Decision Making in Maintenance

The decision making process

When analysing the decision making process maintenance personnel go through there appears to be a pervasive, simplistic view that maintenance decision making is merely an element of the “aviation decision making” process. This is true and would be acceptable if the majority of research on aviation decision making did not focus, almost exclusively, on pilot decision making. Understanding maintenance human factors is lagging that of pilots however, there has been greater effort towards researching maintenance human actors. It is entirely appropriate to consider the decision making processes within the context of the aviation decision making process. However, the environment, time constraints and long term implications are key differentiators for maintenance personnel.

For pilots, the underlying issue will normally be resolved, one way or another, by the end of the flight. For maintenance activities, the decision made regarding an issue resolution may have implications for months and even years. This places a different type of pressure on maintainers[i] (Hobbs, 2005).

This article will look at maintenance decision making using three models of decision making;

- Normative,
- Prescriptive, and
- Descriptive.

Normative Model

Under the normative model standards of decision making are defined as being the optimal standards provided that certain axioms are accepted. Decision analysis is based on subjective expected-utility theory. For example, a maintainer is assumed to assess the probabilities and values associated with each possible course of action and then to calculate the expected utility of each option[ii].

Prescriptive Model

Prescriptive models avoid the complexities of normative models by suggesting heuristic (educated guess) methods. Prescriptive models don't promise optimal decision making. The efficacy of the chosen path is not tested and its acceptability rests mostly on face validity rather than on scientific evidence[iii].

Descriptive Model

The descriptive model describes how people normally make decisions. Most routine decision making arises directly from situation awareness, mapping directly to response selection. The maintainer's response will likely be affected by an assessment of the seriousness of the situation as well as evaluations of the individual's ability to meet those demands[iv].

The Maintainers' Model

As with most attempts to neatly capture human behaviour, there is no clear cut answer. The descriptive model would, typically, comprise elements of both the normative and the prescriptive models. The decision making process would evolve over time and be directly affected by an individual's experience both life and work. For example, an apprentice's decision making process would more likely be biased towards the normative model as he would need to consider and assess the value of a number of pathways. Conversely, an experienced maintainer who has been working on the same aircraft type for twenty years would have already experienced many of the diagnostic situations he confronts and would be more likely to rely on an educated guess (prescriptive model).

This tendency to evolve the decision making process is similar for both pilots and maintainers. However, there is a significant difference in the start point of this process. The normative model, whilst providing a more structured approach and thus a greater probability of making a good decision, is however, quite time consuming. The diagnosis of a fault whilst airborne is usually associated with a time-poor situation and thus pilots are more likely to follow the prescriptive model. For maintainers, the emphasis is on making the correct diagnosis and they are more likely to commit more time to finding this answer, thus emphasising the normative model.

What needs to be done?

The emphasis on providing decision making training for maintainers is not as advanced as it is for pilots. However, there are many examples and findings as to why a greater level of training should be provided. The Baker Report, a report on the catastrophic accident at a BP oil refinery in Texas, identified that the company had not ensured an appropriate level of process safety awareness, knowledge, and competence in the organization relating to its refineries. Specifically, the company had not effectively ensured that its refinery personnel and contractors had sufficient process safety knowledge and competence. The information that the Panel reviewed indicated that process safety education and training needed to be more rigorous, comprehensive, and integrated. Further, the Panel found that at most refineries, the implementation of and over-reliance on computer based training contributed to inadequate process safety training of refinery employees[v].

Regulators have attempted to implement a higher level of human factor awareness for maintainers but, despite this, the human factor awareness and understanding for most maintainers is a considerable level lower than that of pilots.

Decision Making Training

As previously described in the training process, the decision making process for maintainers is founded in the adherence to established procedures. It is very much oriented towards regulatory compliance.

> *This difference with pilots was highlighted by a study of aircraft logbooks. Pilots noted that the primary use of the logbook was to* ***impart knowledge to maintenance, other flight crew and the company, in that order****. Maintainers stated that their entries were primarily to* ***address regulatory compliance*** *with a* ***secondary function of advising pilots and other maintainers.*** *Maintainers regularly sought additional information to further describe the problem*[vi].

Pilots are provided with a range of mental tools through their training with which to approach a situation and make a decision. Their decision is likely to be prescriptive due to the typical time constraints. The correctness, or otherwise, of their decision will typically be determined at the completion of their flight.

On the other hand, maintainers have, traditionally, not been provided with enhanced decision making awareness tools through their training. Their training is based on a rule-based approach. Their decisions are likely to be more normative than

prescriptive and the correctness, or otherwise, of their decision may last for multiple flights over a number of years.

Conclusion

In the aviation environment the importance of accurate decision making and reduced errors and violations is well recognised. It is highly desirable to ensure that maintainers are more equipped to make decisions and to recognise errors. Organisations should embrace the push to improve human factors training to enhancing the collective, aviation, decision making process.

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[i] Hobbs, A 2005, *HES6605 Human factors in maintenance: Subject module,* Swinburne University of Technology, Hawthorn.
[ii] O'Hare, D 1992, The "artful" decision maker: a framework model for aeronautical decision making, *The International Journal of Aviation Psychology* (1992), 2(3), pp 175-191.
[iii] ibid
[iv] ibid
[v] BP U.S. Refineries Independent Safety Review Panel, 2007, *The Report of the BP U.S. Refineries Independent Safety Review Panel (The Baker report),* January 2007.
[vi] Munro, P, Kanki, B & Jordan, K 2004, *Reporting discrepancies: an assessment of the informational needs of airline pilots and mechanics,* Paper presented at Safety Across High-Consequence Industries Conference, St Louis, Missouri, March 9 and 10, 2004.