**Case #1 – Processing - Screen overload**

Background:An overloaded or unevenly loaded screen can have several disadvantages. Sieve performance can be reduced, machine parts can be overloaded, and the vibration condition can be affected, possibly increasing the overload.

Solution:

* Vibration data from acceleration sensor
* Mass flow from scale
* Particle size distribution at upper deck from measurement
* (Particle size distribution at screen inlet)\*

An overload can be measured in the form of a reduction in vibration amplitude or a change in vibration frequency. An unevenly loaded screen can be detected by parasitic vibrations compared to the usual vibration data. Another possibility is to evaluate the mass flow into or out of the screen, as well as the particle size distribution on the top deck, which contains too much fines (compared to the inlet)\*. In case of overloading, the vibration frequency could be increased and the mass flow reduced while sending a warning to SCADA. In the case of an unevenly loaded screen, the measures described are unlikely to help, so only a warning should be sent to allow the operator to search for the cause of the problem.

A digital twin with simulated or trained data can replace expensive sensors and measure the missing data in the digital twin (e.g., calculate the mass on the screen from the vibration data or estimate the outlet PSD from the vibration data and input material). Countermeasures for the overload can also be weighed by a digital twin to solve the problem as quickly and efficiently as possible.

**Case #2 – Processing - Sustainability**

Background: Operators want to run equipment as efficient as possible, meaning less energy consumption, less water consumption and meeting the production target (quality and throughput) at the same time.

Solution:

* Power consumption data
* Throughput data
* Flowsheet data/ recirculation data (HPGR-specific)
* Particle size distribution (input/ output)

With regards to sustainability and efficiency, one example is the calculation of the specific energy in kW/t which indicates the energy efficiency. Equipment specific, the efficiency can also be related to water consumption or wear reduction. Not all required parameters are always logged by the equipment and/or SCADA itself to grant optimal conditions. Compensation can either be achieved by gathering missing data via connection to DCS, alternatively digital twins can be utilized for compensation of missing values as well.

A digital twin with simulated or trained data can replace expensive sensors and measure the missing data digitally (e.g., calculate the throughput and or PSD at the outlet). Based on historical data alterations to process parameters can be recommended to the operator/ changed automatically.

**Case #3 – Replacement of sub modules / Interchangeability**