Supporting CAM Data Exchange
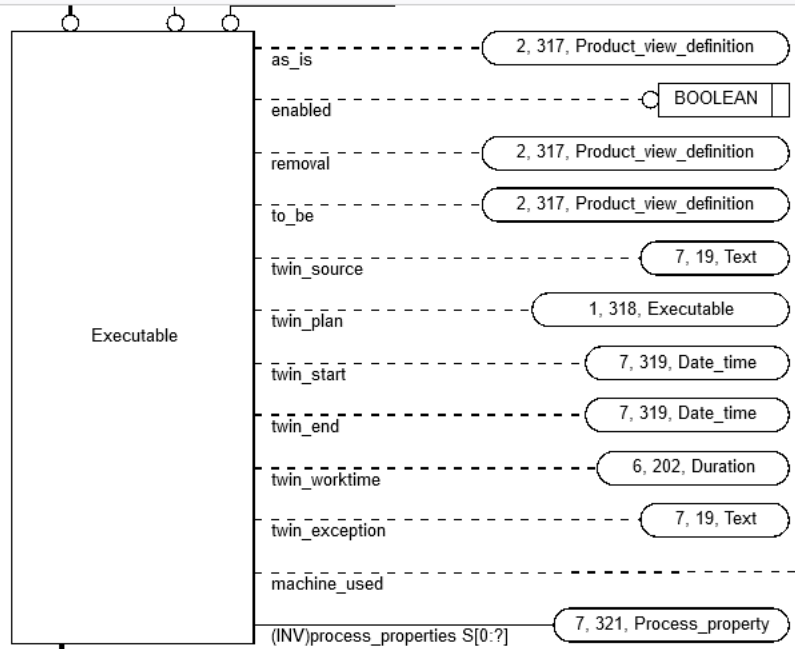
Martin Hardwick

Convenor

ISO TC184/SC4 Industrial Data

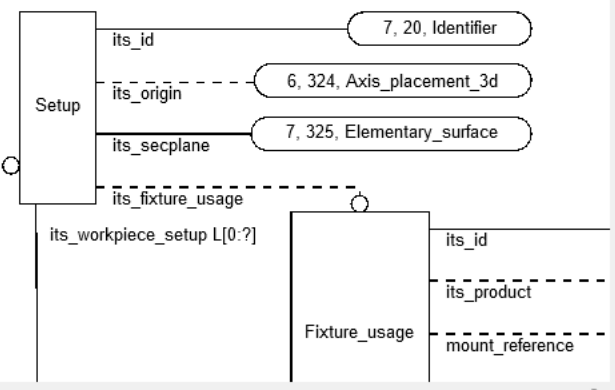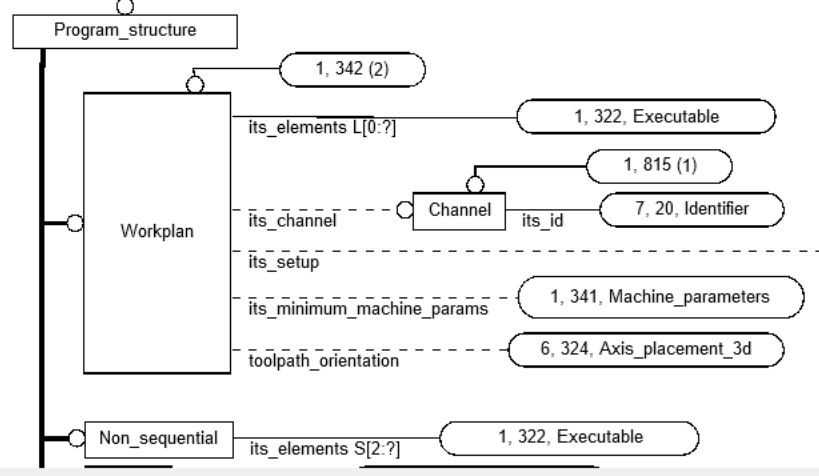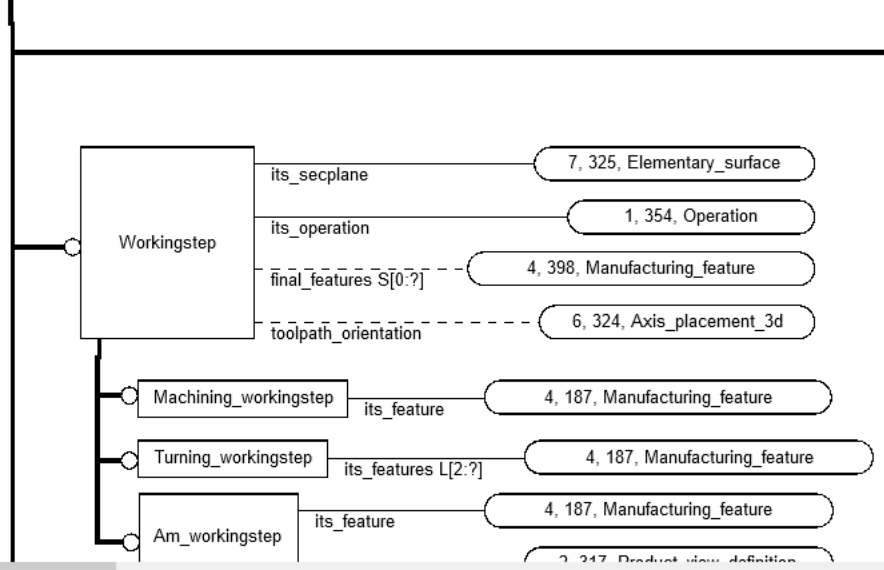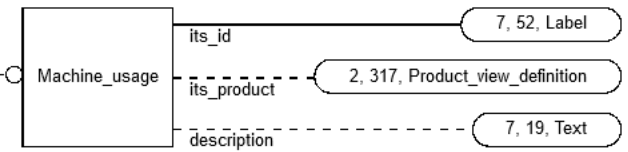*WG15 Digital Manufacturing*

President
STEP Tools, Inc.

Executable

- as_is — 2, 317, Product_view_definition
- enabled — BOOLEAN
- removal — 2, 317, Product_view_definition
- to_be — 2, 317, Product_view_definition
- twin_source — 7, 19, Text
- twin_plan — 1, 318, Executable
- twin_start — 7, 319, Date_time
- twin_end — 7, 319, Date_time
- twin_worktime — 6, 202, Duration
- twin_exception — 7, 19, Text
- machine_used — **Machine_usage**
- (INV)process_properties S[0:?] — 7, 321, Process_property

Data: https://ap238.org/stepncfiles/

Definitions: https://www.steptools.com/stds/stp_expg/arm.html

API: https://www.steptools.com/docs/stepnc_api/AptStepMaker.html

Machine_usage
- its_id — 7, 52, Label
- its_product — 2, 317, Product_view_definition
- description — 7, 19, Text

Workingstep
- its_secplane — 7, 325, Elementary_surface
- its_operation — 1, 354, Operation
- final_features S[0:?] — 4, 398, Manufacturing_feature
- toolpath_orientation — 6, 324, Axis_placement_3d

Machining_workingstep
- its_feature — 4, 187, Manufacturing_feature

Turning_workingstep
- its_features L[2:?] — 4, 187, Manufacturing_feature

Am_workingstep
- its_feature — 4, 187, Manufacturing_feature
- 2, 317, Product_view_definition

Program_structure

1, 342 (2)

Workplan
- its_elements L[0:?] — 1, 322, Executable
- its_channel — **Channel** — 1, 815 (1) / 7, 20, Identifier
  - its_id — 7, 20, Identifier
- its_setup
- its_minimum_machine_params — 1, 341, Machine_parameters
- toolpath_orientation — 6, 324, Axis_placement_3d

Non_sequential
- its_elements S[2:?] — 1, 322, Executable

Setup
- its_id — 7, 20, Identifier
- its_origin — 6, 324, Axis_placement_3d
- its_secplane — 7, 325, Elementary_surface
- its_fixture_usage
- its_workpiece_setup L[0:?]

Fixture_usage
- its_id
- its_product
- mount_reference

AP238 Edition 4

Schedule

- NWI December 2022
- Working Draft June 2023
- Committee Draft November 2023
- DIS register November 2024
- Publication November 2025

Functionalities

- Drill and Fill for air frames (draft available)
- AM for powder bed fusion (draft available)
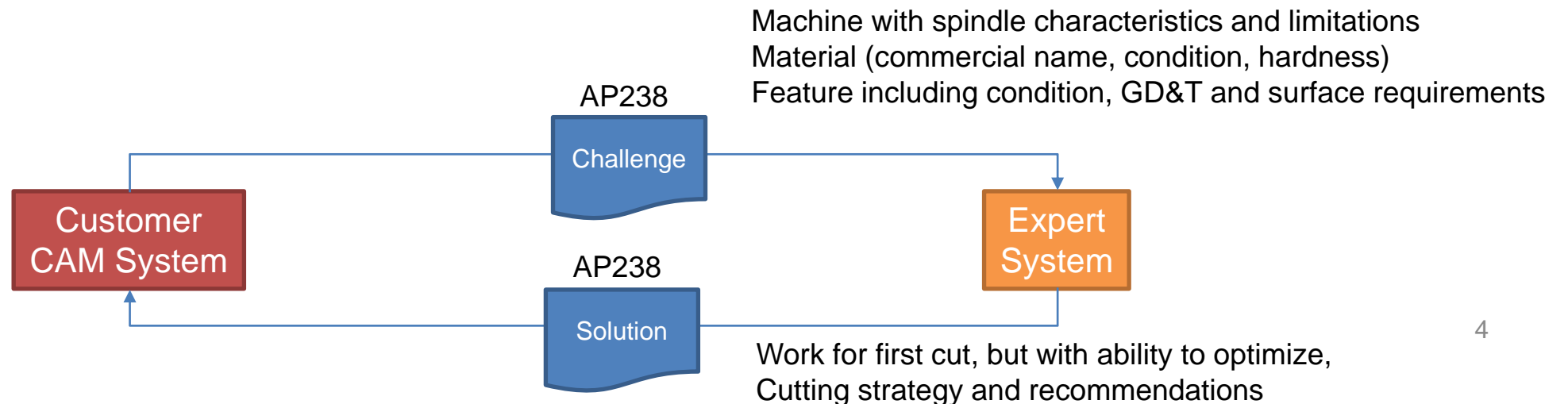- <u>Cutting recommendations (draft required)</u>

Data Exchange for Manufacturing Solutions

Tooling Challenge

- Frequently machined part
- Workpiece containing difficult to machine feature
- Tight tolerance not always being met.
- Solution made expensive by tool wear

Tooling Solution

- Faster solution using customized tool
- Solution showing how to machine the feature using advanced tooling
- Recommended process
- Solution with better management

Machine with spindle characteristics and limitations
Material (commercial name, condition, hardness)
Feature including condition, GD&T and surface requirements

AP238

Challenge

Customer
CAM System

AP238

Solution

Expert
System

Work for first cut, but with ability to optimize,
Cutting strategy and recommendations

4

Information Requirements

- Operation with "<u>window</u>" for speeds and feeds
  - Load on the cutter
  - Chip load
  - Radial engagement
- References to ISO 13199 properties
  - Proper mounting
  - Proper engagement

Window = maximum, minimum, sweet_spot

Homework

- Hardmoldy (https://ap238.org/stepncfiles/moldy/) contains three cutting tool solutions.

- Each is an exact solution with no guidance on how the cutting parameters might be changed for different cutting conditions

- We ask the owner of each solution to "invent" some data to show how appropriate guidance might be given for different cutting conditions.
    - Minimize tool wear
    - Reduce stiffness
    - Increase spindle load