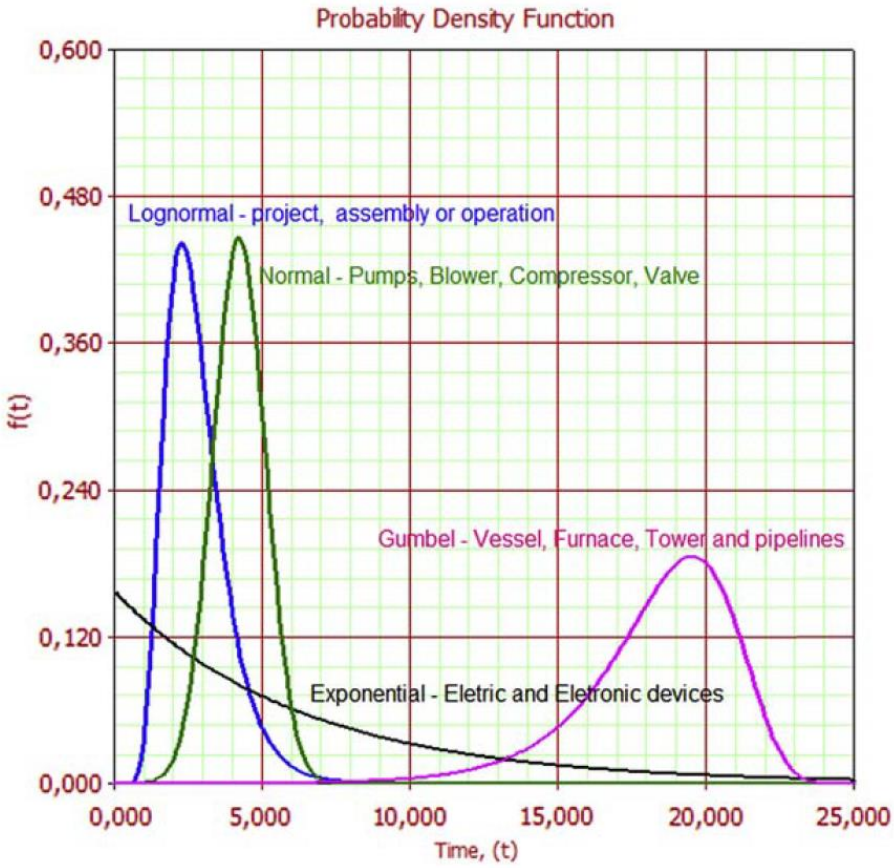
Reliable Reliability and Maintainability Database: The database approach using Weibull 2p for reliability PDF and Normal for maintainability PDF.

One of the big challenges to perform reliability analysis and define reliability performance indexes in equipment and component level is the lack of historical data or even a lack or reliable database as reference.

In the last decades, the process industry such as Oil and Gas, petrochemical and Chemical has been using generic reliability database as input to their reliability and maintenance as well as safety study such as OREDA, AIChE and others.

Despite of very high effort to create such database, it´s necessary to consider the different pattern of failure along time that is represented by different probability density functions (PDF) for rotating, static, electric and electronic equipment.



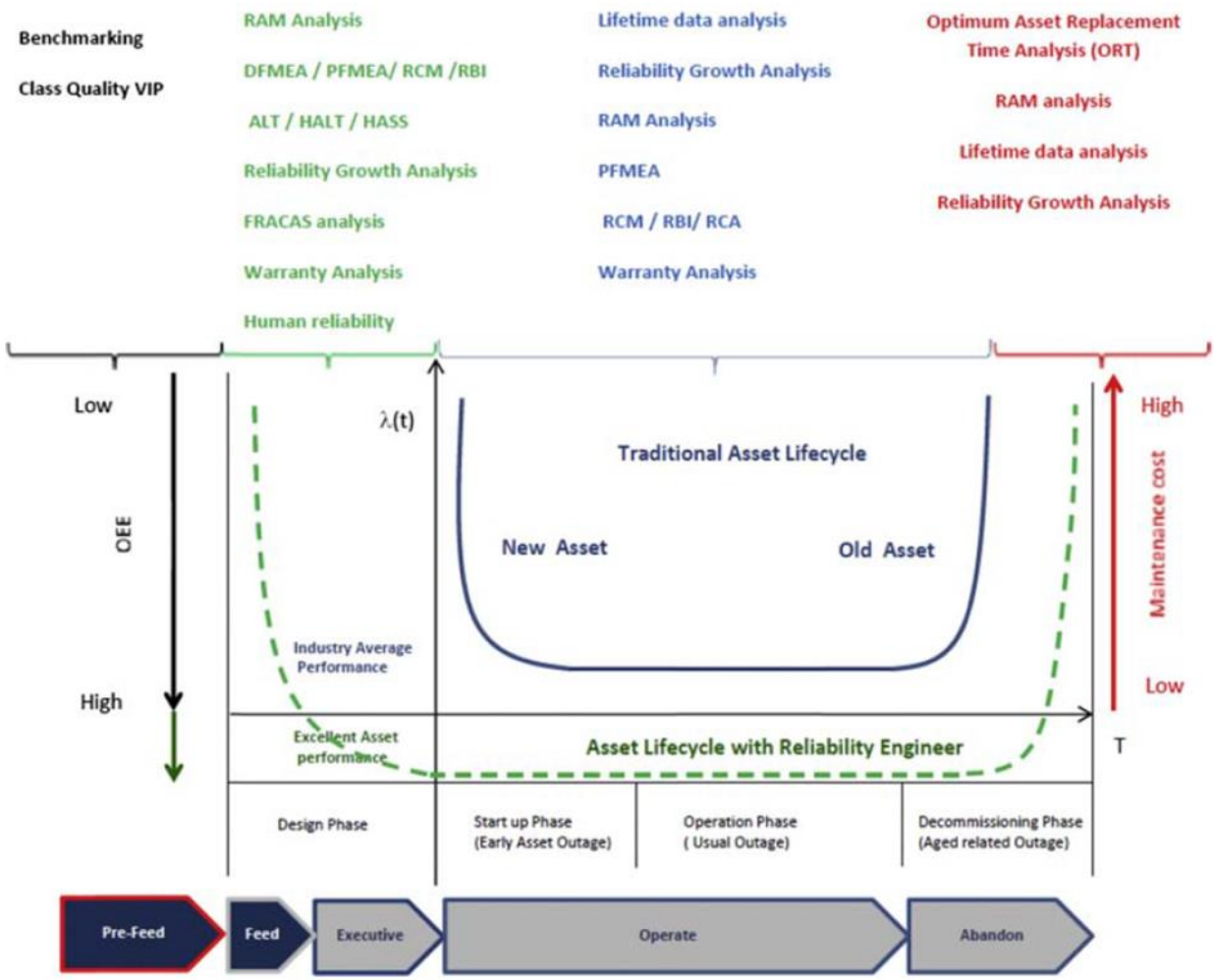
Unfortunately, most of databases developed so far consider the exponential PDF by using MTTF and constant failure rates for all type of equipment. Under such assumption, poses the limitation of random failures and not represent the wear out phase, very characteristic of rotating and static equipment/component.

Another limitation to consider the exponential PDF by using MTTF and constant failure rate is that such approach does not enable to account the positive effect of preventive maintenance and inspection in the reliability by re-establishing the reliability of the state as good as new after repair. The reestablishment of the reliability of the state “as good as new” is possible by

using Weibull 2p, that has the shape of Normal or Gumbel PDF considering the increasing failure rate, or in other words, the wear out phase (β≥2,5). The reliability reestablishment to the state "as good as new" can be proved and demonstrated by using models such as RBD in the RAM analysis.

Therefore, the necessity of a reliability database that consider the real pattern of failure of each different equipment is very necessary. The Weibull 2p, is the generic PDF that represents all pattern of failure occurrence along the time such as early life, useful life and wear out phase by representing the different PDF and failure rate shapes such as Lognormal, Exponential, Normal and Gumbel.

However, the important aspect of the reliability databases is to not consider the early life failures to predict the Weibull PDF parameters as demonstrated by the green failure rate function in the figure below. In fact, the high-performance equipment, that are defined in reliability and maintainability database, has no early life failure, that are triggered by human error during the design, commissioning or operation.



Another important aspect of database is the Maintainability PDF, that must to consider all the downtime caused by the equipment failure or intervention and not only the repair/replace time as defined in many generic databases. If only the repair time is considered, the impact of

operational availability prediction will be lower than expected, given a false optimistic maintainability and operational availability prediction.

Another aspect concerning the maintainability defined in most of data basis so far is to assume random time to repair/ replace equipment or even represent the repair /replace time by lognormal PDF. In fact, on most of industries nowadays, including Oil and Gas, Petrochemical and Chemical, the repair/replace tasks taken place under very good condition, including procedure, training and supervision. The human error still occurs, but in very low number. Therefore, the Maintainability PDF must be represented by a normal PDF in the database.

The final aspect to discuss about the reliability and maintainability database is how representative such database is for different operation conditions in different regions in he globe. In fact, the important aspect is the equipment/component maximum and minimum value of reliability and maintainability PDF´s parameters that enable different process plants, under different operating condition located in different regions to achieve higher performance.

Despite of many engineers believe that the worse reliability performance is associated with the hardest operation condition, by the reliability engineering point of view, the reliability, minimum target is established for each equipment/component to enable the plant achieve its high performance (98%-99% in 5 years for example).

The vendors, who design such equipment/component, need to design the equipment robust and reliable enough to achieve the minimum reliability target for a specific period under their client operation conditions. In order to do that, the vendors need to implement the reliability program since the concept phase considering the design for reliability approach that consider methods such as ALT, HALT, HASS, RGA, LDA, RAM and DFMEA.