FIDES as decision maker for critical systems

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***Abstract*—This document presents a fast abstract about the usage of FIDES at GMV as a decision maker for critical systems.**

Keywords—FIDES, safety critical, reliability estimation

I. INTRODUCTION

Reliability prediction is a key activity in high reliability systems, such as space or aeronautical safety critical systems. They require a reliability behaviour characterization before the system is put into operation and the achievement of reliability targets must be acknowledged during operation. However, reliability evaluation is a very complex task because it involves many factors which may not be defined at early stages of the lifecycle.

II. RELIABILITY ESTIMATION METHODS

Different methodologies have been developed for reliability prediction. Depending on specific characteristics of the system, some methodologies are more suitable for each case. There are some well-known data sources and methodologies that traditionally have been used for the reliability prediction of systems, like MIL-HB-217 [1], Telcordia SR-332 [2] or RCM [3] used for electronic components.

In order to select the most appropriate methodology some relevant factors shall be considered as, for instance, project requirements, availability of manufacturer and user data, quality of data, international recognition of the methodology or how broadly it is used by the industry. A good methodology for reliability prediction shall cover, at least, following issues:

- It shall offer a realistic assessment of different factors affecting reliability, like different operating conditions and system's item level.
- It shall consider the impact of the quality of development and operation processes.
- Data used shall be updated and be appropriate for new technologies.
- It shall allow continuous improvement and control of reliability through the system lifecycle.

One of the methodologies that cover the issues mentioned above is FIDES [4]. This recent standard was developed by the European aeronautical industry and first published on 2004.

III. FIDES MAIN FEATURES

FIDES estimates the failure rates based on the principle of physics of failures and it is supported by analyses of test data, feedback from operations and existing models. It takes into account a set of parameters derived not only from technology characteristics but also from specific processes (design, manufacturing, quality…) and expected usage. This method considers that failures are very largely the consequence of life situations encountered by the product. These capabilities offer visibility on the reliability behaviour during the whole development life cycle.

In particular, FIDES considers the contribution of three main factors, as it is depicted in Fig.1:

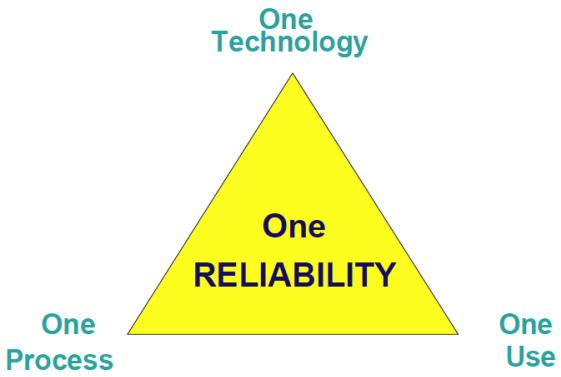

Fig. 1. FIDES Reliability concept

- Technology covers the technology for the item itself and also for its integration into the higher level product.
- Process considers all practices and the state of the art established from the product specification until end of service.

- Use takes into account the constraints defined by the product design and by operation at the final operational environment.

FIDES considers a Technology faced with Usage constraints based on a failure mechanism approach and the associated contributing factors. Those particularly balance the risk of failure by all Process contributing factors that can activate, accelerate or reduce these mechanisms.

IV. USE OF FIDES

Following FIDES guide, GMV has determined the reliability characterization of an aeronautical system considering the whole lifecycle, from the technologies that were used in each component of the system to the quality process, as well as the additional stress suffered by the system in operations.

Our proposal consists in using the standard, not only to estimate the MTBF, but also to develop a reliability programme where the system reliability characterization is reviewed and refined at each phase of the system life cycle. This is especially important in projects where the system requirements cannot be completely specified at the beginning or they evolve iteratively with the design of the system. This methodology is defined in following steps:

- Estimate system MTBF during early phases.
- Detect main contributing factors to MTBF.
- Chose improvement actions with a high benefit-cost ratio to optimize relevant factors.
- Reassess reliability estimation
- Iterate along the whole lifecycle to include more detailed definition of system, environment and process.

GMV has incorporated FIDES methodology for reliability estimation. In particular, it has been used for the development of a critical airborne electronic control unit. MTBF was estimated considering the operational profile, the specific technologies used, as well as the processes involved in the development.

Thanks to the better visibility of the main contributing factors to failure, several mitigation measures have been implemented. Most relevant actions were focused on humidity and thermal control.

Following this methodology, the reliability characterization based on FIDES provides additional information with regards to the identification and control of factors influencing reliability. This allows the evaluation of a cost-benefit trade-off regarding reliability.

Operational environmental conditions do affect reliability. Influence can be evaluated with FIDES methodology and variations of reliability figures can be estimated. For example, a high relative humidity affects electronic components, leading to a shortening of product lifespan. Although atmosphere control may involve a significant cost, such countermeasures could be justified by a reliability of the product in this case.

In addition to this, reliability is sensitive to technology characteristics. A modification of any of the involved factors impacts on reliability and this shall be considered during development.

To summarize, a detailed evaluation at each phase of life cycle of all factors affecting reliability is an adequate strategy to ensure a cost efficient reliable product.

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