The difficulty in designing control charts
with estimated parameters

The performance of control charts, such as the Shewart $\bar{X}$ control chart, with estimated in-control parameters has been widely discussed in the literature. Previous studies showed, for example, that at least $400/(n - 1)$ Phase I samples, where $n > 1$ is the sample size, are required so that the $\bar{X}$-chart performs on average as if the in-control process parameter values were known. This recommendation was based on the in-control expected average run length (ARL) performance. The reliance on the expected ARL metric, however, neglects the practitioner-to-practitioner variability. This variability occurs due to the different historical data sets practitioners use, which results in varying parameter estimates, control limits, and in-control ARL values.

In this presentation, it is shown that taking this additional type of variability into consideration leads to much larger Phase I samples, far beyond what many previous researchers have recommended, in order to have low levels of variation of in-control performance among practitioners. The standard deviation of the ARL (SDARL) metric is used to evaluate performance for various amounts of Phase I data. Surprisingly, we show that for a variety of charts no realistic Phase I sample size is sufficient to have confidence that the attained in-control performance is close to that desired. These results have significant implications on the relationship between process monitoring theory and practice. An alternative approach is presented for designing control charts.

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Rue Louvrex 14, 4000 Liège

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Short biography