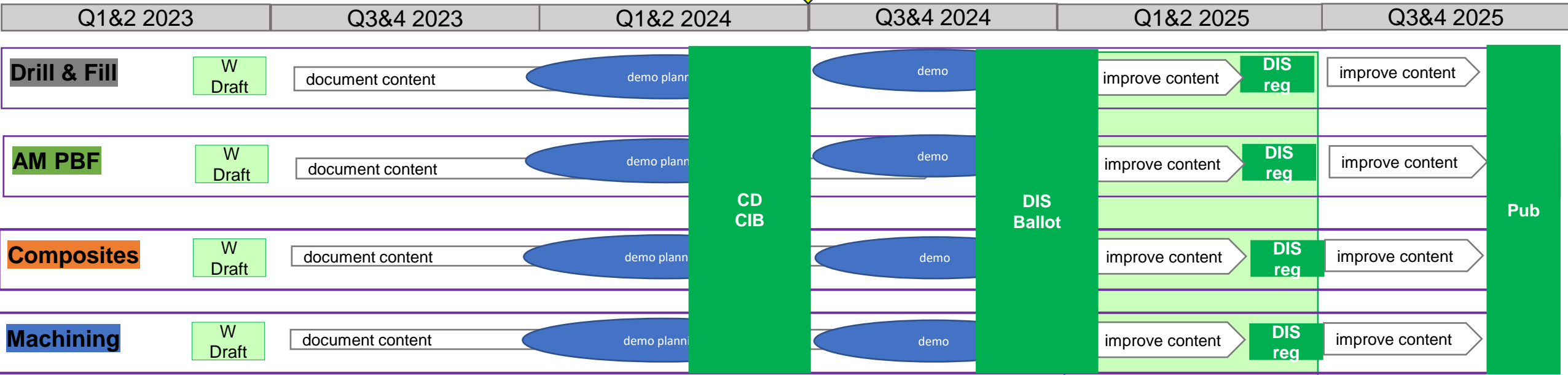


AP238 E4 – Model Based Manufacturing



Drill & Fill

Model based assembly for LOTAR

W Draft

EXPRESS definition of requirements

AM PBF

Interoperability for reliable manufacturing

CIB Ballot

Mapping tables

Composites

Digital Thread for tape layup

DIS reg

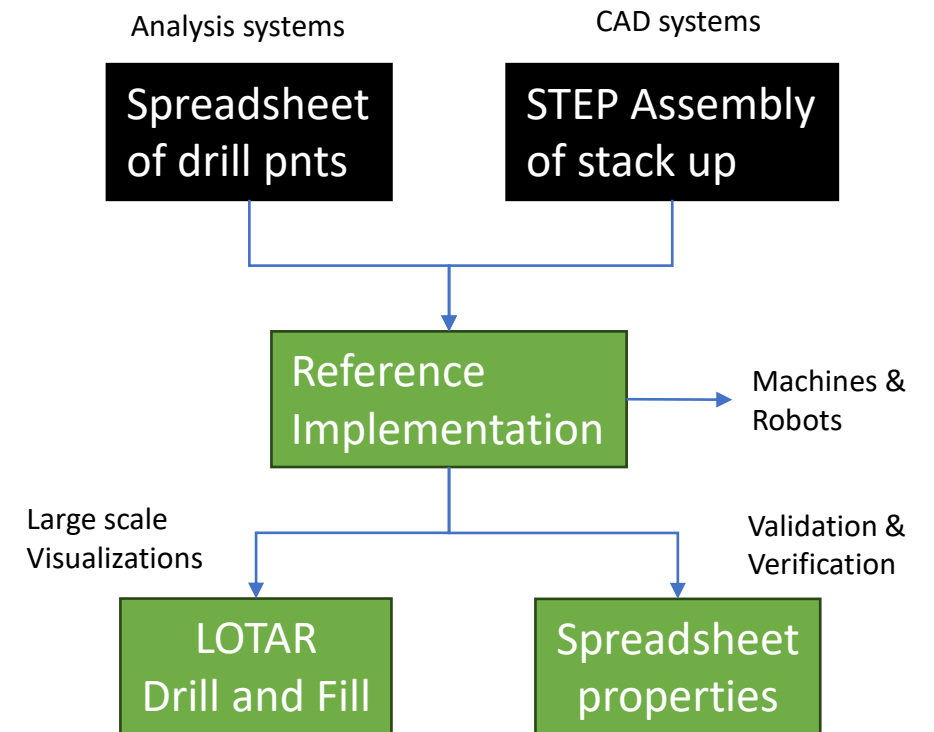
English descriptions (final form)

Machining

Reduced tool wear and cycle time

Drill and Fill for LOTAR

- Spreadsheet Input
 - Point and axis definition of stack-up's
 - Oneup classification for sequencing
 - Material for drill and fill, speed and feeds
- Long Term Archiving
 - Machining operation definition
 - Machining sequence definition
 - Machining result verification



Operation sequence is late bound

Drill and Fill Phases

Phase 1

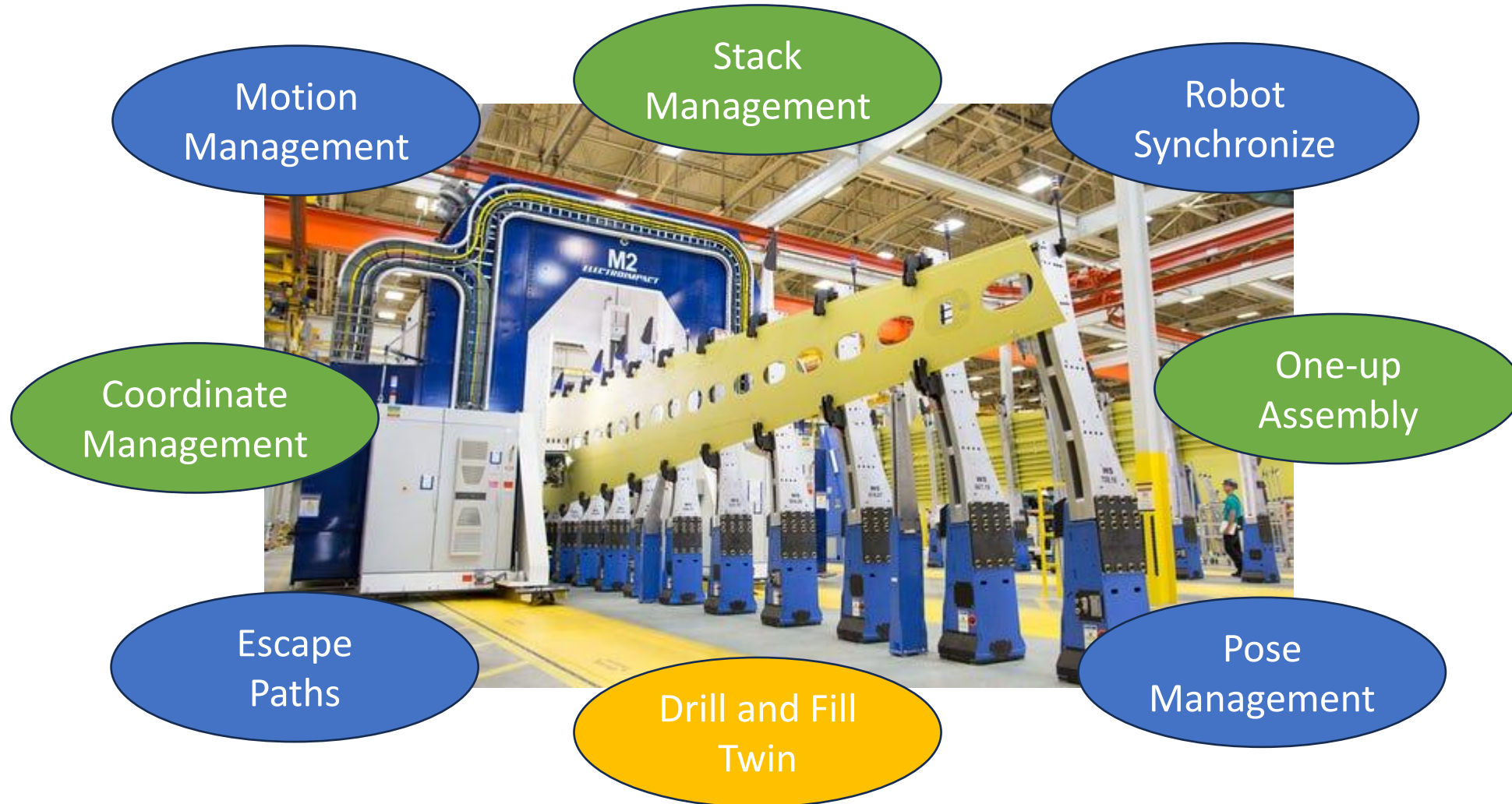
LOTAR

Phase 2

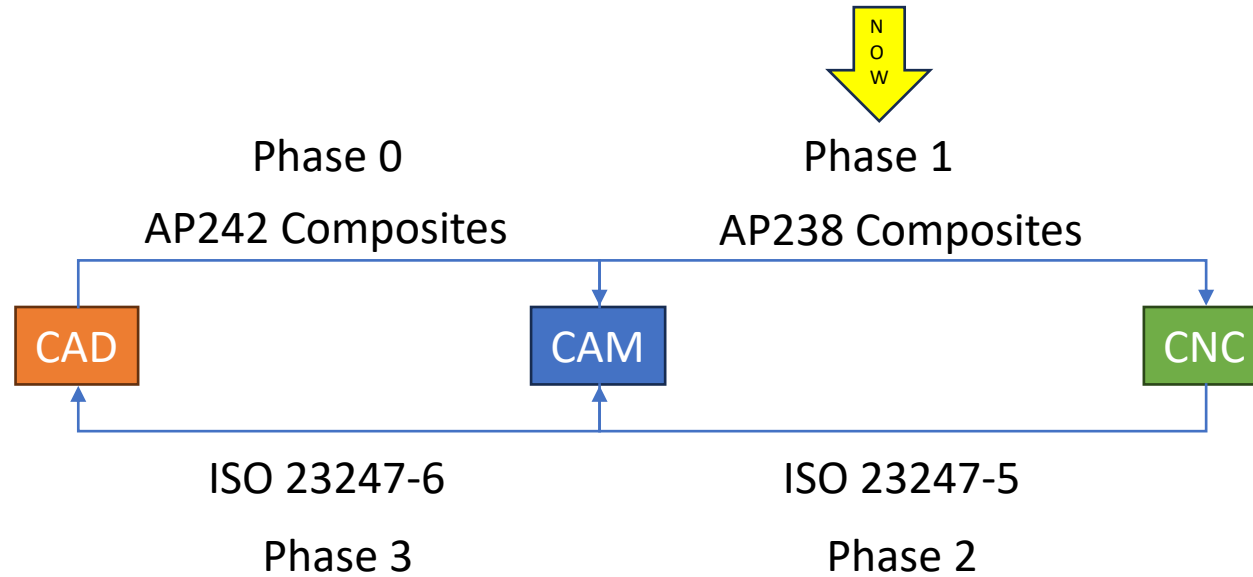
Robot teaming

Phase 3

Weight reduction



Digital Thread for Composite Tape Layup



Phase	Input	Output
0	Composite Assembly Table design	Nominal courses in STEP-NC
1	Manufacturing courses in STEP-NC	Manufacturing codes for tape layup
2	Manufacturing placements	As-laid courses
3	As-laid tapes	As-built assembly table

Digital Thread continued

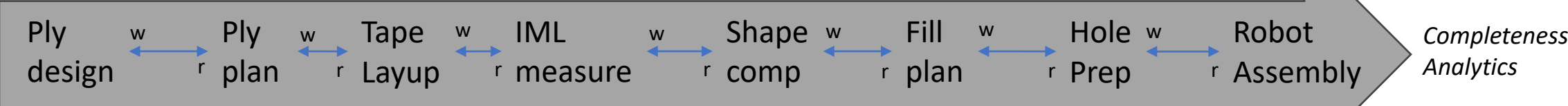
Multiple design disciplines

"How my requirements were met"

Multiple manufacturing solutions



Requirements

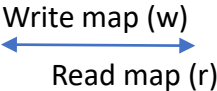


End to end identification

Completeness Analytics

Forward flow

Stability in references



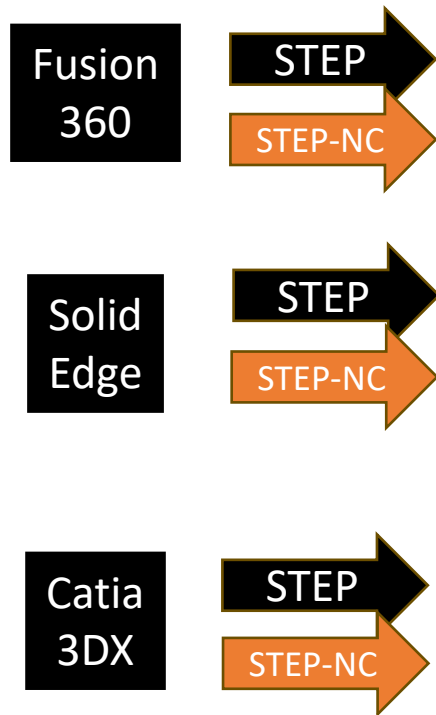
"How my design was used"

PBF data exchange

Phase 3

Update CAD to write STEP-NC

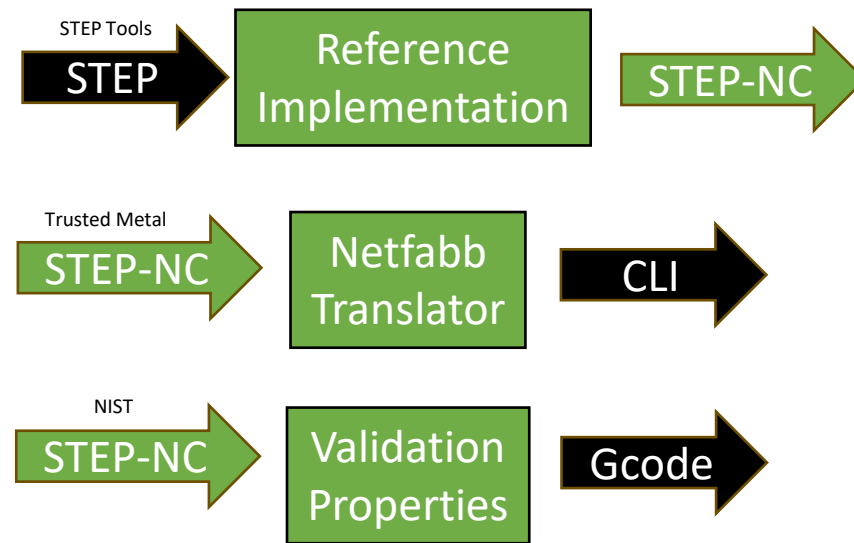
CAD Systems
With STEP



Phase 1

Build Reference systems

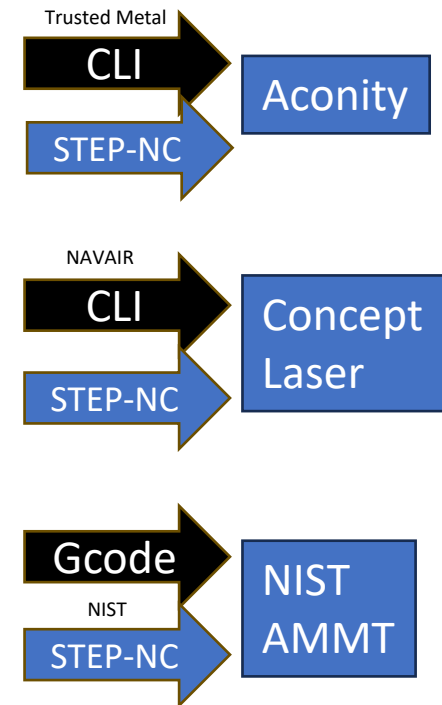
STEP-NC Systems



Phase 2

Update controls to read STEP-NC

Open Control
Powder Bed Fusion

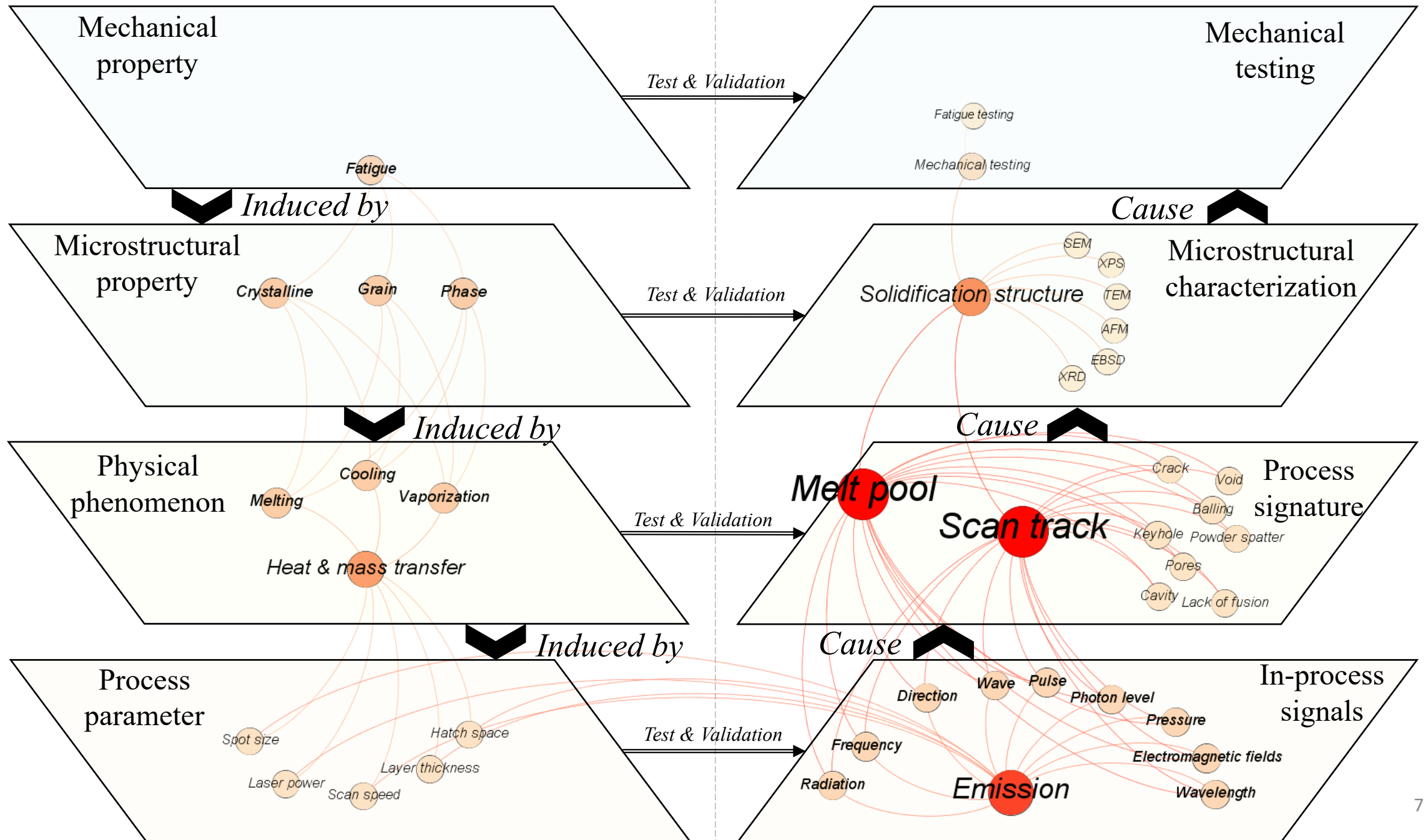


1. Make a part model

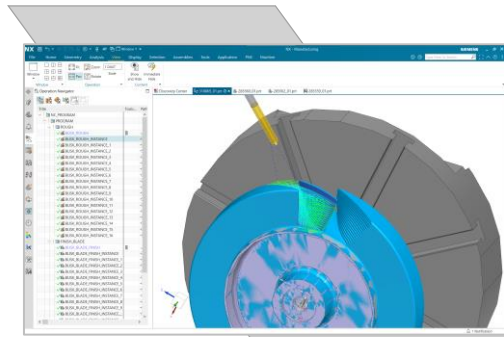
2. Convert to STEP-NC using reference algorithm

3. Same part on different machines more reliably

PBF Fatigue modeling



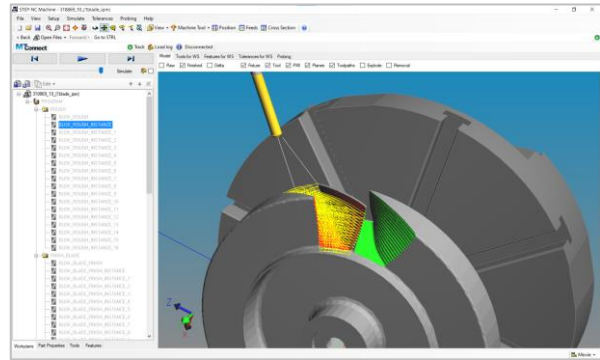
Cutter Based Collaboration



Workpiece material commercial name
Machineability classification
Specific cutting force coefficient (K_c)

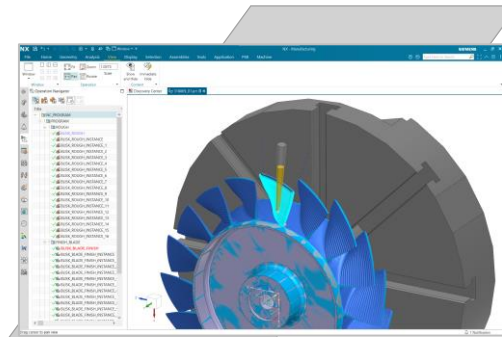
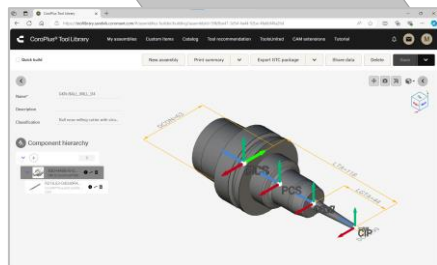
- Solution request
- Predictable tool wear
 - Reduced cycle time

Machining system constraints
(torque, power, accelerations, jerk, stiffness, stability etc.)



SANDVIK
COROMANT

Chip thickness
Equivalent cross section area
Single tool and multi tool



Adoption and comparison
Implementation
Validation of solution

- Solution proposal
- Cutting tool
 - Cutting data

Cutting based data exchange

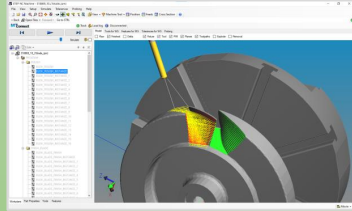
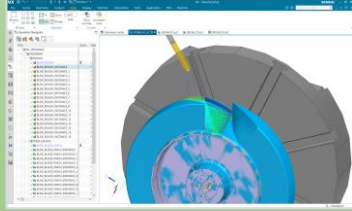
Process planning

Solution provider

3. Develop solution in collaboration

←—————→

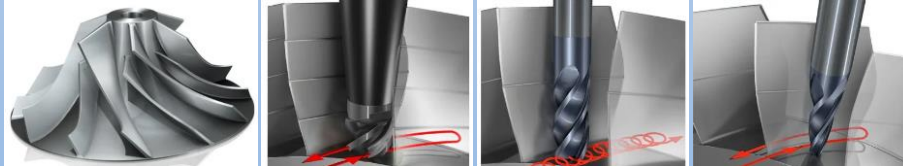
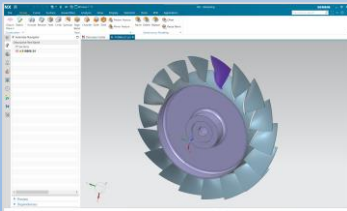
- cutting process detailing
- same** shape
- working steps, cross section, CAM strategy



2. Initiate collaboration

←—————→

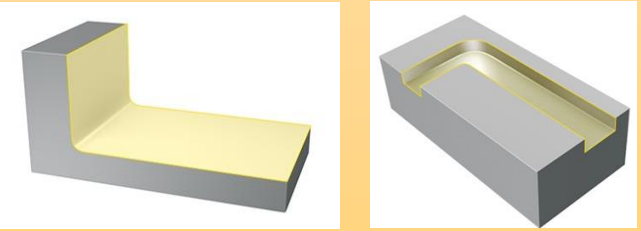
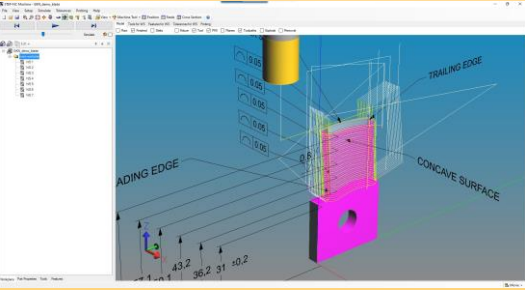
- concept detailing
- similar** shapes



1. Find collaboration

←—————→

evaluate equivalence and opportunities



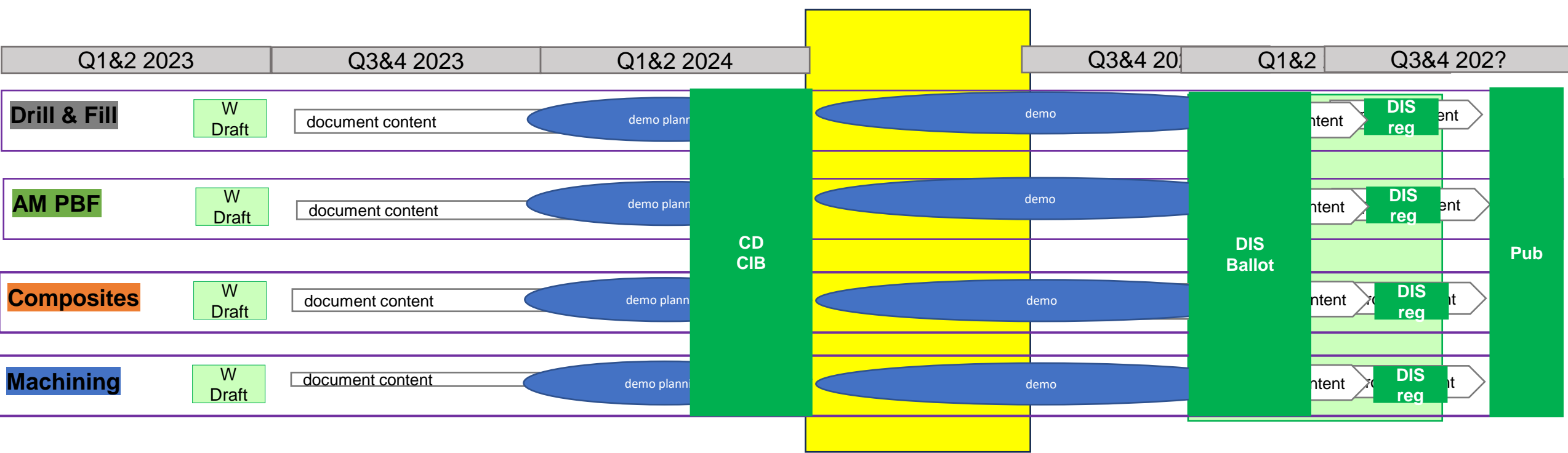
1.

2.

3.

Phases

Conclusion – time budget



Drill & Fill	Model based assembly for LOTAR	W Draft	EXPRESS definition of requirements
AM PBF	Interoperability for reliable manufacturing	CIB Ballot	Mapping tables
Composites	Digital Thread for tape layup	DIS reg	English descriptions (final form)
Machining	Reduced tool wear and cycle time	TBD?	Time extension for Inter-laboratory testing