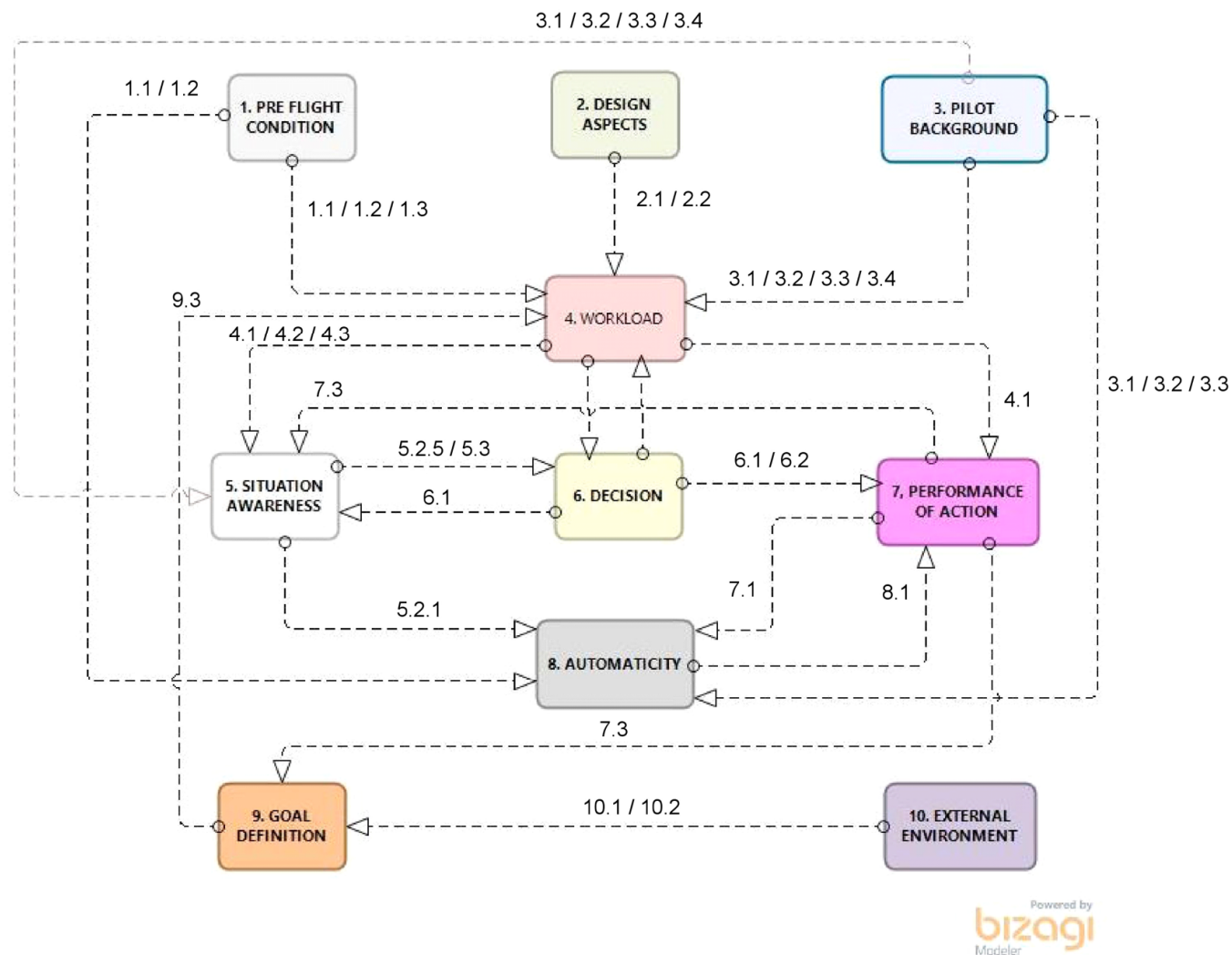


Figure 8 – Human Decision-Making Model for a Single Pilot Summary

5. Results and Discussion

- The Human Decision-Making Model for a Single Pilot is under the process of validation;
- Flight simulation experiments are being carried out to acquire data to validate the model hypothesis.
 - Next steps: possible ways to measure and validate the variables are:
 - Flight data;
 - Monitoring sensores data;
 - Analyst perceptions during simulation;
 - Psicometric's tests;
 - Questionnaires.

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