

Breakout session

Early Fault Detection and Predictive Methods



What is Predictive Maintenance? A Survey

'Watching systems carefully, exchanging cheap parts before they break and track faults'

'A huge relief'

'Prevents a 3am call out'



We Need a Definition/Clarification

Many definitions of **predictive** and **preventative methods** and **maintenance** exist but it was not possible in this session to define one specifically for our applications to which everyone agreed and that could span our range of applications (at least not with a mature level of detail, content and context)!

With much discussion, a definition evolved for predictive methods:

***Predictive methods** uses software and hardware **tools** and means with **human inspection to monitor** equipment, systems, conditions and practise...extracting **data on health** and other criteria to observe **trends** or uncharacteristic **anomalies**...using **risk analysis** to decide on the level of **intervention** required to **prevent a failure** in the most efficient and effective way.*

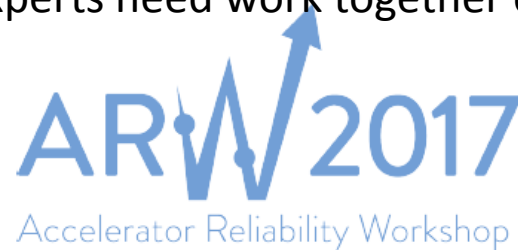
Examples of Predictive Tools and Methods

- Condition monitoring using diagnostic analysis tools within MatLab/LabView or other proprietary systems (ISIS)
- Real-time radiation & temperature monitoring for PC electronics in the tunnels, to predict issues arising (CERN)
- Real-time BLM data as a precursor to fault analysis (CERN)
- Using machine learning to predict the next fault (neural networks)
- **Human experience** versus data analyses (cost vs benefit)
- **Beam data** as a real-time and historical analysis tool



We Need Best Practises Tools, Methods, Do's and Don'ts

- **Operator**...experience over data analysis. Operators involved in analysis and scoping of the specific analysis
- **Beam**...strong indication in predictive fault analysis, check also systems involved in beam production
- **Real or Fake**...Is it a real problem or instrumentation/diagnostics, is it a 1 time event
- **Sensing**...are sufficient sensors installed and taking data with reasonable quality and content
- **Data**... overload, weighting, diagnostic versus critical functions and its separation to avoid un-testability, etc.
- **Robust**...data, comparability of data
- **Sanity checks**...regular (cabling/connection integrity, ID matching, MPS signals)
- **Collaboration**...Analysts and systems experts need work together closely



Conclusion

- Terms of reference. Much discussion and clarification needed from many silos in our industry to agree on the meaning of terms
- Many tools and methods exist to support predictive methods and their applications however cost benefit needs analysing and collaboration with industry and academia to find new and innovative ideas
- Such sessions may best be delivered by experts in the field to trigger an even more fruitful discussion



Thankyou to the session contributors

The audience was fantastic!

Thankyou for all your honest and open minded input!

Very constructive with many contributions!

Hopefully we will be able to learn even more during the next ARW!

