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What are your expected benefits of using digital substation concepts and how to measure if the benefits can be realized?

B5-10641: The large-scale deployment for fully digital substations based on IEC 61850 is based on the following benefits. Note that each of these items is constantly being re-evaluated and improved for optimum delivery and operation.

#1 Carbon footprint:
By going digital the TOTEX investment costs can be reduced as the digital equipment require less floor space so the housing space can be reduced which also lower the operation cost of the buildings, e.g. with less heating needed. Analysis have also shown that digital substation needs around 80% less copper, and there is still room for improvements, e.g. with improved LCC design. With less material and equipment, the gas and oil needed for travel and transport is therefore reduced.

#2 Safety:
Personal safety is improved with less hazardous voltage and current circuits present in the substation cubicles, and with close to none interpanel wiring, except communications on fiber optics. A more holistic testing of the control and protection systems can be tested purely based on IEC 61850 digital data. A better tested system will be safer both during Factory Acceptance Test (FAT), Site Acceptance Test (SAT), Commissioning Test and after the substation has been put into operation.

#3 Flexibility:
Digitalisation of the substations allow for more flexibility in integrating different kind of technology, e.g. smart-grid development and further enhanced protection and control. Such smart-grid application include Wide-Area-Control, which have been presented in previous CIGRE Paris sessions [C2_123_2018 , C2_142_2020]. Those papers have shown that operation and stability of the transmission system in Iceland has been improved with the introduction of smart-grids.
The digital substation concept is also brilliant for retrofit projects, where complex and distributed legacy systems can be significantly improved during refurbishment, where the complete C&P system can be fully tested off-site and the outage-time onsite can then be minimized.

#4 Utilities own specifications:
The digitalization journey has driven Landsnet as utility to write its own requirements, specifications, and implementation guidelines. This process has guaranteed uniformity in substation design, and it optimizes the process during design phase. This is vital for the large-scale deployment of digital substations. These documents and processes are under constant improvements to achieve greater efficiency and better design. The progress in time and effort is constantly improving from project to project.

#5 Time:
Time is one of our most valuable resource, and it is important to make the best of the time we have. The specifications mention in previous topic is important to be able to build and refurbish substation in less time. The digital substation concept with IEC 61850 also allows for more system-based testing. The testing process has also become more automated than before to save time for during all phases of the projects, i.e. FAT, SAT, Commissioning Test, Operational Maintenance Test. There has been particular emphasis on the FAT, where the full setup of the protection and control system is required up and running at an off-site location. It includes detailed and thorough test procedures both for the full system and for the individual functionality. This process has drastically minimized the testing time and travels for engineering specialist to the remote sites.
Secure remote connections into the new digital substations also allow for better and quicker support, both for testing and for operational troubleshooting, again minimizing travel- and response times.

#6 Reliability:
The digital substation concept has an easier option to implement completely redundant protection and control system compared to conventional substations. The concept of Main 1 and Main 2 IEDs is preferred, benefitting the operation, maintenance, and patch processes. It also can allow for outageless maintenance, where one system is operational while the other is fully tested or updated. In this digital trend there has been focus on functions rather than standalone devices like in the past, i.e. fewer devices for the same or better functionality. The digitalisation also allows for more data to be collected and monitored for the assets. This data can then be processes for assets health evaluations and failure prediction.