Enterprise-Wide Accuracy Control in a Digital Environment

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Newport News Shipbuilding – Elmer Dickens, Colin Smith, Stephen Strand, Darreous Moody

Partnered with PSU-ARL and Bath Iron Works

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NATIONAL SHIPBUILDING RESEARCH PROGRAM™
Taking Shipbuilding and Repair to the Next Level

Project Team

NEWPORT NEWS SHIPBUILDING
A DIVISION OF HII

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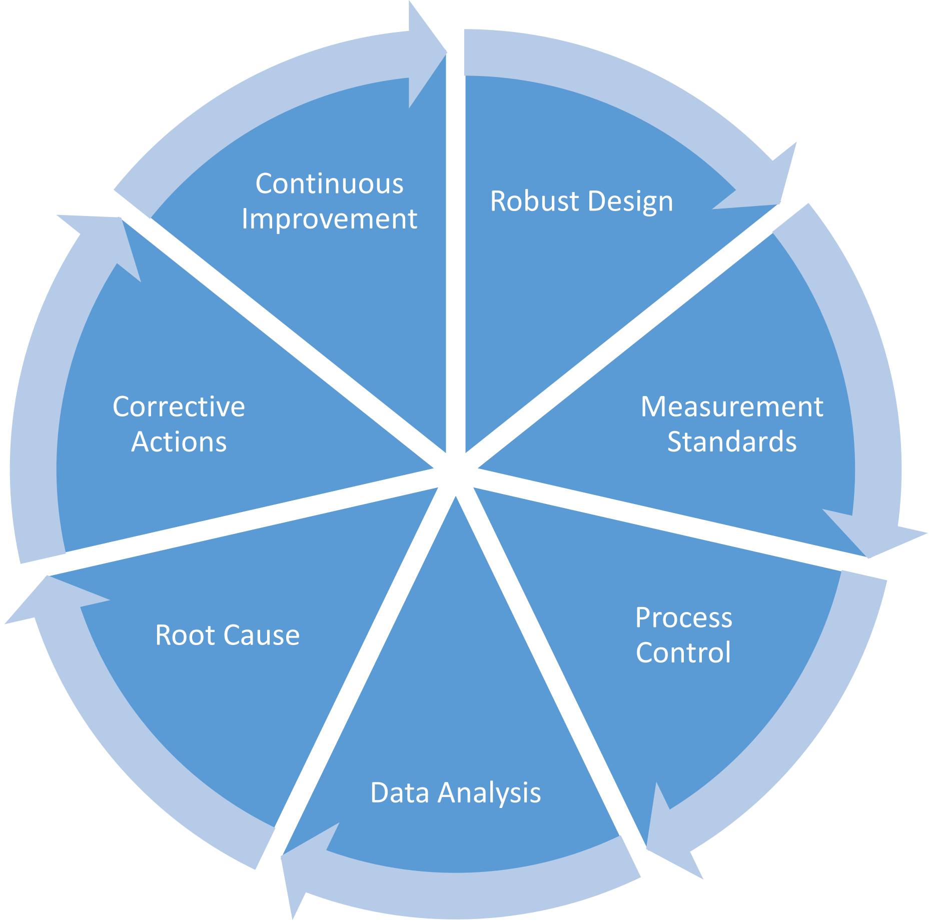
Accuracy Control in Shipbuilding

Mission: Reduce dimensional process and/or part variability

Eliminate cost and schedule risk, improve first time quality, and increase operational health



Definition:

- Accuracy Control(AC) is the process of collecting performance data and using statistical assessments to map out process capabilities, determine routine behaviors, and identify unusual behaviors, all with the objective of reducing variability in processes and resultant products and improving structural alignment.

  AC Program will be developed and implemented to regulate process control, identify product variations and maximize process efficiency

Objectives:

- Increase productivity by improving quality, cutting costs, and shortening lead times
  - Govern AC manufacturing standards and process control
  - Continuously monitor process performance and drive process/production improvements.

Accuracy Control Program Elements

Standards

Operating procedures to establish a disciplined approach to process control.

- -Governing the following:
  - -AC Policies
  - -Procedures
  - -Work Instructions

Planning

Consist of collaborating with a variety of value stream stakeholders to help define AC checkpoints and requirements.

- -Design/Engineering Products
- -Central Planning/ Program Planning
- -Detail Planning
- -Supply Chain Management
- -Metrology Engineering & Planning

Execution

Performing production work in accordance with specified AC requirements and recording results.

- -Measurement Methodologies
- -Data Recording/Reporting
- -Data configuration management and traceability

Evaluation and Analysis

Regularly process control evaluations to measure performance and identify production challenges.

- -SPC Tools and Techniques
- -Performance Metrics
- -Dashboards
- -Data Mining
- -Trending for signals of production challenges.
- -Deckplate feedback

Continuous Improvement

Identification of root causes and improvement opportunities to eliminate performance gaps, waste and barriers within the value stream

- -Root Cause Analysis
- -Corrective Actions
- -Process and Product changes (feedback loop)
- -Implementation Monitoring and evaluation of Sustainability.

Cultural Buy In and Ownership

Recent Accuracy Control History at NNS & BIW

- In 2002, Richard Storch at the University of Washington published the Accuracy Control Implementation Manual, Final Deliverable of NSRP Subcontract #2001-228. This document laid out the basics of Statistical Process Control practices as well as several of the unique problems encountered in Shipbuilding.
- A previous SPC effort at NNS persisted for several years within the Fab Shop only. However, changing leadership led to people unfamiliar with the historic problems. The SPC team was cut due to the high manual effort of SPC at the time, and it was years before problems arose again.
- Between December 2019 and October 2021, BIW in conjunction with Penn State ARL performed ManTech project S2844, Digital Accuracy Control Management System. This project focuses on transitioning from paper- and spread sheet- based data collection, to a system that enables electronic capture of data from all stages of construction in a single data structure.

NNS Problem – Why go digital?

PROBLEM(S) TO BE ADDRESSED:

- ❑Disconnected process checks:
  - ❑Manual and digital
  - ❑In-process and final
  - ❑Wide range of measurement precision – from hundredths of an inch to purely visual checks for "gross and obvious" defects
  - ❑Unable to evaluate Overall Process health across multiple product lines and value streams
- ❑Tolerance Stack-up:
  - ❑Changes made at one stage not reported to later stages
  - ❑Widespread practice of 'leave loose' and 'added material' to be trimmed and corrected at a later stage
  - ❑In-tolerance variations at multiple stages can combine to make out-of-tolerance problems at the downstream stages of construction
  - ❑Scope of correction/or rework increases exponentially at each stage of construction
- ❑Consolidating in one digital location can:
  - ❑Align reporting criteria across shops and various phases of construction
  - ❑Provide accessible information for objective decision making in later-stages of construction
  - ❑Provide insight into stacking impacts and process capabilities

NSRP Project Overview

Enterprise-Wide Accuracy Control in a Digital Environment
Two Phases: 18 Months

M&PE
Establish a Central Accuracy Control Program

NSRP
Phase #1: 16 Months
Conduct AC program maturity level assessment; evaluate DACMS and other COTS software

NSRP
Phase #2: 2 Months
Customize and implement accuracy control software; develop user interface application

MANTECH
Advanced Data Analytics

Deliverables

Our primary deliverable will be a cost effective, user friendly software package for data collection and analysis that integrates with a digital shipbuilding environment and an Accuracy Control system. It will support our advancement to increased pre-cut and, ultimately, to neat build. Furthermore, it will be fully adaptable across the enterprise and available to the shipbuilding industry as a whole.

Technical Approach

- ❑ Lessons Learned from BIW – Digital Accuracy Control Management Software (DACMS – ManTech #S2844)
- ❑ COTS(Commercial Off The Shelf) software selection for enterprise-wide accuracy control program
- ❑ Both existing and new data capture tools
- ❑ Statistical Process Control as the core mechanism
- ❑ Digital database of records and metadata
- ❑ Digital reporting and metrics dashboards
- ❑ Future expansion in partnership with Penn State – ARL to implement advanced data analytics

NSRP Objective and SOW

PROJECT OBJECTIVE:

Develop a **centralized** software solution that forms the foundation of a broader Accuracy Control program that **connects** dimensional data inputs, facilitates process control **signals**, enables real-time analysis and decision making, and offers predictive capabilities that ensure a most accurate and affordable end product.

Statement of Work

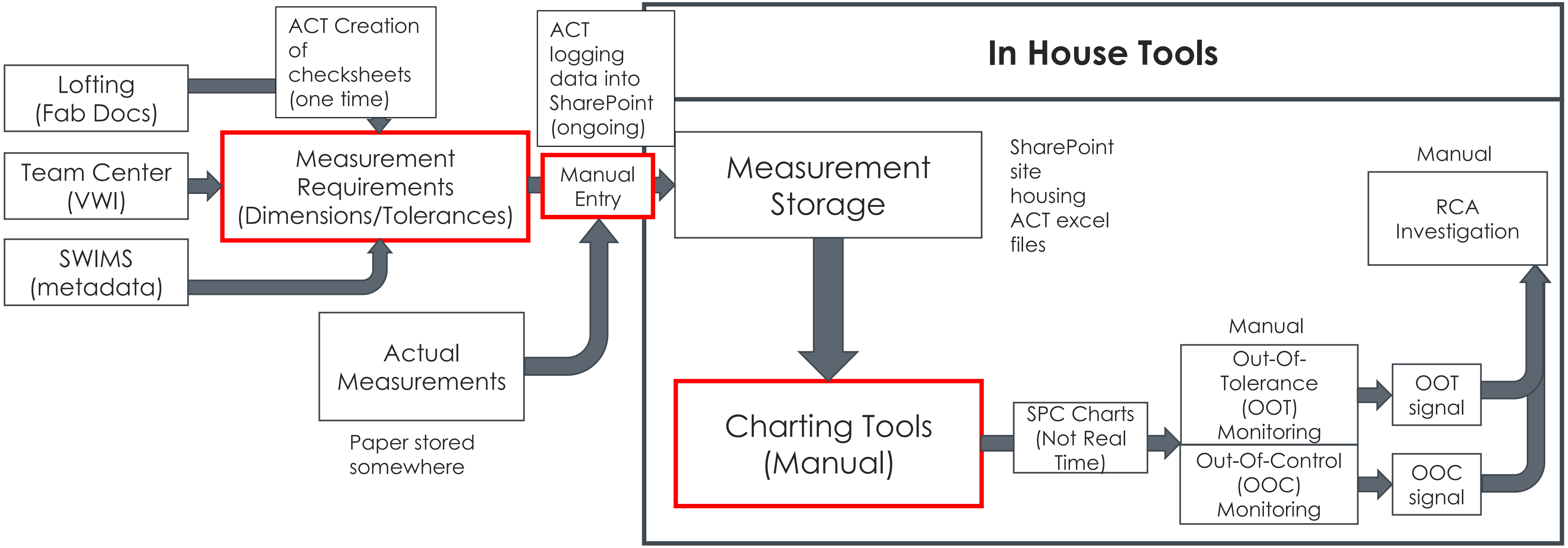
Phase 1: Conduct AC program maturity level assessment; evaluate DACMS and other COTS software (16 Months)

- ❑ Compile and evaluate data from existing sources
- ❑ Assess Navy ManTech project #S2844, Digital Accuracy Control Management System (DACMS), and COTS offerings for suitability
- ❑ Aggregate "back end" data repositories
- ❑ Establish future data capture mechanisms
- ❑ Deploy data capture tool
- ❑ Merge stored data with new data

Phase 2: Customize accuracy control software; develop user interface application (2 Months)

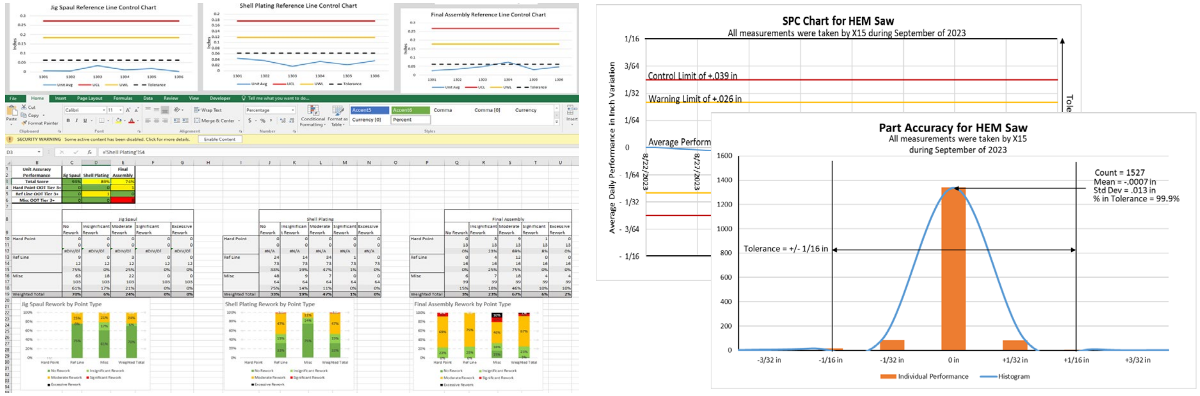
- ❑ Configure software and data system interfaces
- ❑ Develop dashboards to contain SPC charts, data analytics and reporting
- ❑ Develop user interface application

NNS Current State – Disjointed AC System



Barriers

- ❑ **Multiple Data Sources and Streams**
  - ❑ Paper, electronic, historic
  - ❑ Enterprise systems
- ❑ **Disconnected Data and Process Health Signals throughout value stream**
  - ❑ Tolerance stack-up and rework between work centers
- ❑ **Manual Data Entry and Reporting**
  - ❑ Currently data entry is labor intensive (expensive, tedious, and error prone)



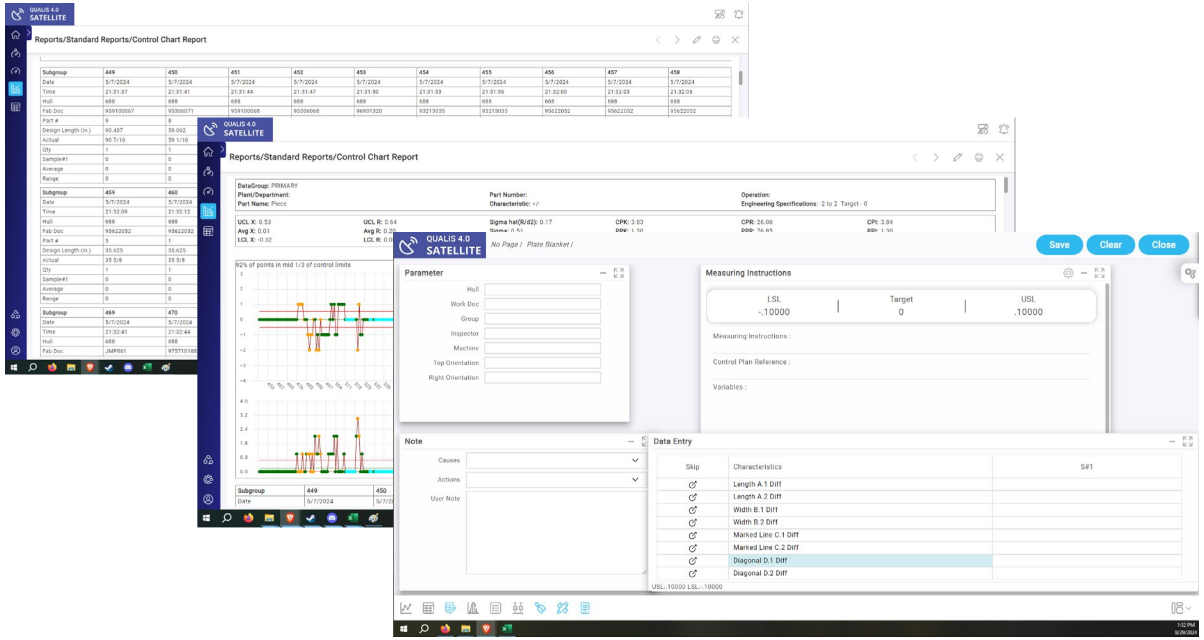
COTS Investigation & Datalyzer Selection

Major Comparisons of COTS SPC software:

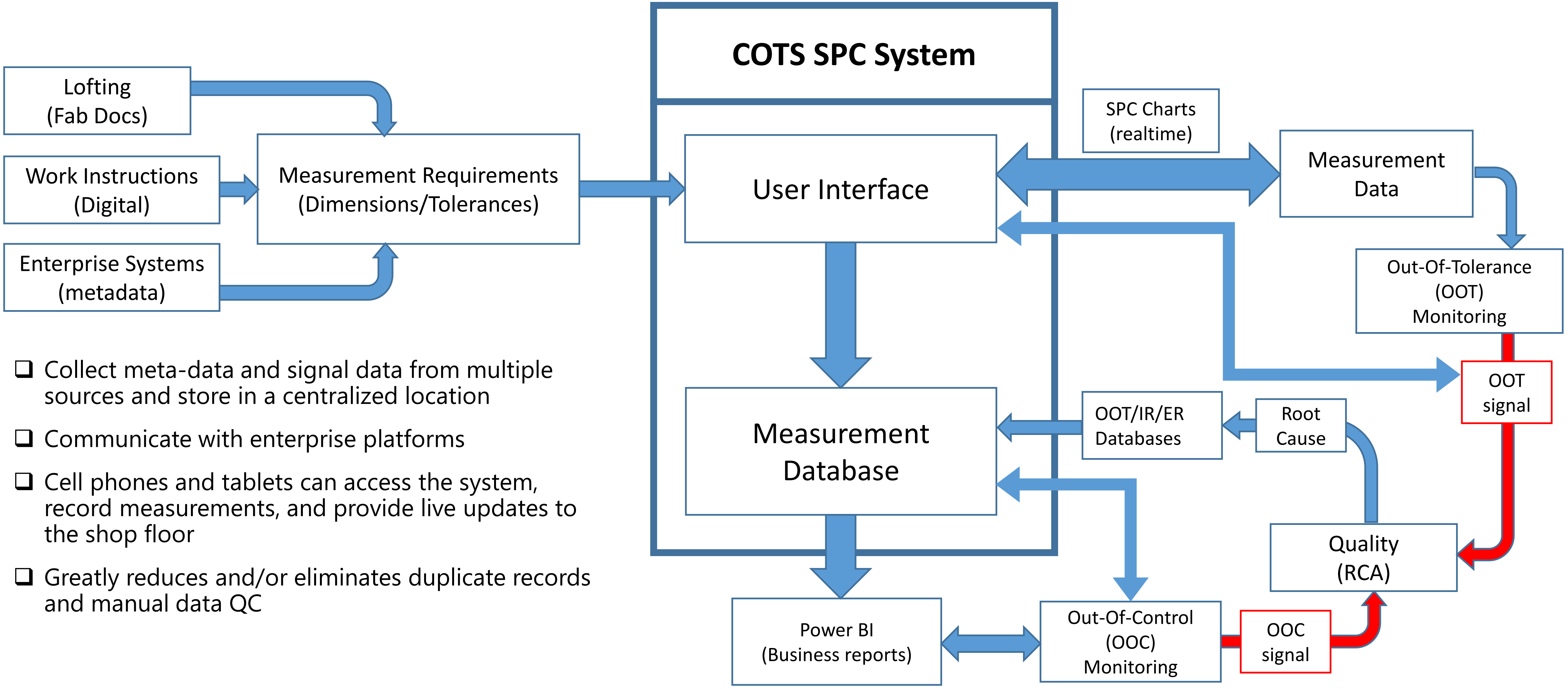
Name	Cloud / Local Install	Compatability with other systems	Short Run / Deviation from Tolerance	Flexibility to Process Changes	Predictive Analytics	Chart Live Update	Alert Live Update	Need Total	RCA Capabilities	2D or 3D Drawing Display	View Data Across Processes	Map Production Line	Meta-Analytics	Flexibility to Data Analytics	Want Total	Total Requirement
Name	Need	Need	Need	Need	Need	Need	Need		Want	Want	Want	Want	Want	Want		
Predisys Analytical Suite	1	1	1	1	1	1	1	7	1	0	1	0	1	1	4	11
DataLyzer Qualis 4.0 SPC	1	1	1	1	0.5	1	1	6.5	1	1	1	0	1	1	5	11.5
SafetyChain SPC	0.5	1	0.5	0.5	0.5	0.5	1	4.5	0.5	1	0.5	0	0	0.5	2.5	7
ZonTec Synergy 2000	1	0.5	0.5	1	0	1	1	5	0.5	1	0	0	0	0	1.5	6.5
QAD EQMS	0.5	1	0.5	1	0	1	1	5	0	0	0	0	0	1	1	6
Hexagon Q-Das	1	0.5	1	0	0	1	1	4.5	0.5	0	0	0	0	0	0.5	5

Key Factors leading to selection:

- ❑ US-based company with decades of experience
- ❑ Site-wide license option
- ❑ Performance-to-Tolerance Analysis vs traditional SPC
- ❑ Rapid analysis by multiple parameters to enhance RCCA
- ❑ Browser-based interface enabling shop floor data entry, analysis, and reporting
- ❑ Local server installation possible
- ❑ High flexibility with user interface, data fields, and schema to suit multiple enterprise inputs/outputs



NNS Future State – Centralized Digital AC System



- Collect meta-data and signal data from multiple sources and store in a centralized location
- Communicate with enterprise platforms
- Cell phones and tablets can access the system, record measurements, and provide live updates to the shop floor
- Greatly reduces and/or eliminates duplicate records and manual data QC

Centralized Digital System Benefits

Expected Benefits

- ❑ Provide user-friendly reporting and metrics that are meaningful to the operator
  - ❑ Full value stream visibility – all data housed in a common, accessible digital environment
  - ❑ Easily accessed shop floor record creation and reporting access
  - ❑ Real-time data to support accuracy scorecards, performance assessments and meaningful feedback to the build teams
- ❑ Data-driven strategic and tactical decision making
  - ❑ Provide full value stream dimensional data connectivity, transparency and historical trending
  - ❑ Early recognition of process and product variation across work centers
  - ❑ Ability to mitigate potential impacts of variation on downstream processes
  - ❑ Support statistical process control (SPC) in key operations
- ❑ Decreased variation
  - ❑ Enable consistent and sustainable first time quality at all phases of construction
  - ❑ Reduce impacts of rework required to address in-process geometric variation
  - ❑ Preserve critical alignment on high aspect ratio components

Going Further – Advanced Data Analytics

- This project will flow into S3010-A Enterprise-Wide Digital Accuracy Control and Data Analytics to build advanced data analytics for trend analysis and predictive analytics.
- Recorded data can be provided to enterprise systems, allowing more efficient and precise RCCA through part history tracking.
- Combined, this can find unrecognized patterns in factors that drive variability – material types, temperature of storage, length of storage, time of year, environmental factors, and more.

Sources

Photo/Video Location	Source	Copyright Permission (Yes/No or N/A) (Only required for photos NOT from the NNS Photo Library, HII Newsroom, HII's social media channels or DVIDS)
Slide 9	Screenshots of internally developed data, nothing sensitive included	N/A
Slide 10	Screenshot from vendor supplied Demo server*	Yes