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Towards Availability versus Cost Assessment for Accelerator Research Infrastructures

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Describing discoveries and rare processes with particle colliders require agreed Quality of Service (QoS) levels at sustainable operation cost over long time periods. It is far from obvious to identify the cost effective levers to achieve this and to push the performance frontiers in a sustainable manner. H. A. Simon and F. Vester coined the term "Sensitivity Analysis" in the late 70ies to foster rational decision taking by increasing confidence in a model by repetitively assessing the impact of a set of input parameters, tested against actual observations. The application to particle accelerators has been verified in concept applied to the LHC run in 2012. Consequently a dedicated activity has been launched in the frame of the Future Circular Collider study to work towards a set of methods to study the optimization of accelerator availability. In this context, the term "availability" means the fraction of time over the operation lifetime at which the infrastructure delivers beam within the QoS boundaries required for physics research.
The opportunities and costs associated with availability improvements change over time, as more operation data is made available, data quality of incident reporting is improved, granularity repair and maintenance become finer. An automated approach enables such an adaptive decision aid process, considering altered reliability and maintenance characteristics due to changes at technical, operational and organizational levels. Such continuous observation, prediction and decision aid process is to our best knowledge novel to the large-scale research Infrastructure domain. With a federated data acquisition, high-performance computing and data analytics ecosystem, this activity may approach a TCO model, assisting decision takers in balancing investments and performance. This contribution summarizes the foundation of concepts, showcases the tools and sheds light on modelling activities at CERN of the LHC and its injector complex.

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