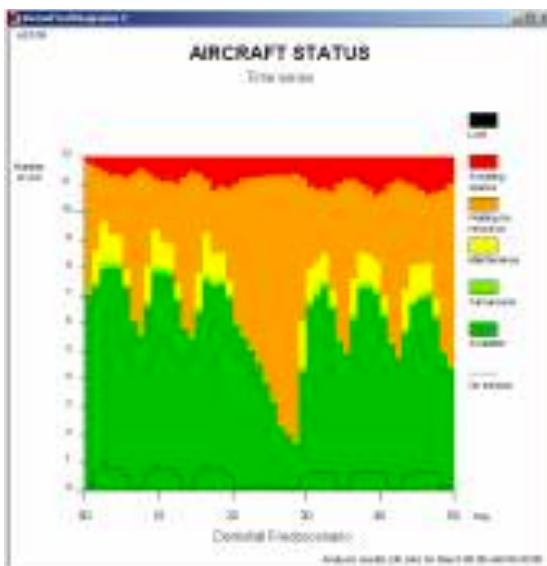


RELIABILITY ANALYSIS

One of our top competences, where we have both deep and long experience, is analyses in connection to reliability issues. At the same time it is hard for us to separate this field from another one of our targeted competences – improvement and optimisation of maintenance activities. Operational Reliability – at maximal or wished for level – is an objective and result that one wants to attain. Maintenance – and the organisation as well as the resources needed – is one of the most important means to ensure a high reliability. For obvious reasons, it is hard to analyse the end without considering the means at hand to reach it!

These types of issues can be found in most businesses and enterprises – in the industry, defence or transportation sectors this is obvious. In all cases these are examples of activities that depend upon machinery, vehicles or other automation. If one ponders over the question a bit more, one realises that this also applies to other environments, since the computer today – and the problems that pop up as a result of it not behaving as reliably as we could wish! – is either present or indirectly affects the work of the most of us. And to be honest, haven't we all cursed once or twice at home, when the home PC, car, refrigerator, washing machine, or boiler behaves in a way that does not coincide with our own master plan!

Availability



A concept often used when working with these issues is Availability. This aims to mirror the extent to which the machine or system in question is in operation at the wished-for level – or at least operative enough to be in operation! The issue is purer and more easily handled when one is dealing with a two-state situation – Off or On. It gets further complicated by situations where the studied system can operate at various levels (variable speed, ...).

When referring to something as 'Availability', it is important to be aware of that the concept represents

different things depending on who you talk with and what type of business/ enterprise/operation you are studying. In this text, we try to encompass several of these viewpoints.

Availability can be expressed in various ways, e.g.:

- As a percentage (92.4% availability)
- As time (available 32 hours of the week)
- As a quantity (15 of our 17 vehicles are available)

It is important to remember though, that during the analysis one tends to focus on the Unavailability rather than its opposite! When the system/machine is available, everything is nice and under control. It is in the alternative scenario that there is something to accomplish and a potential for improvements. Therefore the unavailability is usually divided in various sub states, based on what has caused the operational disturbance.

An entity that often is studied when working with availability is what usually is called Utilisation. In this case also, the unutilised time is split into several categories depending on the reason for the non-usage. As with availability, this gets more complex if there is a possibility to utilise "partly" or to a certain degree, with various tasks or with different hourly fees (as e.g. can be the case for consultants).

When you at the same time study utilisation and availability, it can be established that if a single machine or vehicle is considered, unavailability might cause unutilisation – but not the other way around. Utilisation is seldom used as a measurement for a whole system, but focuses rather on a specific task to be done (where a clear option is that several similar units can handle this task). Availability on the other hand, can be used to describe how much you "get out" from for example a production system, in relation to the maximum capacity. More about considerations like these under the next headline.

Different types of operational reliability analyses

A reliability analysis can mean anything from a deep penetration into the details of the studied system to a more general and all-embracing survey of a whole organisation. Some examples, where we work with and have worked with all variants, follow:

1. When you have a complex construction, where the vehicle's or machine's operational reliability depends upon all the included components and parts (where each and everyone has its own reliability characteristics), advanced analyses can sometimes be necessary to study the expected availability of the whole construction.

2. When several machines are connected (physically and/or through a process of some kind), sometimes together with manual labour, into a system, it can be of interest to study the total availability of the system. Here other degrees of freedom are introduced and the focus moves from the construction of the product (machine, vehicle, ...) to the design of the system or process. Added to the more technical aspects, we now must consider organisation and work schedule (if there are manual components), movements between the various units of the system, intermediate storage and so on.
3. On the most general level, one can study the ability of a whole organisation to deliver or produce. Now the focus is rather on the whole business than on a unique unit or a specific system. The maintenance organisation is for obvious reasons considered (both from a preventive and corrective point of view) but also the logistics, the inventory and stock strategy concerning replacement units and components to get the system operational, what manning choices one has made, and where other important activities are situated.

In all these contexts, we are happy to contribute in the discussions and with suggestions, when it comes to improving the operational reliability – so long that this is possible! Related issues can be found under Maintenance optimisation.

Tools to conduct the analyses

Operational disturbances are more or less per definition unexpected. Even though one knows that they will appear, it can not be said when they will appear. Usually one has some kind of grip of the total amount of unavailability caused by operational disturbances over a longer period of time – expressed in time units or number of occurrences or both. Concepts like MTBF (Mean Time Between Failure), MTTR (Mean Time To Repair), MDT (Mean Down Time) and several others are often used here.

Through their unpredictability, the operational disturbances must be described stochastically and this random behaviour must be possible to analyse. This can sometimes be accomplished by using mathematical probability distributions and then apply established methods to analyse the issue under consideration. Another way forward is to use equivalent probability distributions as input to a simulation model, where the model lets the stochastic behaviour (defined by the distribution) generate the operational disturbances. Due to the complexity that often is characteristic for issues like these, our experience is that Simulation is often the best choice of method.

Independent of whether we discuss simulation or another way to tackle the problem, the methods we use are to a large extent found in the competence field called Operations research.

The operational reliability dimension in the procurement process

When discussing operational reliability and availability, one often automatically presupposes that one is considering a point in time when the system under consideration is operational (or at least should be, in situations when there is an operational disturbance!), the operative phase. There are a lot of reasons to broaden ones way of thinking though!

At least when major investments are under consideration, that will affect both the cash flow and the rest of the business, the expected future operational reliability should be put on the table already when negotiating with potential suppliers. It ought to affect the alternative chosen, as one of several aspects that are weighed into the final decision – and this is of course obvious if one thinks in terms of LCC (Life Cycle Cost).

Actual expected/guaranteed reliability should be considered, as well as how the suppliers plans to solve spare parts issues (and the lead time that will be relevant in this case), as well as what maintenance organisation that has to be established to secure the wished-for level of reliability, and much more. There are also strong reasons to ensure that 'availability' is used as a performance indicator (where one carefully should consider how it is defined) in the legal contracts and is related to guarantees, penalty fees etc.

One way to summarise the logic behind this early focus on questions like these, is to claim that one prefers to be proactive rather than reactive. Operational disturbances and unavailability should not be considered a necessary evil that is to be handled when it appears. It is very much possible to influence, prevent and decrease the extent of these negative happenings. The earlier this is addressed, the better!

These types of issues are also something that we in Trilogik work with and have worked with – and would happily assist with if there is an interest!

