IMTS and JIMTOF 2018 Challenge

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Base Goals

1. Digital Twin machining in multiple booths
   - Read STEP-NC process for fishhead
   - Transmit machining status to large screen TV’s using MTConnect
2. Demonstrate digital twin framework
   - Stop the machining
   - Transfer to another booth
3. Digital Twin measurement to validate results meet AP242 tolerances
   - In process measurement at the CNC
   - Final measurement on a CMM
   - Feedback to the digital twin using QIF

Digital Twin Machining

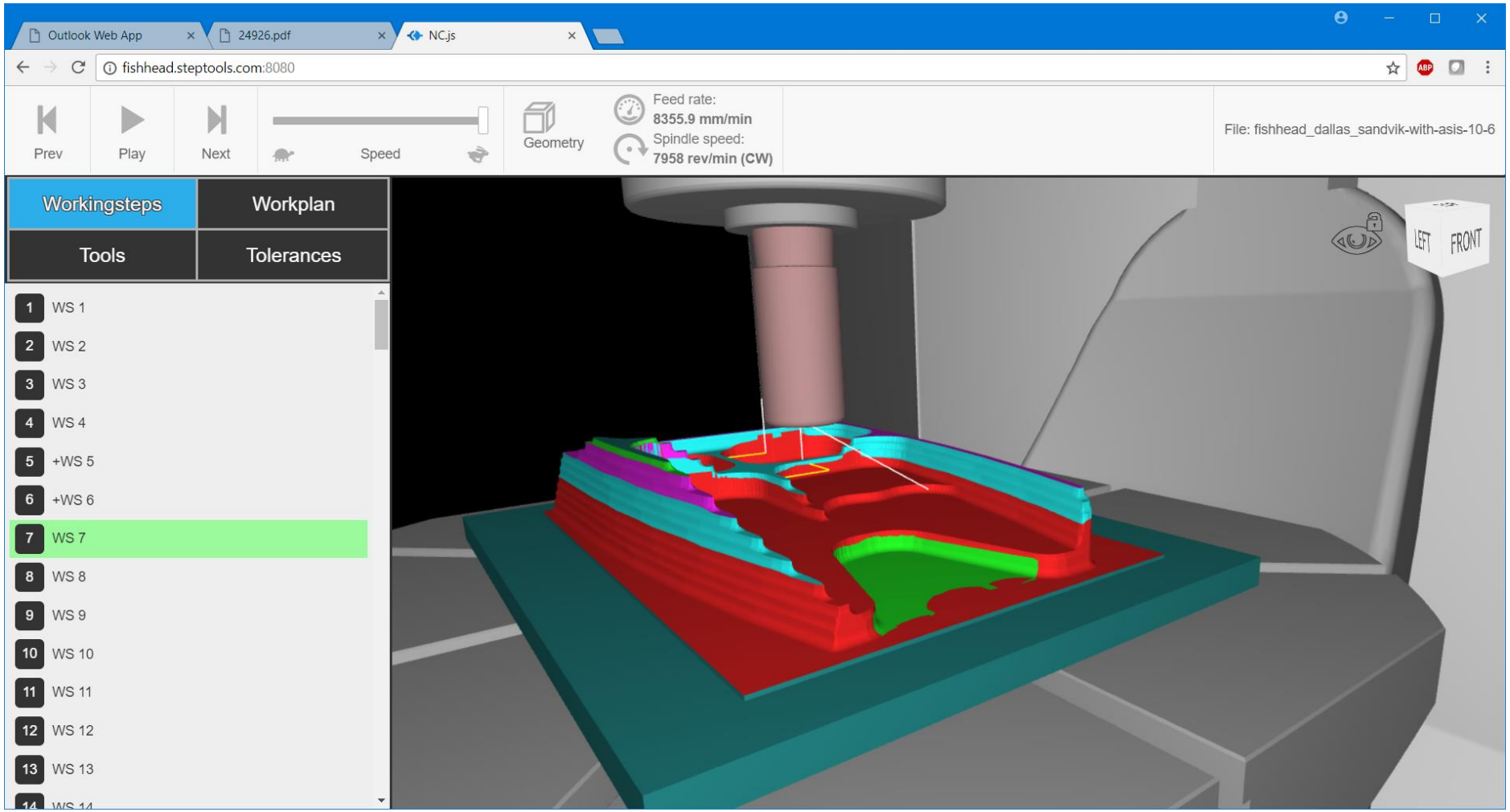
DMDII
a UI LABS Collaboration

"Mind the Gap"14-02-02

http://fishhead.steptools.com:8080/

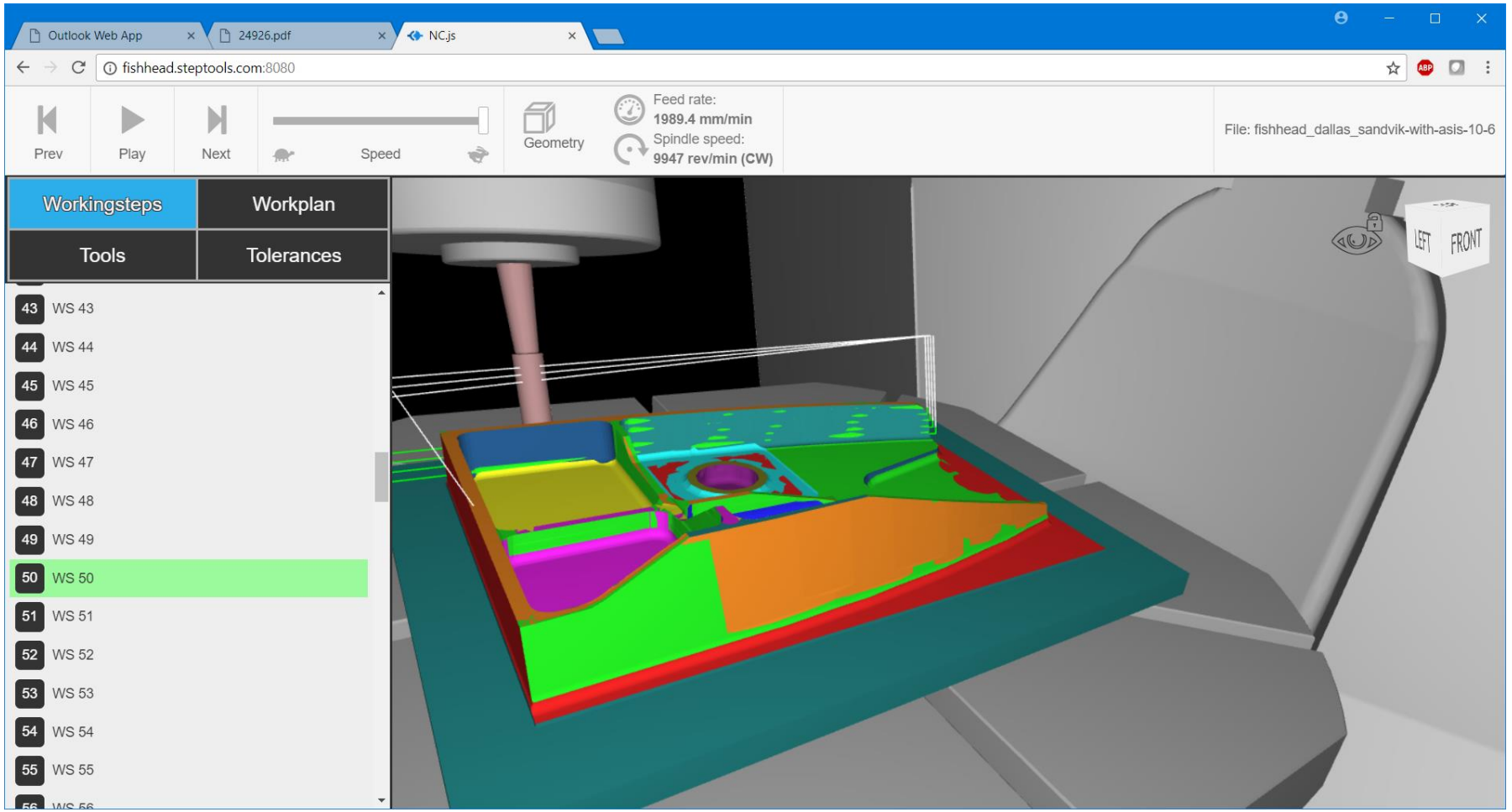
- Real time twinning from MTConnect
  - 1Hz trace the plan data
  - 250Hz model the run data
- Phone and large screen TV display
  - STEP in Node.js
  - View in Three.js
  - UI in React.js

Fishhead (aerospace test) at Workingstep 7



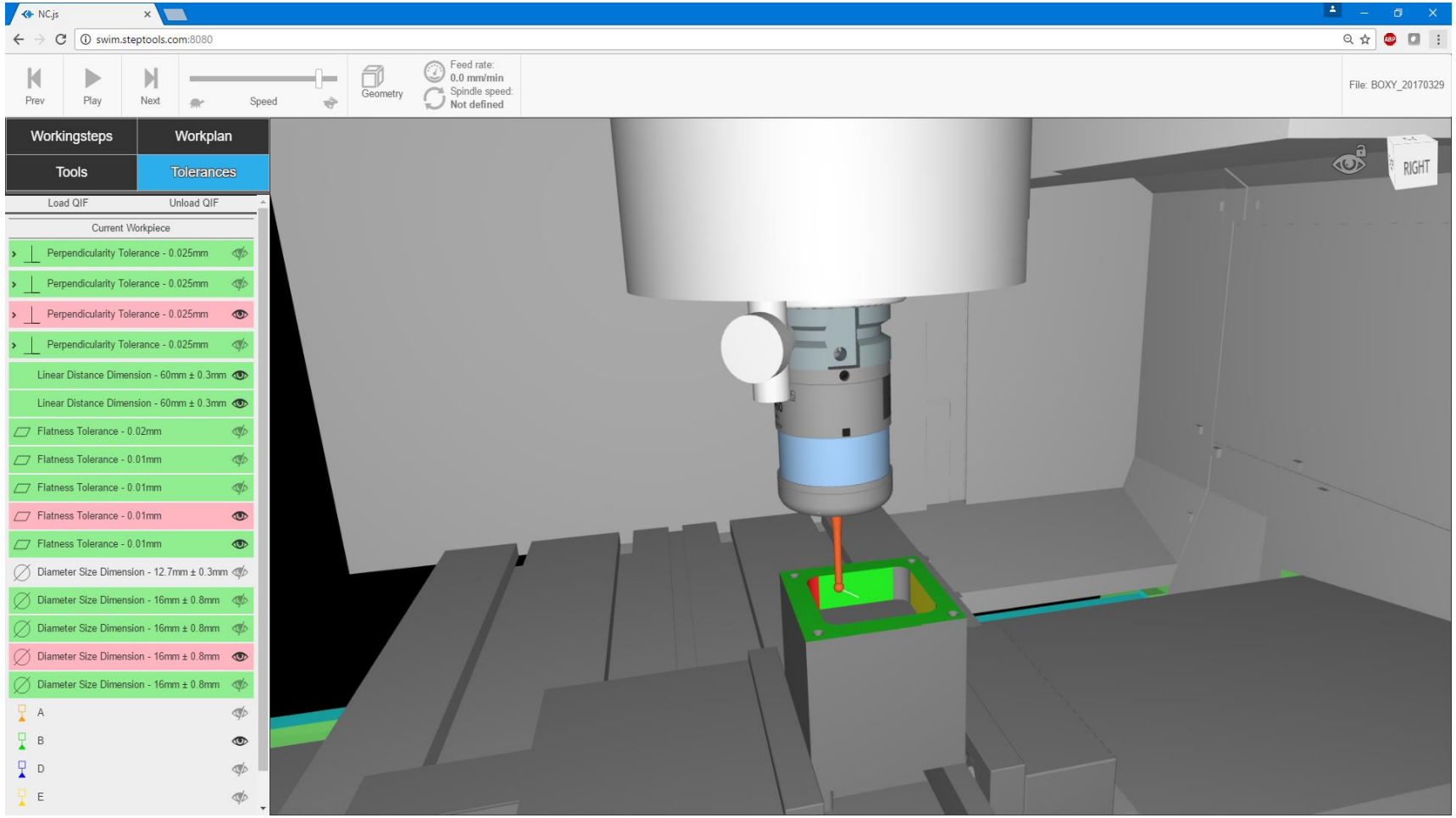
http://fishhead.steptools.com:8080/

Fishhead at Workingstep 50



http://fishhead.steptools.com:8080/

QIF results on STEP twin



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"O3" 14-06-05

Invited Participants

- Makino
- Okuma
- Hyundai
- DMG Mori
- Mazak?

- Limits
  - 4 machine vendors
  - 1 cutter vendor

- <u>Supporters</u>
  - Mitutoyo
  - Renishaw
  - DMSC/QIF
  - Dassault?
  - Autodesk?
  - NIST
  - Boeing
  - OMAC
  - ISO WG15 Digital Manufacturing
  - Sandvik
  - STEP Tools
  - AMT/MTConnect?

Sales pitch for the machine tool vendors

- Visit to Boeing to see a digital twin demonstration and STEP-NC Machining in production
- Write-up on what we are trying to do
  - Who we are
  - What we expect from each participant
  - What are the benefits
  - How we will publicize
- Ask them to participate in showing
  - Work movement with MTConnect at low resolution [1Hz] or high resolution [40Hz] for digital twinning
  - Fishhead to be machined from start to finish in each performance
  - Choice of which vendor performs which operation to be selected randomly at the start of each performance
  - Each performance ends at Mitutoyo for measurement with QIF results shown on the digital twin

- Vendors encouraged to show the advantages of the Digital Twin with applications to show
  - Automated setup
  - On machine Inspection
  - Tracking
  - Optimization
  - Cost estimentation
  - Digital manufacturing framework
  - Other ideas

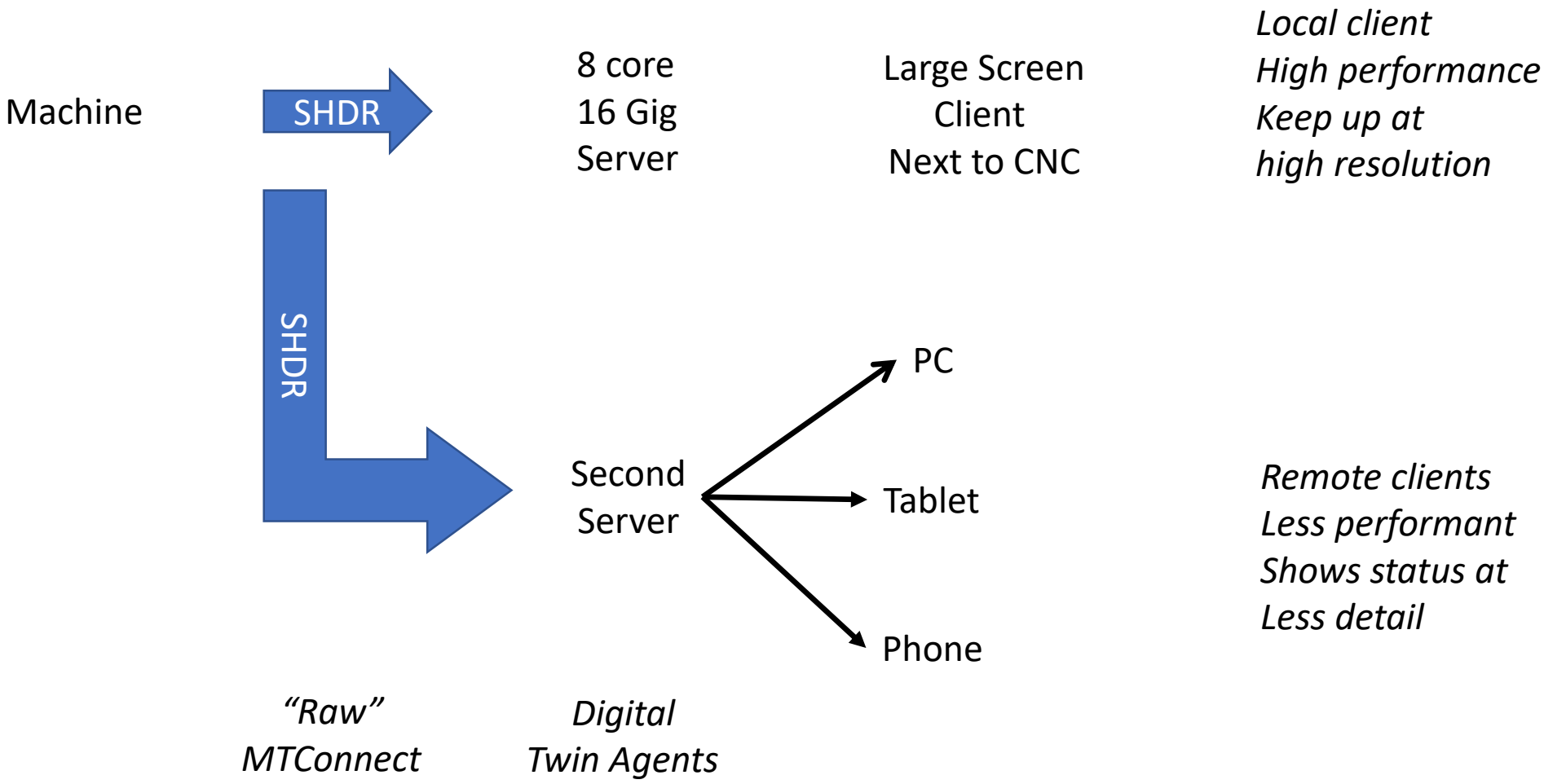
Grand Challenge preparation schedule

- Clean up fishhead data / model – Nov 30th?
  - Mitutoyo tolerances – Nov 30th
  - Boeing defined fixturing – Nov 30th
  - Boeing defined reference points – Nov 30th
  - Boeing defined ws names – Nov 30th
  - Boeing to divide into rough1, rough2, semi-finish, and finish
- Complete extract of AP238 from CATIA – Dec 31st
- **Finalize write-up – Jan 31st**
- Confirm support/funding – Feb 1st
- Visits to Boeing to see STEP-NC production machining, and machining of the fishhead test part
  - Visit 1 – Feb 15 (DMG?)
  - Visit 2 – Feb 28 (Makino?)
  - Visit 3 – March 15
  - Visit 4 – March 31
- Finalization of commitments May 1st
  - After this you may be able to join but we may not be able to help you
- Completion of detailed planning of the show logistics July 1st

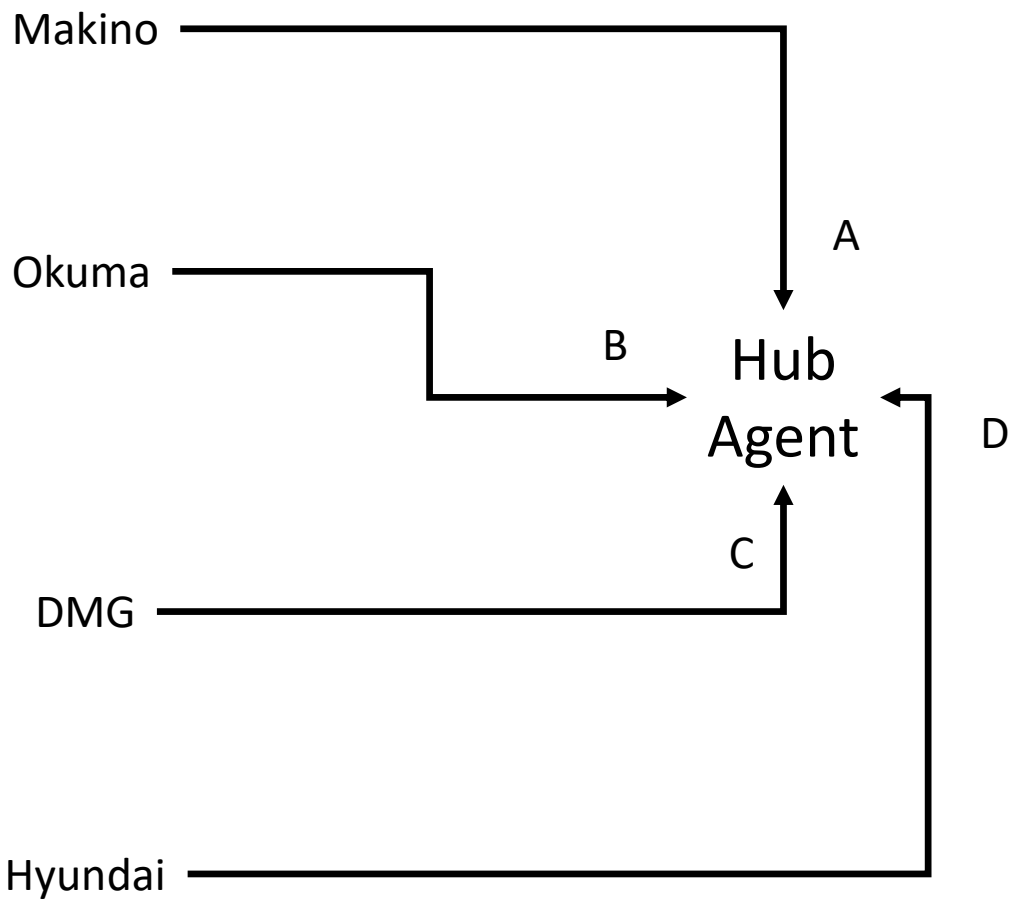
Sandvik hosting of digital twin hub

- Sandvik suppliers cutters under its standard terms for a show
- Sandvik shares models of its tools
- Machine vendor shares model of its machine
- High speed internet delivers MTConnect in real time
- Digital twin can be seen in vendor booth and at the twin hub
- Story board – November 30th
- Write-up – December 31st
- Agreement on minimal functionality – Jan 31st

Machine Twinning



Hub Twinning



Hub agent listens to each socket (one per CNC)

When a CNC starts streaming

Load the right machine model

Continue twin from the last CNC

Contents of the write-up

- Vision statement
- What will happen
- How to participate
- Check-list of requirements for participating
- How supporters can help

IMTS and JIMTOF Audience takeaway’s

- Digital twin manufacturing is inter-operable
- Digital twin manufacturing is measurable
- Digital twin manufacturing is transparent and open

- Digital twin manufacturing enables many new savings
  - See the vendor demos

- Digital twin manufacturing is the future
  - Integration of devices
  - Gateway for machine learning

Action items from Nov 15 call

- Meet deadlines for data preparation
  - David O and Larry
- Determine response rate of MTConnect on Boeing Gantry with FANUC control
  - Sid
- Visit Boeing in January to prepare demonstration
  - Martin
- Investigate inclusion of Sandvik and Renishaw in vendor visits
  - Discussion with vendors
- Investigate expanding role of QIF in the demonstrations by working with DMSC
  - John and Martin
- Sell idea of hosting the digital twin hub to Sandvik
  - Bengt
- Investigate use of robot for transport
  - Larry