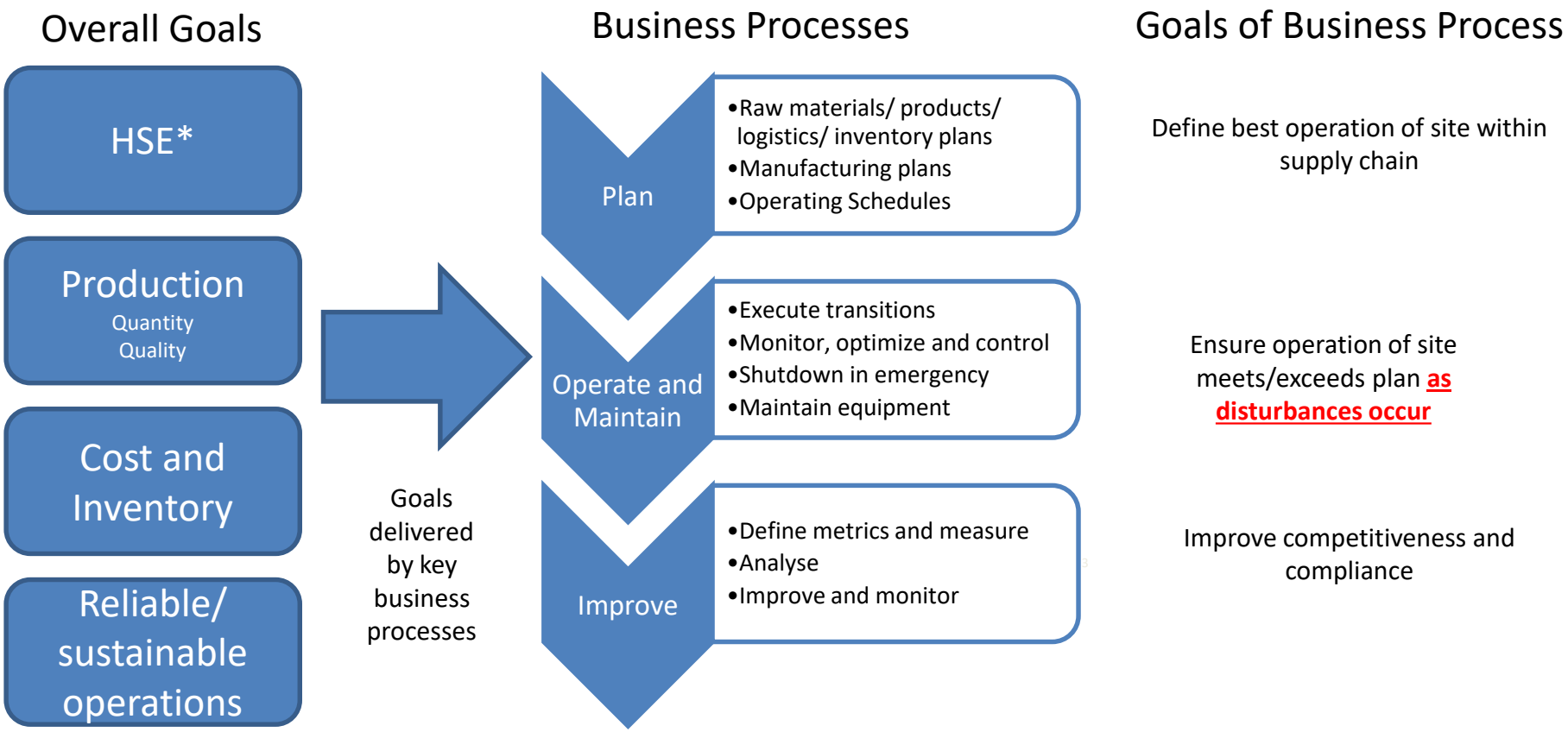
Use of Modern Analytical Tools for Variability Analysis

Agenda

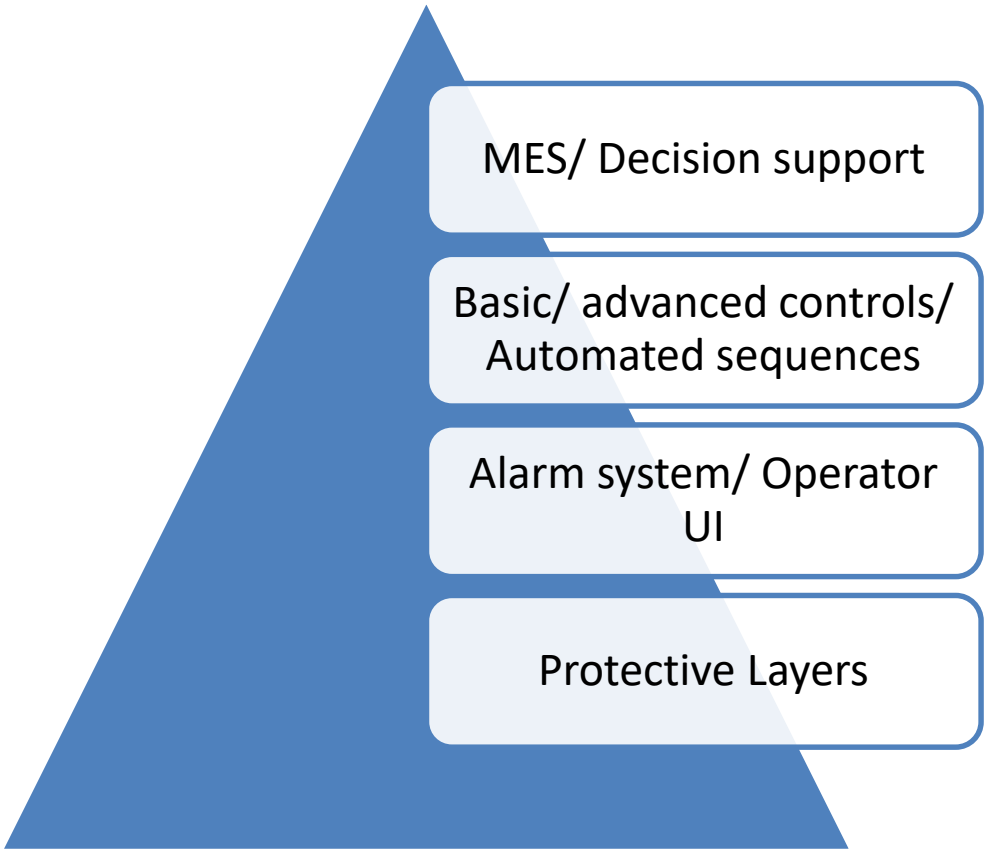
- High level view of plant operations and importance of reducing variability
- Tradition analysis of variability
- Methods used for more extensive analysis of variation
  - Protective layers
  - Operator performance and alarms
  - Improved controls and procedures
  - KPIs
- Leveraging the study to ensure on-going management of variation

Effective Operation of Manufacturing Plants



* Health, Safety and Environment

Manage Variability from Plan/ Goals – A Systems View



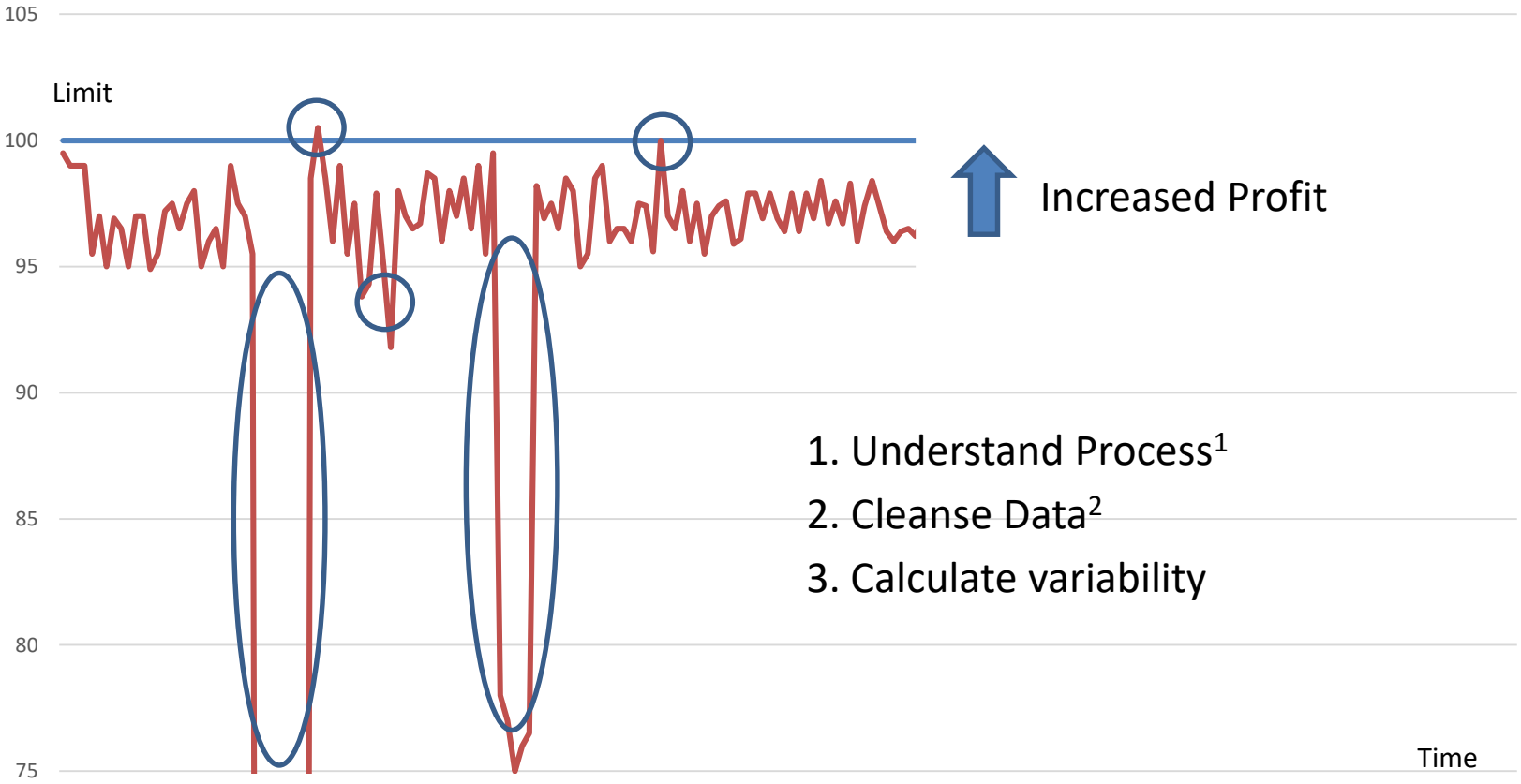
Further optimize performance. Typically complex decisions

Manage typical disturbances using closed loop algorithms and push to optimum

Manage disturbances when control actions are insufficient

Make the plant safe

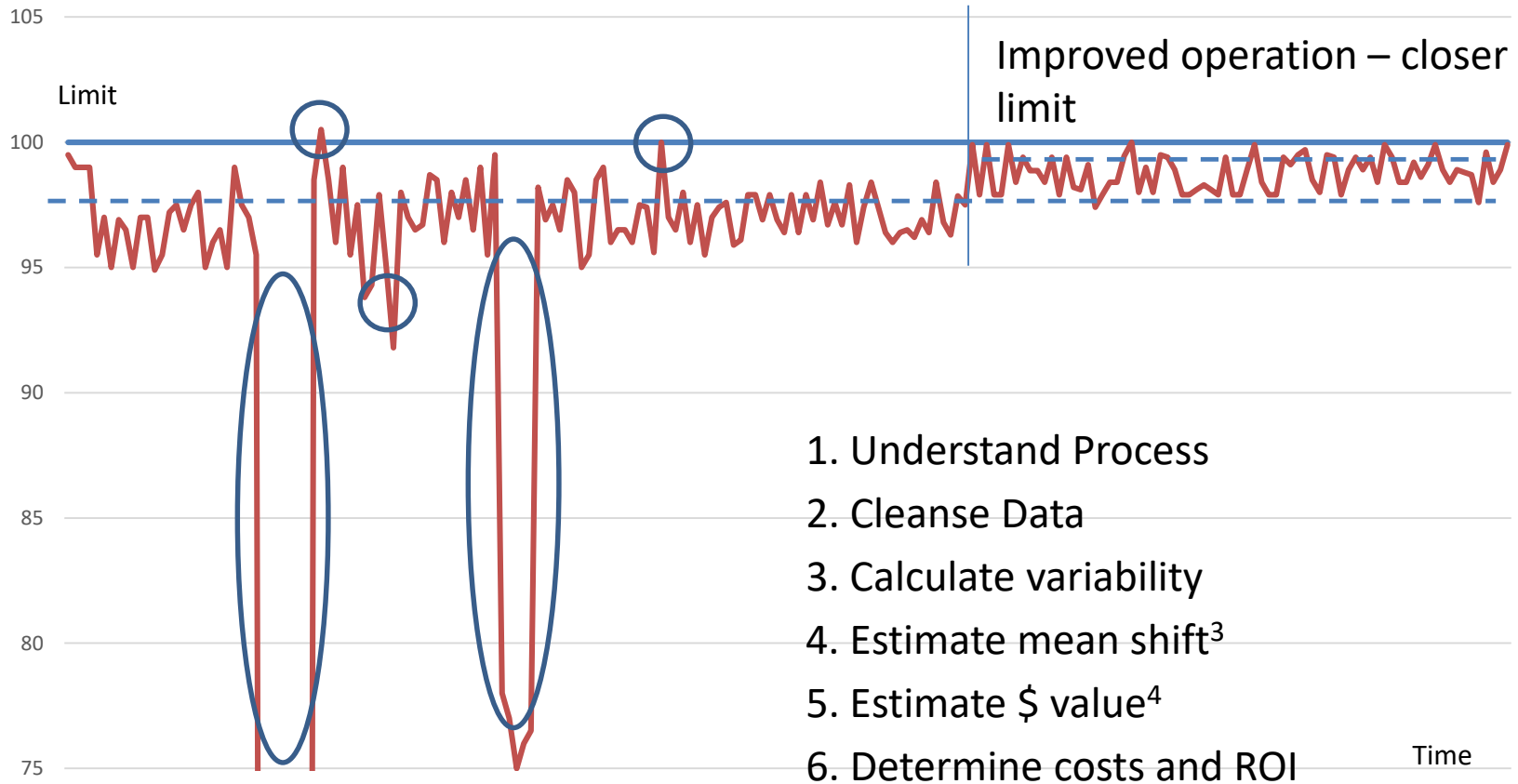
Traditional Investment Justification



Notes

1. Discussions with planners, operations team, engineers
2. Remove data that will give high std dev – procedures/ upsets

Traditional Investment Justification



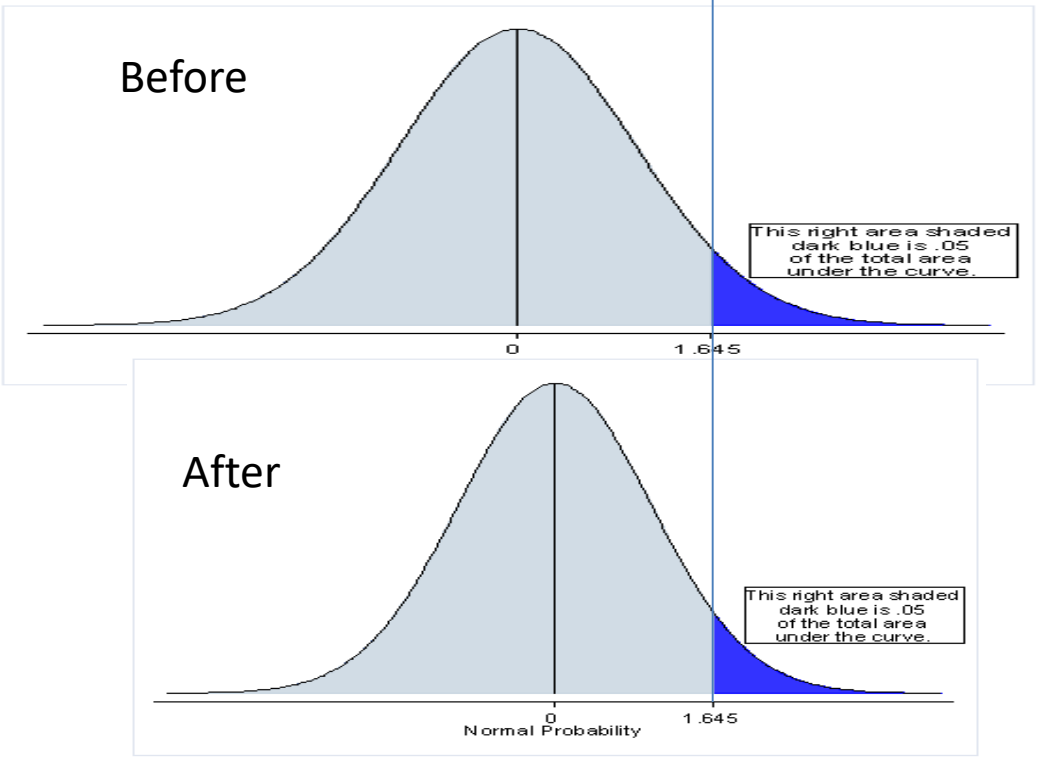
1. Understand Process
2. Cleanse Data
3. Calculate variability
4. Estimate mean shift[3]
5. Estimate $ value[4]
6. Determine costs and ROI

Notes

3. Typically assume 25-50% reduction (shown to be achievable by project post audits). Mean shift = 1.65* change in std dev
4. Estimate relationship on (eg) production/ energy use using regression, simulation or experience

Assuming a Normal Distribution

- Assume that 5% of operations can continue outside the expected operating limit
- Mean shifts by 1.65 times the standard deviation reduction



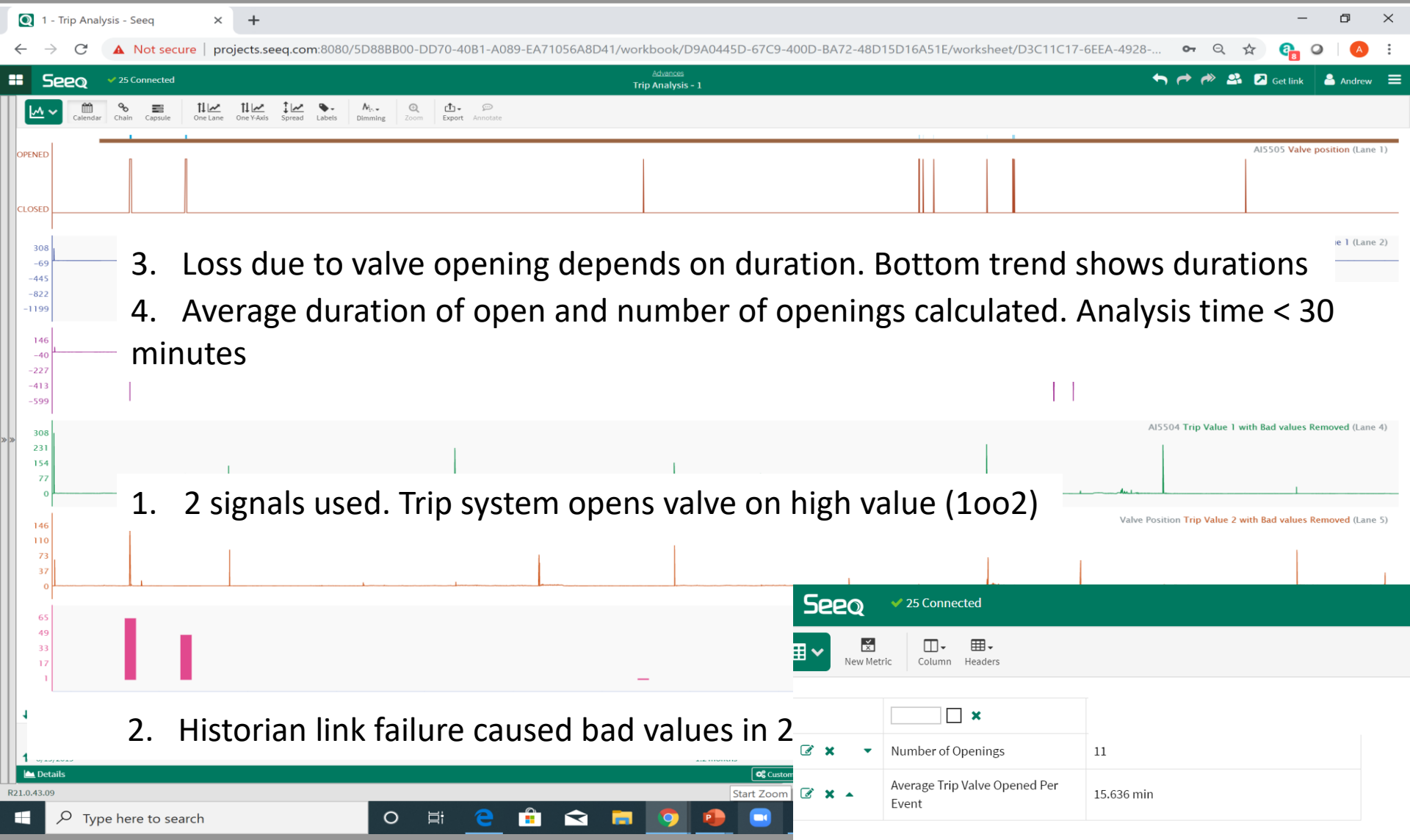
Issues

- Traditional analysis tool = Excel
- OK for simple problems but as analysis gets more complex, Excel becomes too inefficient
- Consequence – analyses traditionally have been limited to improved control
  - Don't get total picture
- More modern process analysis tools
  - Reduce time needed (ease of use)
  - Enable broader analysis in available time/ cost
  - Support deeper analysis
  - Enable better collaboration
  - Provide a better basis for future solutions

  - Protective layers
  - Alarms and operator UI
  - Controls and procedures
  - KPIs

- Next few slides review analysis done on some projects. In some cases, methodology is still being developed

Analysis of Trips



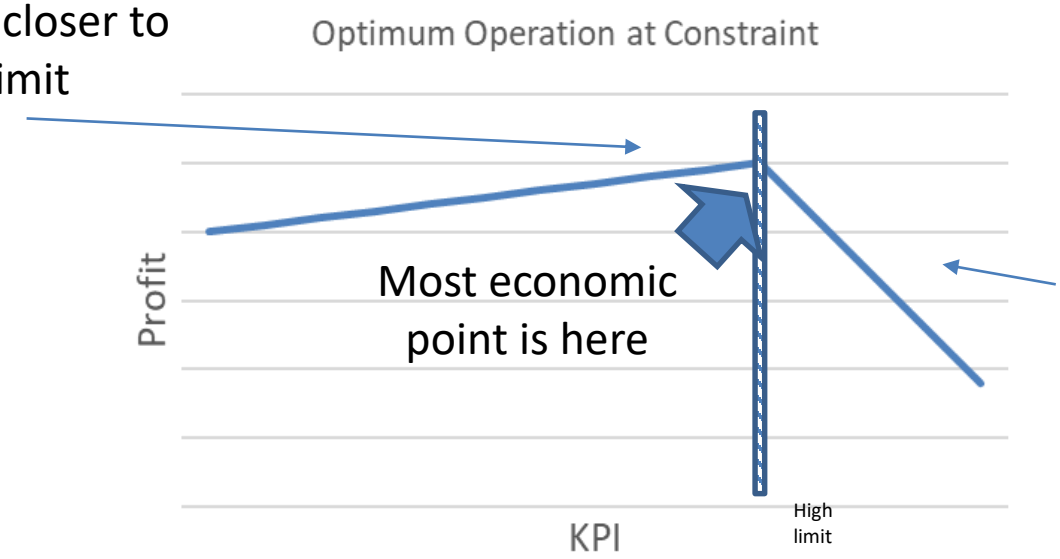
3. Loss due to valve opening depends on duration. Bottom trend shows durations
4. Average duration of open and number of openings calculated. Analysis time < 30 minutes

1. 2 signals used. Trip system opens valve on high value (1oo2)

2. Historian link failure caused bad values in 2

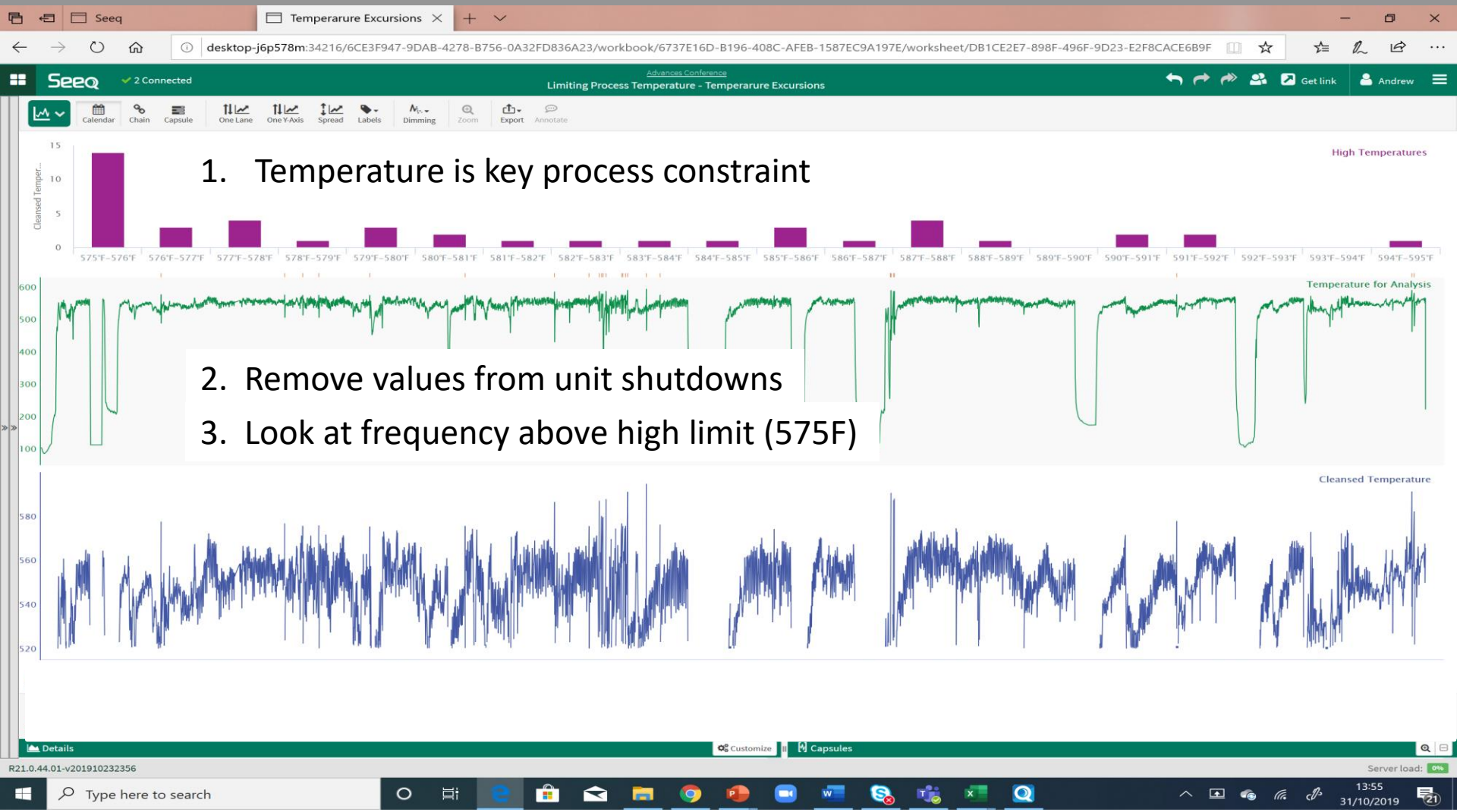
Analysis of Excursions/Upsets

Improved control helps move closer to limit



Can we understand opportunities to reduce time beyond limits?

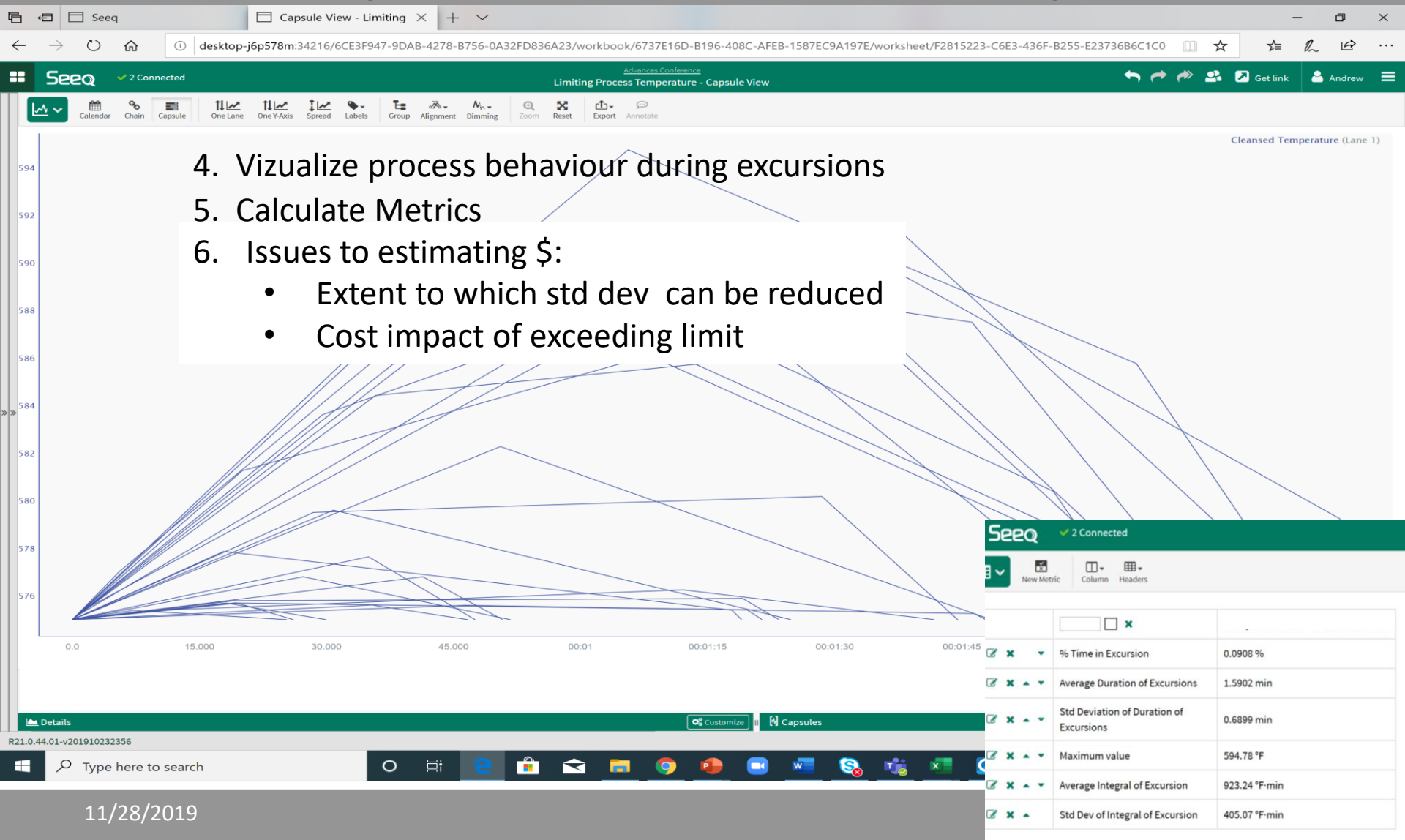
Analysis of Excursions/Upsets



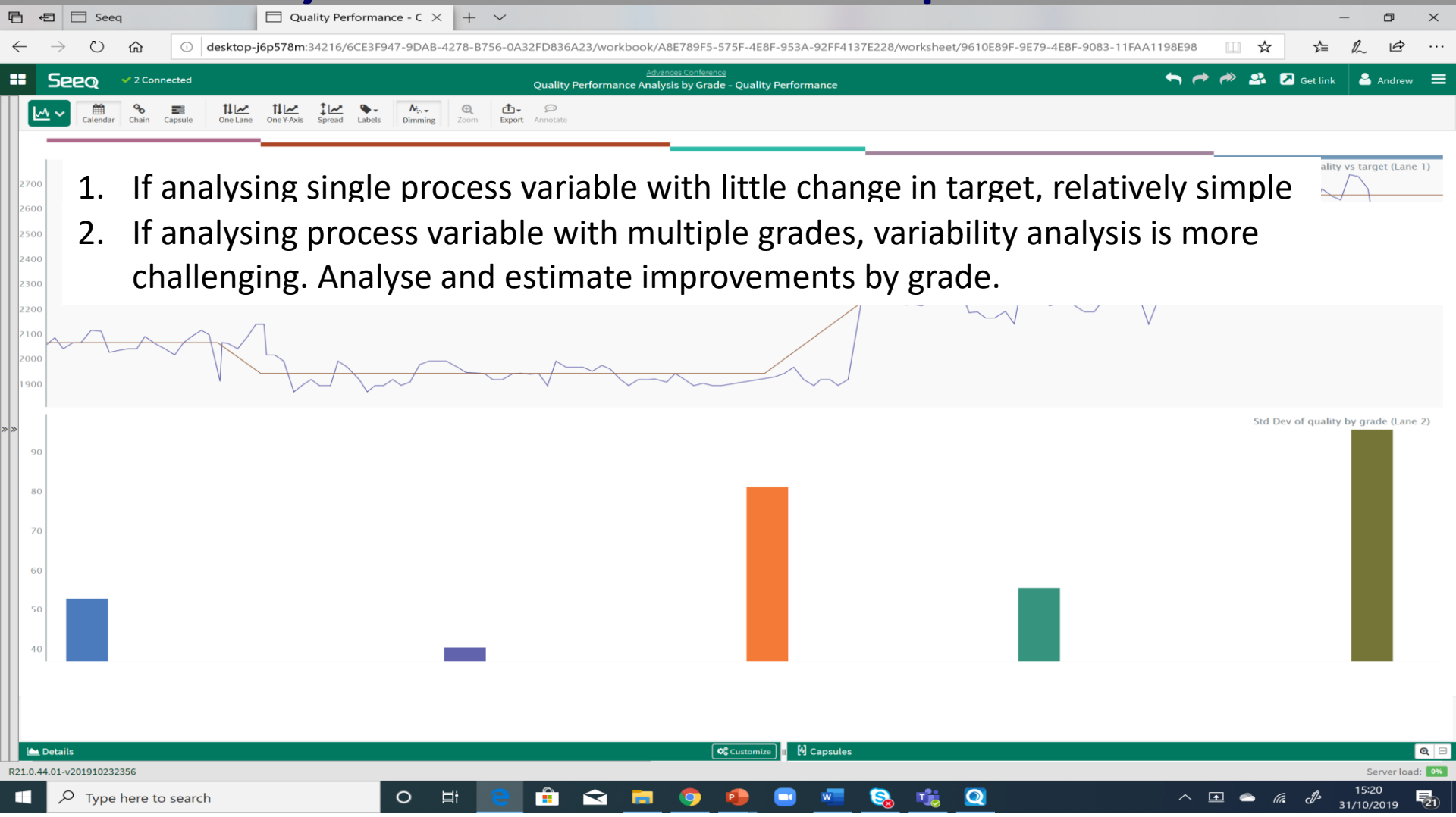
1. Temperature is key process constraint
2. Remove values from unit shutdowns
3. Look at frequency above high limit (575F)

Analysis of Excursions/Upsets

4. Vizualize process behaviour during excursions
5. Calculate Metrics
6. Issues to estimating $:
   - Extent to which std dev can be reduced
   - Cost impact of exceeding limit

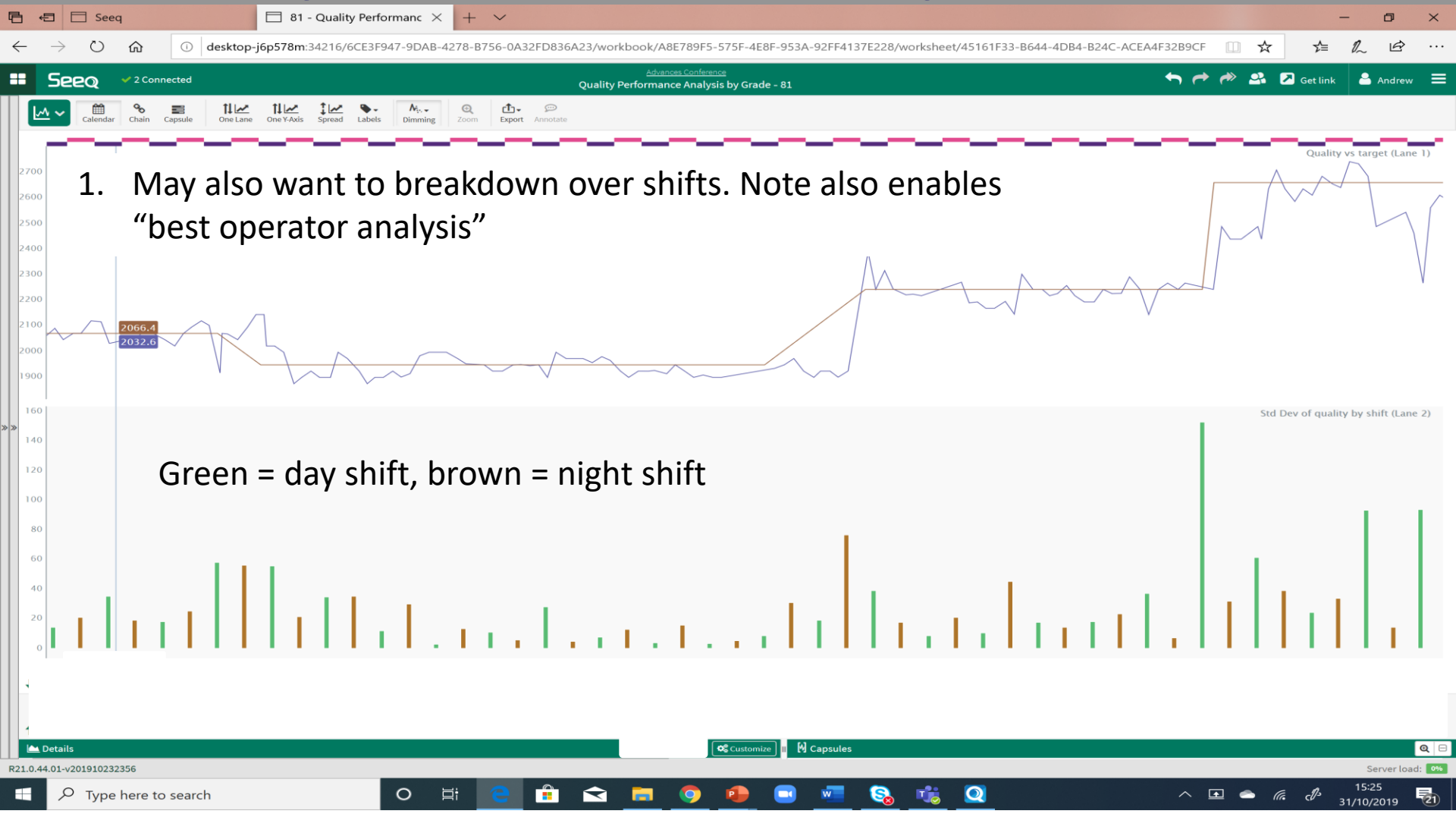


Analysis of Control Improvements



1. If analysing single process variable with little change in target, relatively simple
2. If analysing process variable with multiple grades, variability analysis is more challenging. Analyse and estimate improvements by grade.

Analysis of Control Improvements

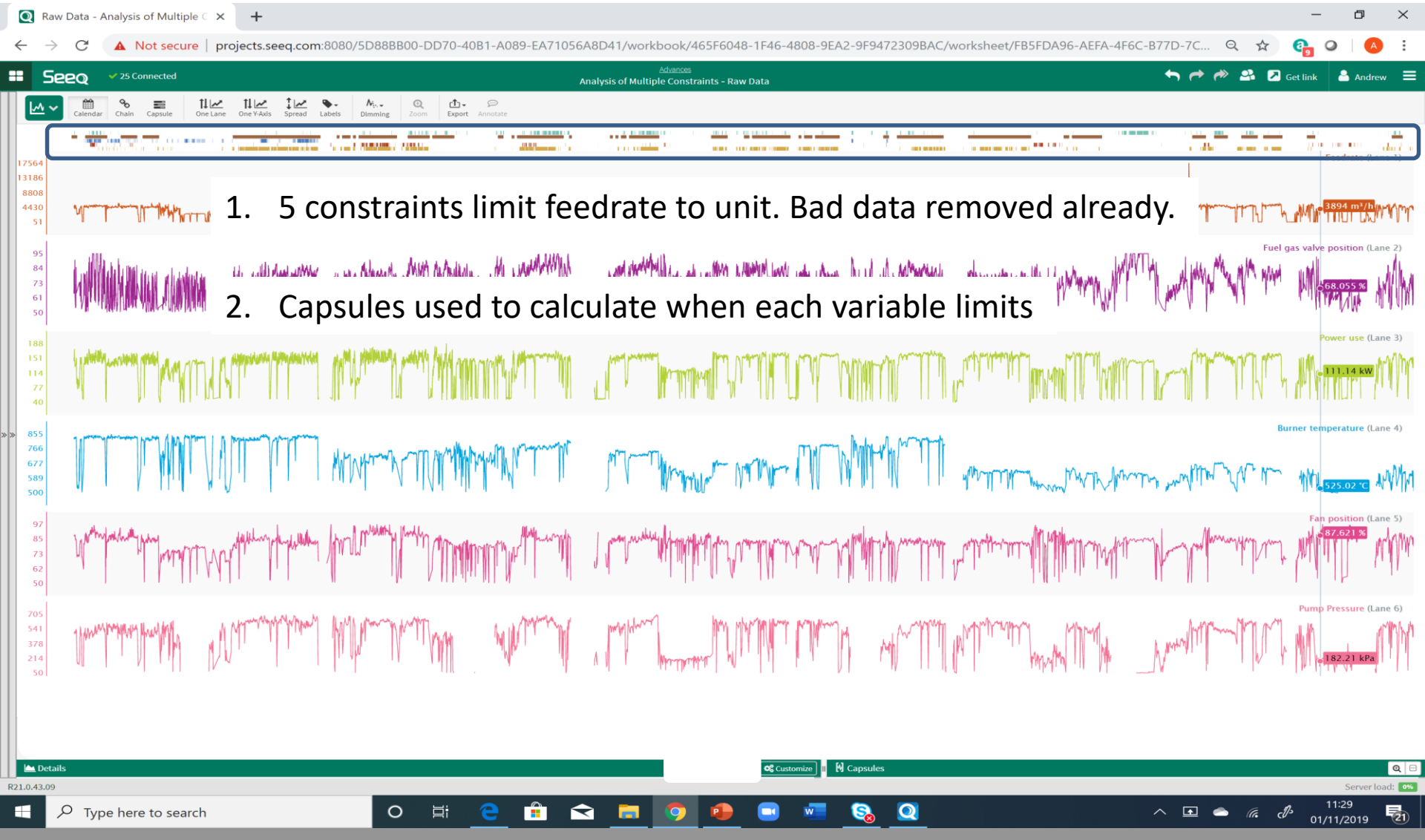


1. May also want to breakdown over shifts. Note also enables "best operator analysis"

Green = day shift, brown = night shift

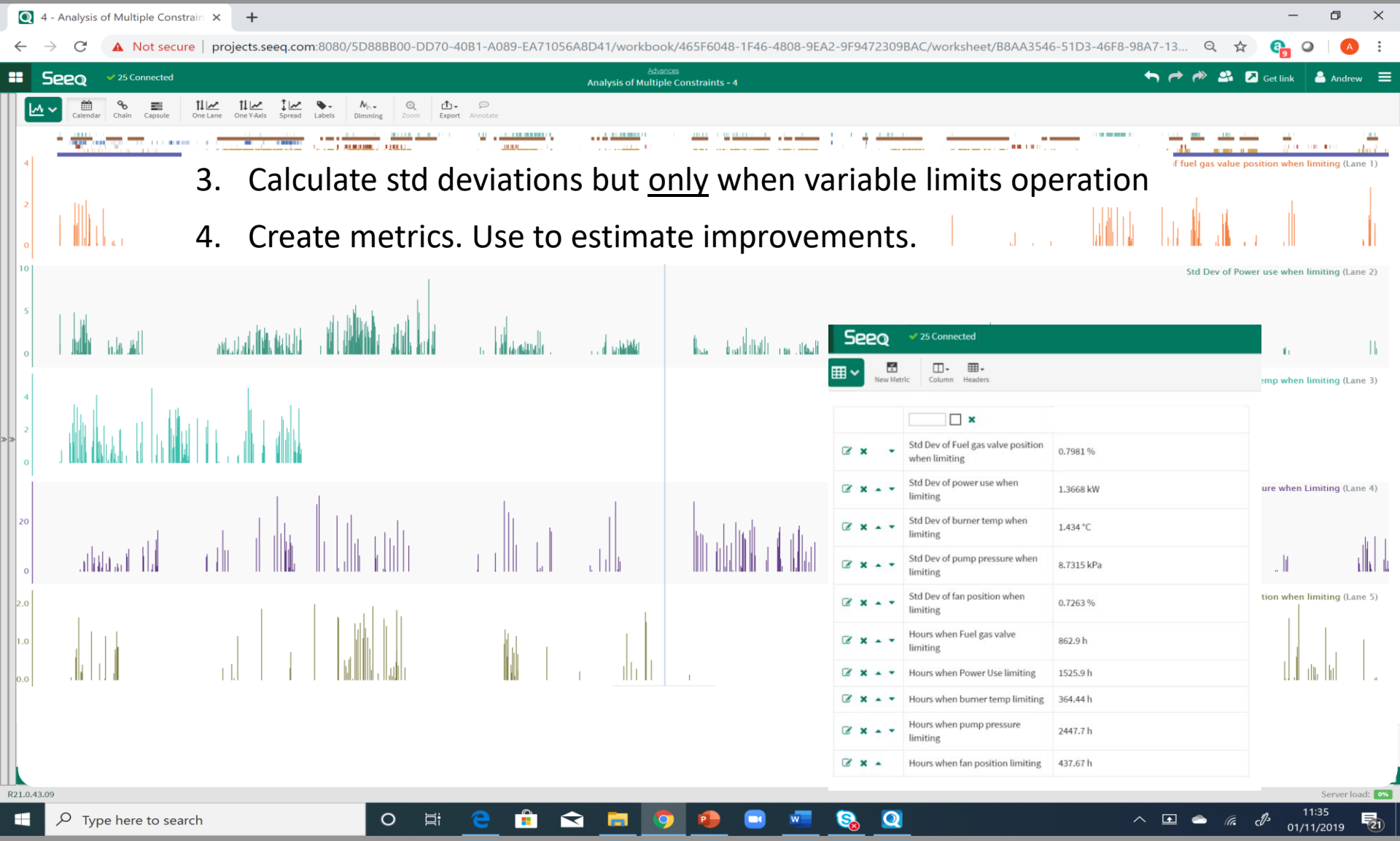
control NewLand

Analysis when Multiple Constraints Active

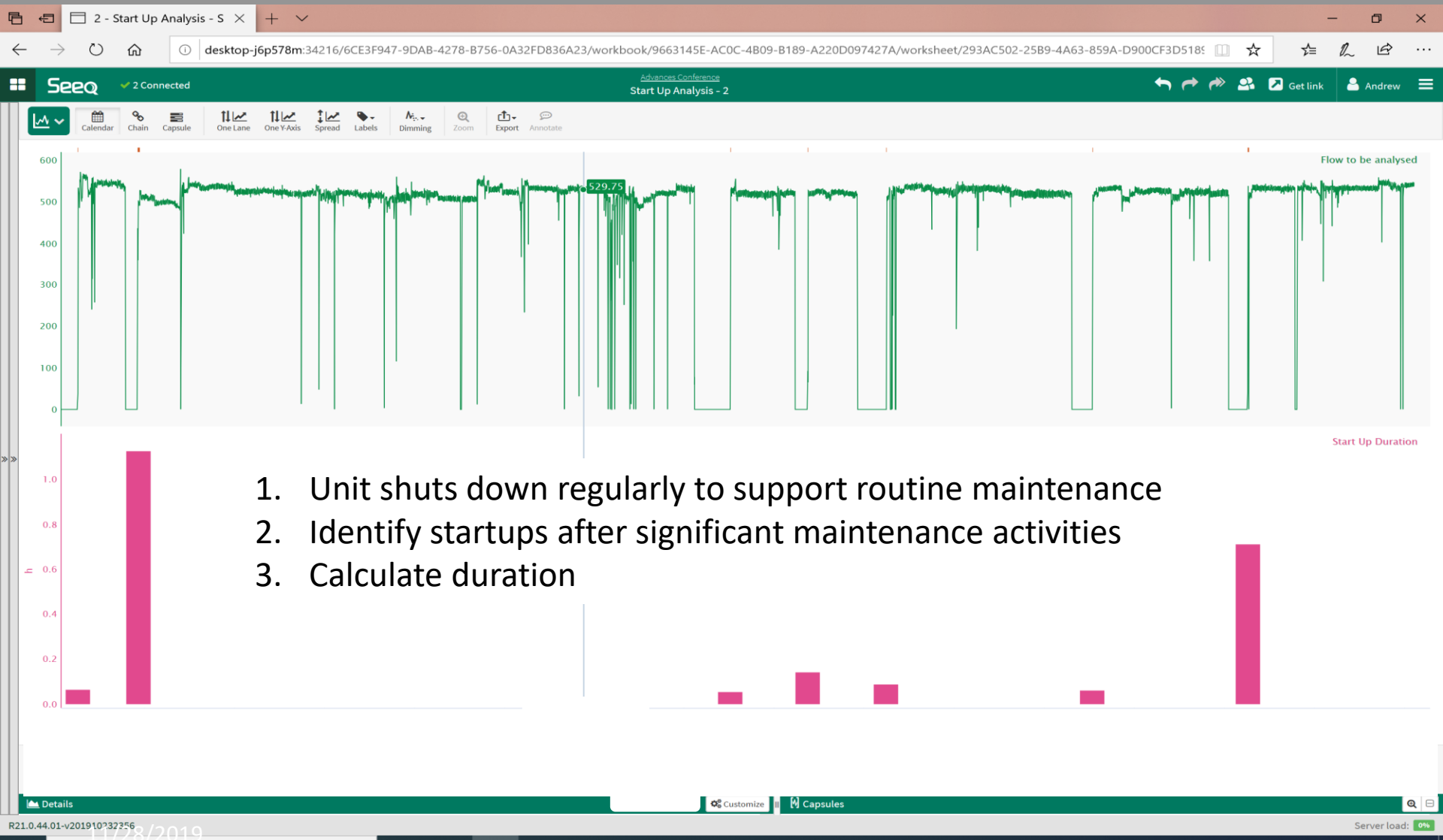


Analysis when Multiple Constraints Active

3. Calculate std deviations but only when variable limits operation
4. Create metrics. Use to estimate improvements.



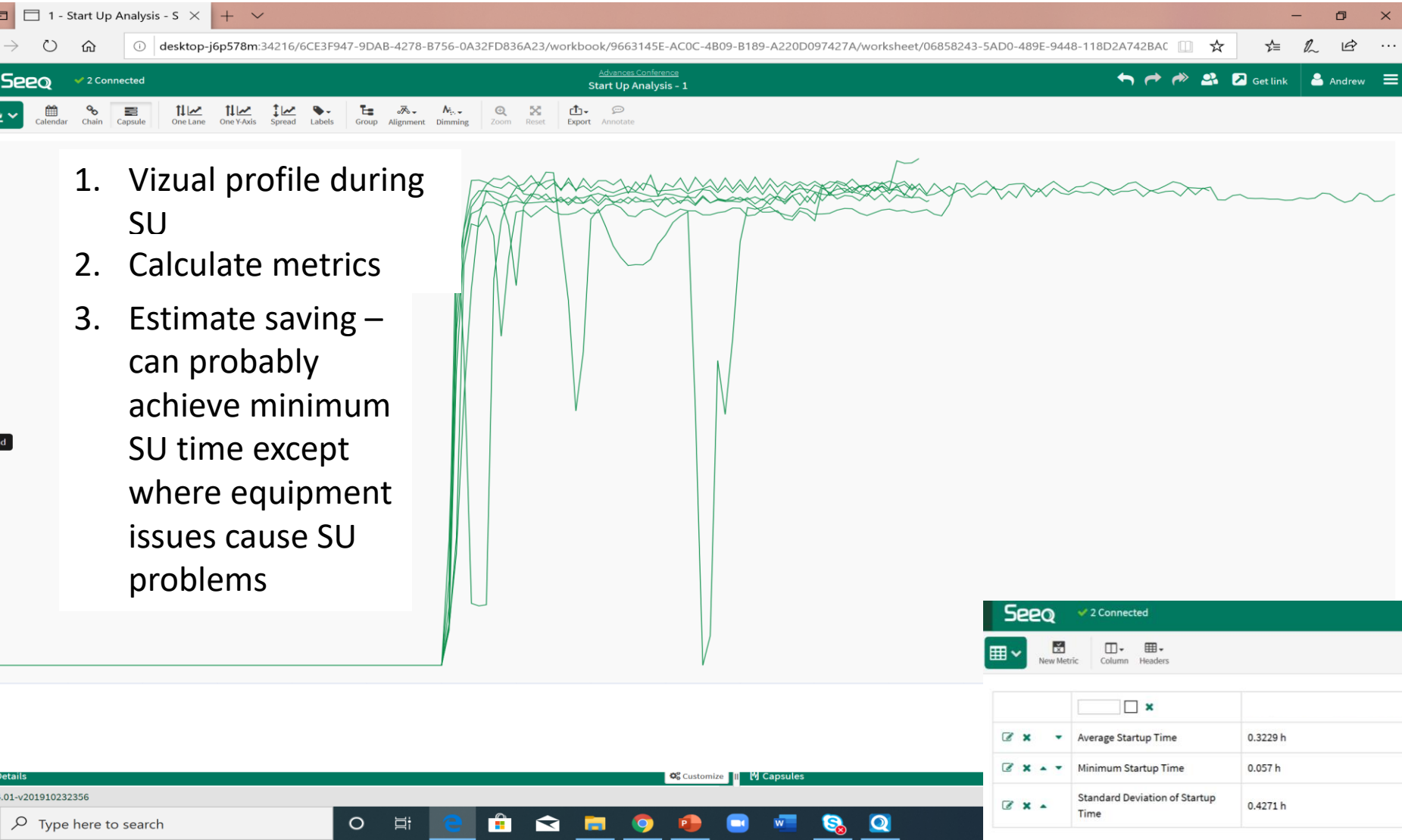
Analysis of Procedure Automation Opportunities



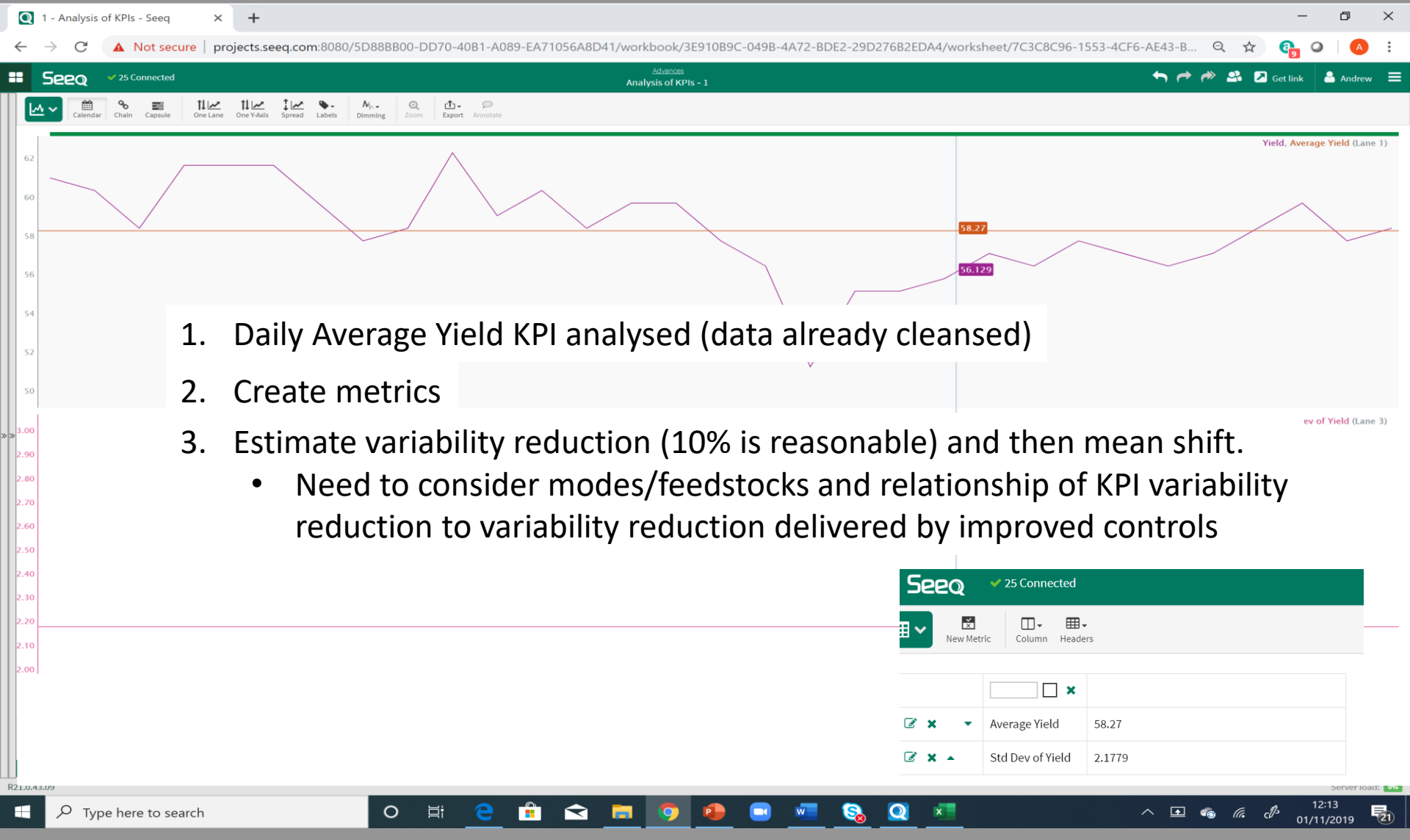
1. Unit shuts down regularly to support routine maintenance
2. Identify startups after significant maintenance activities
3. Calculate duration

Analysis of Procedure Automation Opportunities

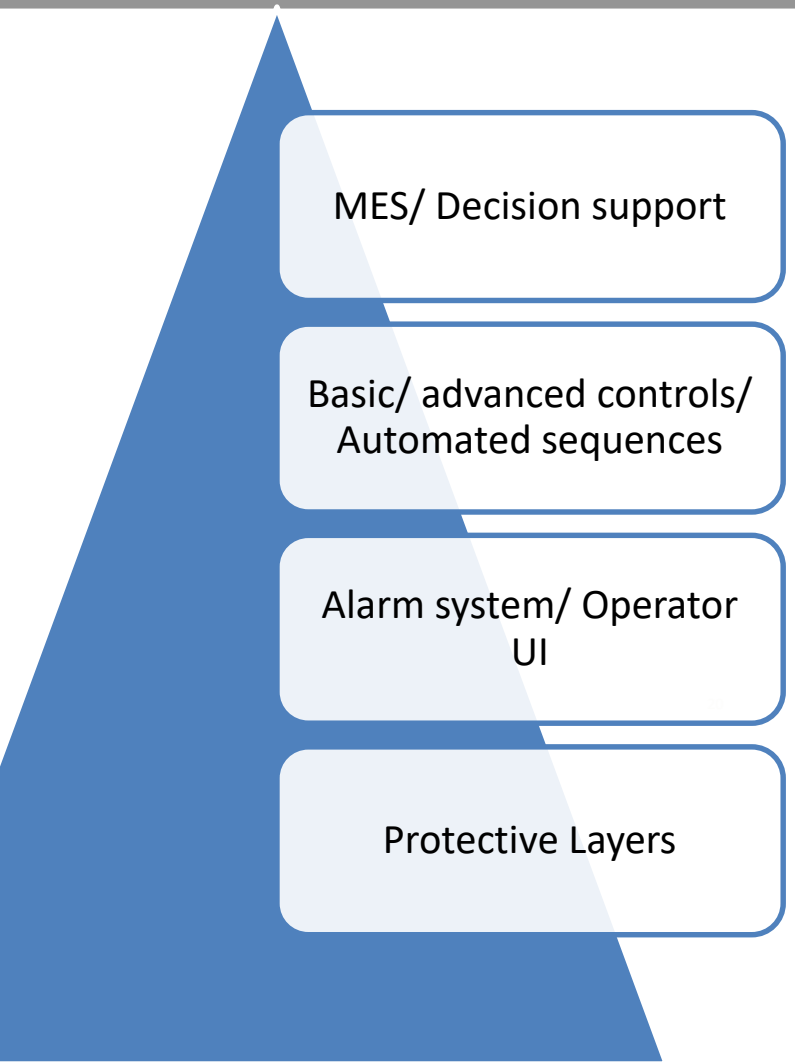
1. Vizual profile during SU
2. Calculate metrics
3. Estimate saving – can probably achieve minimum SU time except where equipment issues cause SU problems



Improved Mgmt of KPIs



Summary



Traditionally estimates very high level
Opportunity to provide more insight but need to consider impact of modes and improved controls

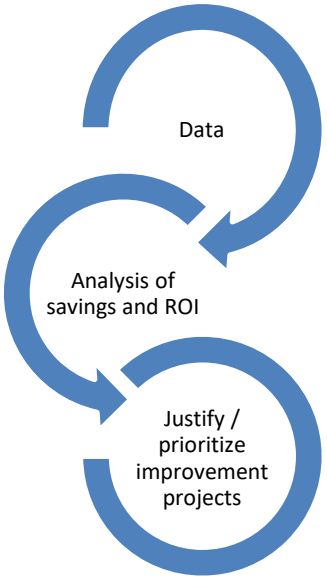
Traditional methods accepted.
Opportunities to improve analysis (by grade/ mode/ shift)
Easy to analyse impact of better procedures

Can gain more insight into performance during excursions
Key issue is economic value

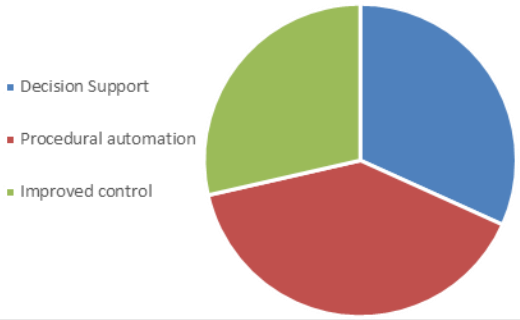
Can easily analyse frequency and costs
Can consider relationship of frequency with protective layer design basis

Leveraging Analysis Results

For Project Justification



Breakdown of savings (Example)



On-Going Performance

Area	Based on study	Extending the study
MES	Extend KPI monitoring to analyse KPI variability on a routine basis.	Implement decision support (equipment, process, production) based on modern analytics.
Procedures	Monitor performance of key procedures and key steps.	Monitor use of automation
Control performance	Monitor variation of critical process variables.	Monitor use and performance of controllers/ advanced controllers
Operator performance and alarms	Monitor excursions and excursion metrics for key variables	Analyse alarm metrics (to understand cognitive load).
Protective layers	Monitor frequency of trips.	Monitor health, maintenance and performance of protective layers (dynamic process risk)

Summary

- Modern process analysis tools radically reduce time for analysis
  - Allows broader/deeper analysis
- Tools can then be leveraged to introduce analytics into day-to-day operations