Contribution ID: **400** Type: **Poster**

Industrialization of 16T Nb3Sn magnet production for HE-LHC and FCC

Tuesday 25 June 2019 16:01 (1 minute)

Cost-effective manufacturing of Nb3Sn magnets for HE-LHC and FCC could be achieved through optimization of HL-LHC magnet manufacturing performance using key performance indicators (KPI) such as cost and quality. However, optimization of Nb3Sn magnet manufacturing performance is computationally expensive due to the large number of manufacturing parameters, design variables, and KPI, whose interrelationships need to be modeled and optimized in order to achieve target performance. Thus, probabilistic modeling using Bayesian networks and dimensional analysis conceptual modeling (DACM) framework is proposed to model production cost. Next, a dimension reduction method using graph centrality theory is proposed to enable screening of variables into groups for optimization, based on their level of influence on performance targets. To achieve KPI-driven performance optimization based on real data from HL-LHC magnet production, a continuous production monitoring platform known as Manufacturing Execution System (MES) is proposed considering the requirements of the production. The MES implementation is assisted by Leanware (Finland) to provide functionalities such as, resource monitoring, magnet component traceability within facility, production scheduling and execution, and support in-process quality control. The MES, Bayesian Networks and dimension reduction based analytics methods enable cost-driven optimization and accurate cost-drivers identification in Nb3Sn magnet production.

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Session Classification: Poster session

Track Classification: Superconducting magnets & associated technologies