# PAM Asset Survival Models Module

## Introduction

The Asset Survival Models module develops the predictive asset survival models that are at the centre of **PAM**. They are based on the Cox proportional hazards model (see the appendix in *Introduction to PAM* in PAM Introduction) and establish the factors that contribute to asset failure, so providing insight into and understanding of asset failure. The models are used in the Predicted Maintenance Interventions and Asset Survival Simulations modules.

## The Asset Survival Model

The input data to the module is the output file from the Time to Failure Transformations module and other data. The output from the module is the asset survival model, and the cumulative hazard, i.e. the expected number of failures if failures are repeatable, and survival probability, i.e. the probability that the asset will survive to at least that time, for each asset. (Cumulative hazard and survival probability have an inverse relationship.)

There is one asset survival model for each functional equipment class or similar asset classification variable. The models have two types of predictor variable: static factors and dynamic factors.

- Static factors do not change over time, for example the assets' manufacturers and design specifications. They can be controlled at the tactical level.
- Dynamic factors describe the assets' dynamic maintenance and failure histories. They can be controlled at the operational level to improve the assets' day-to-day reliability.

## The Asset Survival Model in PAM and Current Asset Management Systems

Current asset management systems model the risk of asset failure as a static phenomenon. In contrast, **PAM** models it as a dynamic phenomenon that is determined by the assets' maintenance and failure histories, and other data. By using each asset's maintenance and failure histories in the survival models, **PAM** models each asset as a unique and distinct entity with its own risk of failure profile rather than as a member of a group that share common values for the predictors, for example manufacturer, and therefore the same risk of failure profile with respect to the common values of the predictors. Thus, the

 

dynamic asset survival models in **PAM** provide much greater insight and understanding of how each predictor affects the performance of individual assets.

## The Effects of the Most Recent Intervention

The module can also be used to compare the effects of different types of the most recent intervention on the cumulative hazard. Figure 1 shows this variation for 2,250 pumps in waste water pumping stations in 800 locations based on 12 years of maintenance and failure data. Terminal and non-terminal interventions are defined and described in *Time to Transformations Module* in PAM Modules.

**Figure 1**

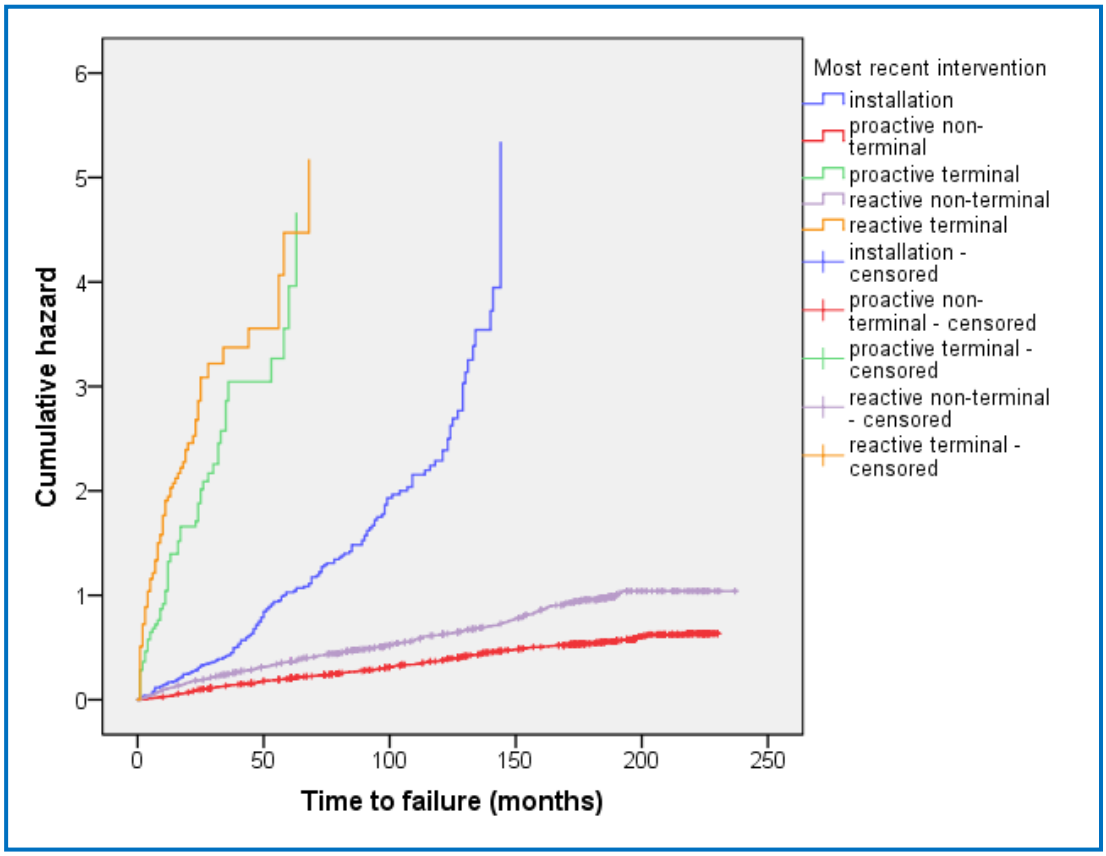


Figure 1 shows that the cumulative hazard is greatest after reactive terminal interventions **(orange curve)** and smallest after proactive non-terminal interventions **(red curve)** at all times to failure. It is interesting to note that installation **(blue curve)** separates the terminal interventions from the non-terminal interventions equally. The figure also shows that non-terminal interventions (below the installation curve) reduce the cumulative hazard more than terminal interventions (above the installation curve).

 