Availability Analysis

What is it?

Availability of a component is defined as the proportion of time that it is able to produce or deliver its required function within specified conditions. It can be assessed using the item's uptime, otherwise known as Mean Time Between Failure (MTBF), and its downtime, otherwise known as Mean Time To Repair (MTTR), as per the following formula:

$$Availability\ (\%) = \frac{uptime}{(uptime\ +\ downtime)} = \frac{MTBF}{(MTBF\ +\ MTTR)}$$

As can be seen, a component's availability can be improved by either improving reliability (increasing the uptime), improving maintainability (reducing the downtime), or both. At a system level, there are additional methods of improving availability, such as adding redundancy of key constituent components and introducing standby systems. Availability analysis involves understanding the failure modes of the component or system and determining the effect that each has on reliability and/or maintainability. It can be performed using similar techniques to those used to assess reliability, e.g. reliability block diagrams, fault tree analysis. For complex systems, with multiple inputs, simulation software is often employed, using the reliability model as a starting point.

Why is it important?

Availability analysis informs system optimisation and can aid managers in achieving high levels of performance at reduced cost. It can be used throughout the system's lifecycle aiding in decisions about upgrades and replacement programmes based on current system performance.

Availability Analysis is recognised as an essential part of best practice in understanding the operation of engineered systems. This is true across different industries, which each work to recognised standards. For example; EN-50126 in Rail, ISO 20815 in the Petrochemical industry, and DEF STAN 00-42 in Defence.

Availability analysis is used throughout the lifecycle of a project. For example, during the definition stages of a project, availability analysis can be used to assess the different design options. As the design develops it can also be used to assess different maintenance options and inform estimates of life cycle costs. As the design progresses further, availability analysis can also be used to confirm that the requirements placed on a new item as part of its specification can be met. Similarly, in a system where the availability requirements have been allocated to sub-systems, or components, availability analysis can be used to ensure that the lower-level requirements have been met.

What we do

CRA has extensive experience of developing reliability models for complex systems. These models can be used in conjunction with maintainability data to perform availability analysis.

CRA staff are experienced and trained in the use of simulation software for availability analysis (such as Isograph's Availability Workbench). The end goal of availability analysis is the interpretation of results to give meaningful insights about clients' operations, and CRA never loses sight of this aim.

Our work

CRA can undertake an individual availability assessment, or integrate it into an overall life cycle cost estimate. Our previous experience includes:

- CRA has carried out many availability analysis studies for nuclear power stations using the existing reliability models and inputting maintenance data based on previous operating experience. In a number of cases, this analysis has been extended to assess the effect on system availabilities of applying the most severe permissible maintenance configurations based on the station's operating rules;
- Channel Tunnel Rail Link (CTRL) - Monitored RAMS activities for the Mechanical and Electrical contract on the CTRL Project to assess the adequacy of engineering safety management processes and emerging documents (incl. Contractors' Safety Case documentation);
- Performed a case study investigating the effects of different plant configurations on the availability of a cooling water system. Lifecycle costs were also estimated based on this analysis;
- Independent Verification of RAMS activities for a Mechanised Track Patrol Vehicle (MTPV).