

1.3 Disclaimer

This work is an official contribution of the NIST and not subject to copyright in the United States. Certain commercial systems are identified in this paper. Such identification does not imply recommendation or endorsement by NIST. Nor does it imply that the products identified are necessarily the best available for the purpose.

1.4 Overview

The remainder of this document contains a description of the current resources (Section 2) and the planned or future resources (Section 3) of the SMS Test Bed. In closing, this document will list citations and additional references (Section 4) for the SMS Test Bed, which will provide guidance on using and replicating the SMS Test bed.

2. Current Resources

2.1 CAx Lab

The CAx Lab contains several computer-aided technology tools from the computer-aided design (CAD), computer-aided manufacturing (CAM), computer-aided inspection (CAI), product-data management (PDM), and verification & validation (V&V) domains. Uses of the CAx Lab include, but are not limited to, developing test cases for conformance validation to standards, generating CAD models for experiments, and testing cyber-physical connections across the product lifecycle. Table 1 and Table 2 list the current software and hardware resources, respectively, available within the CAx Lab.

Table 1. Software-based resources available currently in the CAx Lab

Name	Description	Category	Manufacturer
Anark Core WS	PDF/PRC generator	DEX	Anark Corp
CADIQ	Model validation	V&V	ITI
Creo	Parametric modeling system	CAD	PTC
ESPRIT CAM	Computer numerical control (CNC) programming tool	CAM	DP Technology Corp
IDA-STEP	STEP file viewer	CAD	LKSoftWare GmbH
Innovator	Open-source PDM tool	PDM	Aras Corp
MasterCAM	CNC programming tool	CAM	CNC Software
mCosmos	On-line and off-line coordinate-measurement machine (CMM) execution	CAI	Mitutoyo
MeasureLink	Measurement analysis	CAI	Mitutoyo
MiCat Planner	CMM planning software	CAI	Mitutoyo
NiFi	Data-flow system	PDM	Apache Software Foundation
NX	Parametric modeling system	CAD	Siemens PLM
Solidworks	Parametric modeling system	CAD	Dassault Systems
Solidworks MBD	Model-based generation tool	CAD	Dassault Systems

Legend: CAD = computer-aided design, CAM = computer-aided manufacturing, CAI = computer-aided inspection, DEX = data exchange, PDM = product-data management, V&V = verification & validation

Table 2. Hardware-based resources available currently in the CAx Lab

Purpose	Processor	RAM	Video	HHD	OS
General Use	Intel, i5-3550S, 4-core, 3 GHz	4 GB, 1600 MHz	Intel HD Graphics 2500	250 GB, 7.2K	Windows
Workstation	Intel, E5-2630, 6-core, 2.6 GHz	4x4GB (16GB), 1600 MHz	AMD FirePro V5900 (2GB)	1 TB, 7.2K	Windows
Workstation	Intel, E5-2630, 6-core, 2.6 GHz	4x4GB (16GB), 1600 MHz	AMD FirePro V5900 (2GB)	1 TB, 7.2K	Windows
Workstation	Intel, E5-2609, 4-core, 2.4 GHz	4x4GB (16GB), 1600 MHz	AMD FirePro V5900 (2GB)	1 TB, 7.2K	Windows
Workstation	Intel, E5-2609, 4-core, 2.4 GHz	4x4GB (16GB), 1600 MHz	AMD FirePro V5900 (2GB)	1 TB, 7.2K	Windows
License Server	Intel, i5-3550S, 4-core, 3 GHz	4 GB, 1600 MHz	Intel HD Graphics 2500	250 GB, 7.2K	Windows
Server	2x Intel, E5-2670, 12-core, 2.3 GHz	2x16GB (32GB), 2133 MHz	on-board	4x 1TB, 7.2k	Linux
Server	2x Intel, E5-2670, 12-core, 2.3 GHz	2x16GB (32GB), 2133 MHz	on-board	8x 1TB, 7.2k	Windows

2.2 Manufacturing Lab

The Manufacturing Lab, in partnership with the NIST Fabrication Technology Office (FTO), mimics the configuration of a contract-manufacturing shop. The Manufacturing Lab contains several fabrication machine tools (e.g., CNC milling, CNC turning) and metrology / inspection equipment (e.g., CMM, digital micrometers). Table 3 and Table 4 list the current machine tools and metrology equipment resources, respectively, available within the Manufacturing Lab.

Table 3. Machine-tool resources available for fabrication activities currently in the Manufacturing Lab

Device	UUID	Manufacturer	Model	Type
GFAgie01	mtc_adapter001	Agie Charmilles	Micron HPM600U	5-axis milling center
Mazak01	mtc_adapter002	Mazak	Integrex 100-IV	Mill-turn center
Mazak03	mtc_adapter004	Mazak	QuickTurn Nexus 300	Turning center
Hurco01	mtc_adapter005	Hurco	VMX 24	3-axis milling center
Hurco02	mtc_adapter006	Hurco	VMX 24	3-axis milling center
Hurco03	mtc_adapter007	Hurco	VMX 24	3-axis milling center
Hurco04	mtc_adapter008	Hurco	VMX 24	3-axis milling center
Hurco05	mtc_adapter009	Hurco	VMX 42	3-axis milling center
Hurco06	mtc_adapter010	Hurco	VMX 64	3-axis milling center

Table 4. Metrology equipment resources available for digital-inspection activities currently in the Manufacturing Lab

Device	UUID	Manufacturer	Model	Type
Mitutoyo01	mtc_met_adapter001	Mitutoyo	BHN 710	5-axis CMM
Mitutoyo02	mtc_met_adapter002	Mitutoyo	293-130	Micrometers
Mitutoyo03	mtc_met_adapter003	Mitutoyo	SJ-210	Surface profilometer

2.3 Web Services

Data is collected from the Manufacturing Lab using the MTConnect standard [1]. That data is aggregated and published internally and externally of NIST via web services. Three channels of data dissemination are available from the SMS Test Bed: (1) a volatile-data stream (VDS) using an MTConnect agent, (2) a query-able data repository (QDR) using the NIST Material Data Curation System (MDCS), and (3) pre-compiled technical-data packages (TDP) that include a collection of CAx Lab data and associated Manufacturing Lab data.

Table 5 through Table 13 provide the available DataItems in both the VDS and QDR for each device listed in Table 3. Each DataItem is listed by its Id, Name, Category, Type, Sub Type, and Units. Any DataItem that has a “x:” prefixing its Type and/or Sub Type is a machine-specific

extension of the MTConnect Data Dictionary. Refer to Part 2 of the MTConnect standard [2] for more information about DataItem, Category, Type, and Sub Type. The raw probe output¹ from MTconnect agent in the VDS is provided in Appendix A.

Table 5. Available DataItem in the VDS and QDR for the GFAGie01 device

Id	Name	Category	Type	Sub Type	Units
GFAGie01-dtop_1	avail	EVENT	AVAILABILITY	null	null
GFAGie01-dtop_2	estop	EVENT	EMERGENCY_STOP	null	null
GFAGie01-dtop_3	system	CONDITION	SYSTEM	null	null
GFAGie01-X_2	Xposition	SAMPLE	POSITION	ACTUAL	MILLIMETER
GFAGie01-Y_2	Yposition	SAMPLE	POSITION	ACTUAL	MILLIMETER
GFAGie01-Z_2	Zposition	SAMPLE	POSITION	ACTUAL	MILLIMETER
GFAGie01-C_2	Cposition	SAMPLE	ANGLE	ACTUAL	DEGREE
GFAGie01-A_2	Aposition	SAMPLE	ANGLE	ACTUAL	DEGREE
GFAGie01-controller_basic_2	Fovr	EVENT	PATH_FEEDRATE_OVERRIDE	null	PERCENT
GFAGie01-controller_basic_3	Sovr	EVENT	ROTARY_VELOCITY_OVERRIDE	null	PERCENT
GFAGie01-controller_basic_4	servo	CONDITION	ACTUATOR	null	null
GFAGie01-controller_basic_5	comms	CONDITION	COMMUNICATIONS	null	null
GFAGie01-controller_basic_6	pneumatic	CONDITION	COMMUNICATIONS	null	null
GFAGie01-controller_basic_7	hydraulic	CONDITION	COMMUNICATIONS	null	null
GFAGie01-controller_basic_8	logic	CONDITION	LOGIC_PROGRAM	null	null
GFAGie01-controller_basic_9	motion	CONDITION	MOTION_PROGRAM	null	null
GFAGie01-controller_basic_10	cnc_temp	CONDITION	TEMPERATURE	null	null
GFAGie01-path_basic_2	execution	EVENT	EXECUTION	null	null
GFAGie01-path_basic_3	mode	EVENT	CONTROLLER_MODE	null	null
GFAGie01-path_basic_4	program	EVENT	PROGRAM	null	null
GFAGie01-path_basic_5	line	EVENT	LINE	null	null
GFAGie01-path_basic_6	move	EVENT	x:MOTION	null	null
GFAGie01-path_basic_7	path_pos	SAMPLE	PATH_POSITION	null	MILLIMETER_3D

¹The real-time probe out is available at <https://smstestbed.nist.gov/vds/probe>

Table 6. Available DataItem in the VDS and QDR for the Mazak01 device

Id	Name	Category	Type	Sub Type	Units
Mazak01-dtop.1	avail	EVENT	AVAILABILITY	null	null
Mazak01-base.1	servo_cond	CONDITION	ACTUATOR	null	null
Mazak01-X.1	Xabs	SAMPLE	POSITION	ACTUAL	MILLIMETER
Mazak01-X.2	Xtravel	CONDITION	POSITION	null	null
Mazak01-X.3	Xload	SAMPLE	LOAD	null	PERCENT
Mazak01-X.4	Xfirt	SAMPLE	AXIS_FEEDRATE	null	MILLIMETER/SECOND
Mazak01-Y.1	Yabs	SAMPLE	POSITION	ACTUAL	MILLIMETER
Mazak01-Y.2	Ytravel	CONDITION	POSITION	null	null
Mazak01-Y.3	Yload	SAMPLE	LOAD	null	PERCENT
Mazak01-Y.4	Yfirt	SAMPLE	AXIS_FEEDRATE	null	MILLIMETER/SECOND
Mazak01-Z.1	Zabs	SAMPLE	POSITION	ACTUAL	MILLIMETER
Mazak01-Z.2	Ztravel	CONDITION	POSITION	null	null
Mazak01-Z.3	Zload	SAMPLE	LOAD	null	PERCENT
Mazak01-Z.4	Zfirt	SAMPLE	AXIS_FEEDRATE	null	MILLIMETER/SECOND
Mazak01-B.1	Bload	SAMPLE	LOAD	null	PERCENT
Mazak01-B.2	Bfirt	SAMPLE	ANGULAR_VELOCITY	null	DEGREE/SECOND
Mazak01-B.3	Btravel	CONDITION	ANGLE	null	null
Mazak01-B.4	Bdeg	SAMPLE	ANGLE	ACTUAL	DEGREE
Mazak01-C.1	Cload	SAMPLE	LOAD	null	PERCENT
Mazak01-C.2	Sload	SAMPLE	LOAD	null	PERCENT
Mazak01-C.3	Ctravel	CONDITION	ANGLE	null	null
Mazak01-C.4	Cfirt	SAMPLE	ANGULAR_VELOCITY	null	DEGREE/SECOND
Mazak01-C.5	Srpm	SAMPLE	ROTARY_VELOCITY	ACTUAL	REVOLUTION/MINUTE
Mazak01-C.6	Sovr	EVENT	ROTARY_VELOCITY_OVERRIDE	null	PERCENT
Mazak01-C.7	Stemp	SAMPLE	TEMPERATURE	null	CELSIUS
Mazak01-C.8	Cdeg	SAMPLE	ANGLE	ACTUAL	DEGREE
Mazak01-C.9	Sload_cond	CONDITION	LOAD	null	null
Mazak01-C.10	Stemp_cond	CONDITION	TEMPERATURE	null	null
Mazak01-C2.1	S2load	SAMPLE	LOAD	null	PERCENT
Mazak01-C2.2	S2rpm	SAMPLE	ROTARY_VELOCITY	ACTUAL	REVOLUTION/MINUTE
Mazak01-C2.3	S2temp	SAMPLE	TEMPERATURE	null	CELSIUS
Mazak01-C2.4	S2load_cond	CONDITION	LOAD	null	null
Mazak01-C2.5	S2temp_cond	CONDITION	TEMPERATURE	null	null
Mazak01-controller.1	comms_cond	CONDITION	COMMUNICATIONS	null	null
Mazak01-controller.2	logic_cond	CONDITION	LOGIC_PROGRAM	null	null
Mazak01-controller.3	system_cond	CONDITION	SYSTEM	null	null
Mazak01-controller.4	estop	EVENT	EMERGENCY_STOP	null	null
Mazak01-path.1	program	EVENT	PROGRAM	null	null
Mazak01-path.2	subprogram	EVENT	PROGRAM	x:SUB	null
Mazak01-path.3	line	EVENT	LINE	null	null
Mazak01-path.4	unitNum	EVENT	x:UNIT	null	null
Mazak01-path.5	sequenceNum	EVENT	x:SEQUENCE_NUMBER	null	null
Mazak01-path.6	PartCountAct	EVENT	PART_COUNT	null	null
Mazak01-path.7	Fact	SAMPLE	PATH_FEEDRATE	ACTUAL	MILLIMETER/SECOND
Mazak01-path.8	Frapidovr	EVENT	PATH_FEEDRATE_OVERRIDE	RAPID	PERCENT
Mazak01-path.9	Fovr	EVENT	PATH_FEEDRATE_OVERRIDE	PROGRAMMED	PERCENT
Mazak01-path.10	Tool_number	EVENT	TOOL_NUMBER	null	null
Mazak01-path.11	Tool_group	EVENT	x:TOOL_GROUP	null	null
Mazak01-path.12	Tool_suffix	EVENT	x:TOOL_SUFFIX	null	null
Mazak01-path.13	execution	EVENT	EXECUTION	null	null
Mazak01-path.14	mode	EVENT	CONTROLLER_MODE	null	null
Mazak01-path.15	program_cmt	EVENT	x:PROGRAM_COMMENT	null	null
Mazak01-path.16	subprogram_cmt	EVENT	x:PROGRAM_COMMENT	x:SUB	null
Mazak01-path.17	auto_time	SAMPLE	ACCUMULATED_TIME	x:AUTO	null
Mazak01-path.18	total_time	SAMPLE	ACCUMULATED_TIME	x:TOTAL	null
Mazak01-path.19	cut_time	SAMPLE	ACCUMULATED_TIME	x:CUT	null
Mazak01-path.20	motion_cond	CONDITION	MOTION_PROGRAM	null	null
Mazak01-path.21	path_system	CONDITION	SYSTEM	null	null
Mazak01-electric.1	power	EVENT	POWER_STATE	null	null
Mazak01-electric.2	electric_temp	CONDITION	TEMPERATURE	null	null
Mazak01-hydraulic.1	hydra_cond	CONDITION	PRESSURE	null	null
Mazak01-coolant.1	coolant_pres	CONDITION	PRESSURE	null	null
Mazak01-coolant.2	coolant_temp	CONDITION	TEMPERATURE	null	null
Mazak01-coolant.3	coolant_level	CONDITION	LEVEL	null	null
Mazak01-pneumatic.1	pneu_cond	CONDITION	PRESSURE	null	null

Table 7. Available DataItem in the VDS and QDR for the Mazak03 device

Id	Name	Category	Type	Sub Type	Units
Mazak03-dtop_1	avail	EVENT	AVAILABILITY	null	null
Mazak03-base_2	servo_cond	CONDITION	ACTUATOR	null	null
Mazak03-X_2	Xabs	SAMPLE	POSITION	ACTUAL	MILLIMETER
Mazak03-X_3	Xtravel	CONDITION	POSITION	null	null
Mazak03-X_4	Xload	SAMPLE	LOAD	null	PERCENT
Mazak03-X_5	Xfirt	SAMPLE	AXIS_FEEDRATE	null	MILLIMETER/SECOND
Mazak03-Z_2	Zabs	SAMPLE	POSITION	ACTUAL	MILLIMETER
Mazak03-Z_3	Ztravel	CONDITION	POSITION	null	null
Mazak03-Z_4	Zload	SAMPLE	LOAD	null	PERCENT
Mazak03-Z_5	Zfirt	SAMPLE	AXIS_FEEDRATE	null	MILLIMETER/SECOND
Mazak03-C_2	Cload	SAMPLE	LOAD	null	PERCENT
Mazak03-C_3	Cfirt	SAMPLE	ANGULAR_VELOCITY	null	DEGREE/SECOND
Mazak03-C_4	Cdeg	SAMPLE	ANGLE	ACTUAL	DEGREE
Mazak03-C_5	Ctravel	CONDITION	ANGLE	null	null
Mazak03-S_2	Srpm	SAMPLE	ROTARY_VELOCITY	ACTUAL	REVOLUTION/MINUTE
Mazak03-S_3	S1load	SAMPLE	LOAD	null	PERCENT
Mazak03-S_4	Stemp	SAMPLE	TEMPERATURE	null	CELSIUS
Mazak03-S_5	Sload_cond	CONDITION	LOAD	null	null
Mazak03-S_6	Stemp_cond	CONDITION	TEMPERATURE	null	null
Mazak03-S2_2	S2rpm	SAMPLE	ROTARY_VELOCITY	ACTUAL	REVOLUTION/MINUTE
Mazak03-S2_3	S2load	SAMPLE	LOAD	null	PERCENT
Mazak03-S2_4	S2temp	SAMPLE	TEMPERATURE	null	CELSIUS
Mazak03-S2_5	S2load_cond	CONDITION	LOAD	null	null
Mazak03-S2_6	S2temp_cond	CONDITION	TEMPERATURE	null	null
Mazak03-controller_2	comms_cond	CONDITION	COMMUNICATIONS	null	null
Mazak03-controller_3	logic_cond	CONDITION	LOGIC_PROGRAM	null	null
Mazak03-controller_4	system_cond	CONDITION	SYSTEM	null	null
Mazak03-controller_5	pallet_num	EVENT	x:PALLET_NUMBER	null	null
Mazak03-path_2	Sovr	EVENT	ROTARY_VELOCITY_OVERRIDE	null	null
Mazak03-path_3	program	EVENT	PROGRAM	null	null
Mazak03-path_4	subprogram	EVENT	PROGRAM	x:SUB	null
Mazak03-path_5	line	EVENT	LINE	null	null
Mazak03-path_6	unitNum	EVENT	x:UNIT	null	null
Mazak03-path_95	sequenceNum	EVENT	x:SEQUENCE_NUMBER	null	null
Mazak03-path_96	PartCountAct	EVENT	PART_COUNT	null	null
Mazak03-path_7	Fact	SAMPLE	PATH_FEEDRATE	ACTUAL	MILLIMETER/SECOND
Mazak03-path_8	Frapidovr	EVENT	PATH_FEEDRATE_OVERRIDE	RAPID	PERCENT
Mazak03-path_9	Fovr	EVENT	PATH_FEEDRATE_OVERRIDE	PROGRAMMED	PERCENT
Mazak03-path_10	execution	EVENT	EXECUTION	null	null
Mazak03-path_11	mode	EVENT	CONTROLLER_MODE	null	null
Mazak03-path_12	program_cmt	EVENT	PROGRAM_COMMENT	null	null
Mazak03-path_13	subprogram_cmt	EVENT	PROGRAM_COMMENT	x:SUB_PROGRAM	null
Mazak03-path_14	auto_time	SAMPLE	ACCUMULATED_TIME	x:AUTO	SECOND
Mazak03-path_15	total_time	SAMPLE	ACCUMULATED_TIME	x:TOTAL	SECOND
Mazak03-path_16	cut_time	SAMPLE	ACCUMULATED_TIME	x:CUT	SECOND
Mazak03-path_17	motion_cond	CONDITION	MOTION_PROGRAM	null	null
Mazak03-path_18	motion_cond2	CONDITION	MOTION_PROGRAM	x:MOTION_PROGRAM_2	null
Mazak03-path_19	motion_cond3	CONDITION	MOTION_PROGRAM	x:MOTION_PROGRAM_3	null
Mazak03-path_20	motion_cond4	CONDITION	MOTION_PROGRAM	x:MOTION_PROGRAM_4	null
Mazak03-path_21	path_system	CONDITION	SYSTEM	null	null
Mazak03-path_22	path_system2	CONDITION	SYSTEM	x:SYSTEM_1	null
Mazak03-path_23	path_system3	CONDITION	SYSTEM	x:SYSTEM_2	null
Mazak03-path_24	path_system4	CONDITION	SYSTEM	x:SYSTEM_3	null
Mazak03-path_25	Tool_number	EVENT	TOOL_ASSET_ID	null	null
Mazak03-path_26	Tool_group	EVENT	x:TOOL_GROUP	null	null
Mazak03-path_27	Tool_suffix	EVENT	x:TOOL_SUFFIX	null	null
Mazak03-electric_2	power	EVENT	POWER_STATE	null	null
Mazak03-electric_3	electric_temp	CONDITION	TEMPERATURE	null	null
Mazak03-hydraulic_2	hydra_cond	CONDITION	PRESSURE	null	null
Mazak03-coolant_2	coolant_pres	CONDITION	PRESSURE	null	null
Mazak03-coolant_3	coolant_temp	CONDITION	TEMPERATURE	null	null
Mazak03-coolant_4	coolant_level	CONDITION	LEVEL	null	null
Mazak03-pneumatic_2	pneu_cond	CONDITION	PRESSURE	null	null

Table 8. Available DataItem in the VDS and QDR for the Hurco01 device

Id	Name	Category	Type	Sub Type	Units
Hurco01-dtop_1	avail	EVENT	AVAILABILITY	null	null
Hurco01-C_1	Spindle_Speed	SAMPLE	ROTARY_VELOCITY	ACTUAL	REVOLUTION/MINUTE
Hurco01-C_2	Spindle_Override	EVENT	ROTARY_VELOCITY_OVERRIDE	null	PERCENT
Hurco01-controller_1	EStop_State	EVENT	EMERGENCY_STOP	null	null
Hurco01-path_1	Block_Number	EVENT	LINE	null	null
Hurco01-path_2	Program_Name_Running	EVENT	PROGRAM	null	null
Hurco01-path_3	Program_Name_Editing	EVENT	PROGRAM_EDIT_NAME	null	null
Hurco01-path_4	Part_Count	EVENT	PART_COUNT	ALL	null
Hurco01-path_5	Program_Status	EVENT	EXECUTION	null	null
Hurco01-path_6	Current_Tool	EVENT	TOOL_NUMBER	null	null
Hurco01-path_7	Program_Runtime_Seconds	SAMPLE	ACCUMULATED_TIME	null	SECOND
Hurco01-path_8	Spindle_Time	SAMPLE	ACCUMULATED_TIME	null	SECOND
Hurco01-path_9	Feed_Rate	SAMPLE	PATH_FEEDRATE	ACTUAL	MILLIMETER/SECOND
Hurco01-path_10	Feed_Override	SAMPLE	PATH_FEEDRATE_OVERRIDE	null	PERCENT
Hurco01-path_11	Rapid_Override	SAMPLE	PATH_FEEDRATE_OVERRIDE	RAPID	PERCENT

Table 9. Available DataItem in the VDS and QDR for the Hurco02 device

Id	Name	Category	Type	Sub Type	Units
Hurco02-dtop_1	avail	EVENT	AVAILABILITY	null	null
Hurco02-C_1	Spindle_Speed	SAMPLE	ROTARY_VELOCITY	ACTUAL	REVOLUTION/MINUTE
Hurco02-C_2	Spindle_Override	EVENT	ROTARY_VELOCITY_OVERRIDE	null	PERCENT
Hurco02-controller_1	EStop_State	EVENT	EMERGENCY_STOP	null	null
Hurco02-path_1	Block_Number	EVENT	LINE	null	null
Hurco02-path_2	Program_Name_Running	EVENT	PROGRAM	null	null
Hurco02-path_3	Program_Name_Editing	EVENT	PROGRAM_EDIT_NAME	null	null
Hurco02-path_4	Part_Count	EVENT	PART_COUNT	ALL	null
Hurco02-path_5	Program_Status	EVENT	EXECUTION	null	null
Hurco02-path_6	Current_Tool	EVENT	TOOL_NUMBER	null	null
Hurco02-path_7	Program_Runtime_Seconds	SAMPLE	ACCUMULATED_TIME	null	SECOND
Hurco02-path_8	Spindle_Time	SAMPLE	ACCUMULATED_TIME	null	SECOND
Hurco02-path_9	Feed_Rate	SAMPLE	PATH_FEEDRATE	ACTUAL	MILLIMETER/SECOND
Hurco02-path_10	Feed_Override	SAMPLE	PATH_FEEDRATE_OVERRIDE	null	PERCENT
Hurco02-path_11	Rapid_Override	SAMPLE	PATH_FEEDRATE_OVERRIDE	RAPID	PERCENT

Table 10. Available DataItem in the VDS and QDR for the Hurco03 device

Id	Name	Category	Type	Sub Type	Units
Hurco03-dtop_1	avail	EVENT	AVAILABILITY	null	null
Hurco03-C_1	Spindle_Speed	SAMPLE	ROTARY_VELOCITY	ACTUAL	REVOLUTION/MINUTE
Hurco03-C_2	Spindle_Override	EVENT	ROTARY_VELOCITY_OVERRIDE	null	PERCENT
Hurco03-controller_1	EStop_State	EVENT	EMERGENCY_STOP	null	null
Hurco03-path_1	Block_Number	EVENT	LINE	null	null
Hurco03-path_2	Program_Name_Running	EVENT	PROGRAM	null	null
Hurco03-path_3	Program_Name_Editing	EVENT	PROGRAM_EDIT_NAME	null	null
Hurco03-path_4	Part_Count	EVENT	PART_COUNT	ALL	null
Hurco03-path_5	Program_Status	EVENT	EXECUTION	null	null
Hurco03-path_6	Current_Tool	EVENT	TOOL_NUMBER	null	null
Hurco03-path_7	Program_Runtime_Seconds	SAMPLE	ACCUMULATED_TIME	null	SECOND
Hurco03-path_8	Spindle_Time	SAMPLE	ACCUMULATED_TIME	null	SECOND
Hurco03-path_9	Feed_Rate	SAMPLE	PATH_FEEDRATE	ACTUAL	MILLIMETER/SECOND
Hurco03-path_10	Feed_Override	SAMPLE	PATH_FEEDRATE_OVERRIDE	null	PERCENT
Hurco03-path_11	Rapid_Override	SAMPLE	PATH_FEEDRATE_OVERRIDE	RAPID	PERCENT

Table 11. Available DataItem in the VDS and QDR for the Hurco04 device

Id	Name	Category	Type	Sub Type	Units
Hurco04-dtop_1	avail	EVENT	AVAILABILITY	null	null
Hurco04-C_1	Spindle_Speed	SAMPLE	ROTARY_VELOCITY	ACTUAL	REVOLUTION/MINUTE
Hurco04-C_2	Spindle_Override	EVENT	ROTARY_VELOCITY_OVERRIDE	null	PERCENT
Hurco04-controller_1	EStop_State	EVENT	EMERGENCY_STOP	null	null
Hurco04-path_1	Block_Number	EVENT	LINE	null	null
Hurco04-path_2	Program_Name_Running	EVENT	PROGRAM	null	null
Hurco04-path_3	Program_Name_Editing	EVENT	PROGRAM_EDIT_NAME	null	null
Hurco04-path_4	Part_Count	EVENT	PART_COUNT	ALL	null
Hurco04-path_5	Program_Status	EVENT	EXECUTION	null	null
Hurco04-path_6	Current_Tool	EVENT	TOOL_NUMBER	null	null
Hurco04-path_7	Program_Runtime_Seconds	SAMPLE	ACCUMULATED_TIME	null	SECOND
Hurco04-path_8	Spindle_Time	SAMPLE	ACCUMULATED_TIME	null	SECOND
Hurco04-path_9	Feed_Rate	SAMPLE	PATH_FEEDRATE	ACTUAL	MILLIMETER/SECOND
Hurco04-path_10	Feed_Override	SAMPLE	PATH_FEEDRATE_OVERRIDE	null	PERCENT
Hurco04-path_11	Rapid_Override	SAMPLE	PATH_FEEDRATE_OVERRIDE	RAPID	PERCENT

Table 12. Available DataItem in the VDS and QDR for the Hurco05 device

Id	Name	Category	Type	Sub Type	Units
Hurco05-dtop_1	avail	EVENT	AVAILABILITY	null	null
Hurco05-C_1	Spindle_Speed	SAMPLE	ROTARY_VELOCITY	ACTUAL	REVOLUTION/MINUTE
Hurco05-C_2	Spindle_Override	EVENT	ROTARY_VELOCITY_OVERRIDE	null	PERCENT
Hurco05-controller_1	EStop_State	EVENT	EMERGENCY_STOP	null	null
Hurco05-path_1	Block_Number	EVENT	LINE	null	null
Hurco05-path_2	Program_Name_Running	EVENT	PROGRAM	null	null
Hurco05-path_3	Program_Name_Editing	EVENT	PROGRAM_EDIT_NAME	null	null
Hurco05-path_4	Part_Count	EVENT	PART_COUNT	ALL	null
Hurco05-path_5	Program_Status	EVENT	EXECUTION	null	null
Hurco05-path_6	Current_Tool	EVENT	TOOL_NUMBER	null	null
Hurco05-path_7	Program_Runtime_Seconds	SAMPLE	ACCUMULATED_TIME	null	SECOND
Hurco05-path_8	Spindle_Time	SAMPLE	ACCUMULATED_TIME	null	SECOND
Hurco05-path_9	Feed_Rate	SAMPLE	PATH_FEEDRATE	ACTUAL	MILLIMETER/SECOND
Hurco05-path_10	Feed_Override	SAMPLE	PATH_FEEDRATE_OVERRIDE	null	PERCENT
Hurco05-path_11	Rapid_Override	SAMPLE	PATH_FEEDRATE_OVERRIDE	RAPID	PERCENT

Table 13. Available DataItem in the VDS and QDR for the Hurco06 device

Id	Name	Category	Type	Sub Type	Units
Hurco06-dtop_1	avail	EVENT	AVAILABILITY	null	null
Hurco06-C_1	Spindle_Speed	SAMPLE	ROTARY_VELOCITY	ACTUAL	REVOLUTION/MINUTE
Hurco06-C_2	Spindle_Override	EVENT	ROTARY_VELOCITY_OVERRIDE	null	PERCENT
Hurco06-controller_1	EStop_State	EVENT	EMERGENCY_STOP	null	null
Hurco06-path_1	Block_Number	EVENT	LINE	null	null
Hurco06-path_2	Program_Name_Running	EVENT	PROGRAM	null	null
Hurco06-path_3	Program_Name_Editing	EVENT	PROGRAM_EDIT_NAME	null	null
Hurco06-path_4	Part_Count	EVENT	PART_COUNT	ALL	null
Hurco06-path_5	Program_Status	EVENT	EXECUTION	null	null
Hurco06-path_6	Current_Tool	EVENT	TOOL_NUMBER	null	null
Hurco06-path_7	Program_Runtime_Seconds	SAMPLE	ACCUMULATED_TIME	null	SECOND
Hurco06-path_8	Spindle_Time	SAMPLE	ACCUMULATED_TIME	null	SECOND
Hurco06-path_9	Feed_Rate	SAMPLE	PATH_FEEDRATE	ACTUAL	MILLIMETER/SECOND
Hurco06-path_10	Feed_Override	SAMPLE	PATH_FEEDRATE_OVERRIDE	null	PERCENT
Hurco06-path_11	Rapid_Override	SAMPLE	PATH_FEEDRATE_OVERRIDE	RAPID	PERCENT

3. Future Resources

3.1 CAx Lab

New, alternative, or upgraded software solutions are investigated periodically for inclusion in the CAx Lab. We strive to have a mix of open-source, low-to-mid cost, and enterprise-class solutions in the CAx Lab. No specific additions are identified at this time.

3.2 Manufacturing Lab

Similar to the CAx Lab, new, alternative, or upgraded hardware solutions are investigated periodically for inclusion in the Manufacturing Lab. We focus on solutions that would help both small-and-medium enterprises (SMEs) and large enterprises – specifically, how the two types of enterprises could be integrated more closely. At this time, we are planning the following additions to the Manufacturing Lab resources.

- Integrating external sensors into the machine tools (see Table 3)
 - Thermocouples to capture temperature of various systems in the machine tools (e.g., coolant, motors, servos)
 - Power meters to capture energy usage of the machine tools
- Emerging, commercially available, all-in-one manufacturing-data-capture solutions
- Enabling automated inspection data collection from the metrology equipment (see Table 4) using Quality Information Framework (QIF) [3]

4. Usage and Guidelines

This section provides details on how to cite the various resources, documents, and guidelines of the SMS Test Bed. Also, a description of each resource, document, and guideline is provided with the citations. Each citation is intended to direct the reader to the important information required to use and/or duplicate the SMS Test Bed.

The current document provides the overview of the SMS Test Bed. If someone wishes to reference the SMS Test Bed in general, this document should be cited. The citation for this document is as follows.

Citation: Hedberg Jr T, Helu M (2017) Design and configuration of the smart manufacturing systems test bed. National Institute of Standards and Technology, Report NIST AMS 200-1. doi: 10.6028/NIST.AMS.200-1

4.1 Architecture

We prepared a paper that presents the reference four-tiered architecture of the SMS Test Bed. The architecture is designed to manage the data generated by manufacturing systems for the digital thread. The architecture provides segregated access to internal and external clients, which protects

intellectual property and other sensitive information, and enables the fusion of manufacturing and other product lifecycle data. We have implemented the architecture in the SMS Test Bed and used it to generate knowledge and identify performance improvement opportunities that would otherwise be unobservable to a manufacturing decision maker. The citation for the architecture paper is as follows.

Citation: Helu M, Hedberg Jr T, Barnard Feeney A (2017) Reference architecture to integrate heterogeneous manufacturing systems for the digital thread. *CIRP Journal of Manufacturing Science and Technology* doi: 10.1016/j.cirpj.2017.04.002

4.2 Connectivity, Deployment, and Usage

Documentation is available that describes how to connect, deploy, and use the technologies integrated in the SMS Test Bed. This document should provide baseline guidance for replicating the SMS Test Bed in both research and production environments. Specific guidance on communication protocols, information systems, and automation is included in the documentation. The citation for the connectivity, deployment, and usage guide is as follows.

Citation: Helu M, Hedberg Jr T (2017) Connecting, deploying, and using the smart manufacturing systems test bed. National Institute of Standards and Technology, Report NIST AMS 200-2. doi: 10.6028/NIST.AMS.200-2

4.3 Distributing Data

We published a software requirements specification (SRS) document to describe the requirements specifications for the applications and data repository used to distribute manufacturing data from the SMS Test Bed. A software system to distribute manufacturing data via a web service is the application being defined by the SRS document. The software system contains two component applications. The first component is an application to stream time-synchronized manufacturing data, referred to as the VDS. The second component is an application for querying a database containing manufacturing data, referred to as the QDR. The citation for the SRS document is as follows.

Citation: Hedberg Jr T, Helu M, Newrock M (2017) Software requirements specification to distribute manufacturing data. National Institute of Standards and Technology, Report NIST AMS 300-2. doi: 10.6028/NIST.AMS.300-2

4.4 QDR User Manual

The purpose of the QDR User Manual is to provide an overview of and operational guide for the QDR, which is a data curation and database management tool. The QDR has been deployed as a web service in the NIST SMS Test Bed. The purpose of the QDR is to transform collected data into structured formats that may be shared with interested end-users. Data is inputted into

the QDR by a system administrator in an Extensible Markup Language (XML) format. This data is organized using predefined templates encoded in XML Schema Definition (XSD) that are also used to create query templates. Data is saved within the QDR in a Non-Structured Query Language (NoSQL) database. Users can search and retrieve data from this database by specifying parameter values and search criteria using a web-based form that represents the predefined query template and performs an endpoint query through a representational state transfer (REST)ful Application Programming Interface (API) call. Retrieved data may be formatted in either American Standard Code for Information Interchange (ASCII) comma separated value (CSV), JavaScript object notation (JSON), or XML structured with a reference data schema. The citation for the QDR user manual is as follows.

Citation: Bardakoff A, Dima A, Long B, Amaral GS, Helu M, Hedberg Jr T (2017) Query-able data repository: User manual, version 1.4.0-beta3. National Institute of Standards and Technology, Report NIST AMS 200-3. doi: 10.6028/NIST.AMS.200-3

4.5 Data Repositories

Data is collected from the NIST SMS Test Bed's Manufacturing Lab using the MTConnect standard [1]. That data is aggregated and published internally and externally of NIST via web services. Three channels of data dissemination are available from the SMS Test Bed: (1) a VDS using an MTConnect agent, (2) a QDR using the NIST MDCS, and (3) pre-compiled TDP that include a collection of CAx Lab data and associated Manufacturing Lab data. The citations for the VDS, QDR, and TDP are as follows.

VDS Citation: Helu M, Hedberg Jr T, Barnard Feeney A, Luce M (2016, Last Accessed 6/28/2017) Volatile data stream (VDS) for the smart manufacturing systems (SMS) test bed using MTConnect, Web Page. doi: 10.18434/T4FK54. URL <https://smstestbed.nist.gov/vds>

QDR Citation: Hedberg Jr T, Helu M, Barnard Feeney A, Luce M (2016, Last Accessed 6/28/2017) Query-able data repository (QDR) for the smart manufacturing systems (SMS) test bed using mt-connect, Web Page. URL <https://smstestbed.nist.gov/qdr>

TDP Citation: Hedberg Jr T, Helu M, Barnard Feeney A (2016, Last Accessed 6/28/2017) Technical data packages (TDPs) from the smart manufacturing systems (SMS) test bed, Web Page. URL <https://smstestbed.nist.gov/tdp>

References

- [1] MTConnect Institute (2014, Last Accessed June 2017) MTConnect Standard, Version 1.3, Part 1 - Overview and Protocol, Standard. URL <http://www.mtconnect.org/standard-documents>.

- [2] MTConnect Institute (2014, Last Accessed June 2017) MTConnect Standard, Version 1.3, Part 2 - Components and Data Items, Standard. URL <http://www.mtconnect.org/standard-documents>.
- [3] Dimensional Metrology Standards Consortium (2014) Part 1: Overview and fundamental principles in quality information framework (QIF) – an integrated model for manufacturing quality information, Standard. URL <http://qifstandards.org/>.
- [4] Hedberg Jr T, Helu M (2017) Design and configuration of the smart manufacturing systems test bed. National Institute of Standards and Technology, Report NIST AMS 200-1. doi: 10.6028/NIST.AMS.200-1
- [5] Helu M, Hedberg Jr T, Barnard Feeney A (2017) Reference architecture to integrate heterogeneous manufacturing systems for the digital thread. *CIRP Journal of Manufacturing Science and Technology* doi: 10.1016/j.cirpj.2017.04.002
- [6] Helu M, Hedberg Jr T (2017) Connecting, deploying, and using the smart manufacturing systems test bed. National Institute of Standards and Technology, Report NIST AMS 200-2. doi: 10.6028/NIST.AMS.200-2
- [7] Hedberg Jr T, Helu M, Newrock M (2017) Software requirements specification to distribute manufacturing data. National Institute of Standards and Technology, Report NIST AMS 300-2. doi: 10.6028/NIST.AMS.300-2
- [8] Bardakoff A, Dima A, Long B, Amaral GS, Helu M, Hedberg Jr T (2017) Query-able data repository: User manual, version 1.4.0-beta3. National Institute of Standards and Technology, Report NIST AMS 200-3. doi: 10.6028/NIST.AMS.200-3
- [9] Helu M, Hedberg Jr T, Barnard Feeney A, Luce M (2016, Last Accessed 6/28/2017) Volatile data stream (VDS) for the smart manufacturing systems (SMS) test bed using MTConnect, Web Page. doi: 10.18434/T4FK54. URL <https://smstestbed.nist.gov/vds>
- [10] Hedberg Jr T, Helu M, Barnard Feeney A, Luce M (2016, Last Accessed 6/28/2017) Query-able data repository (QDR) for the smart manufacturing systems (SMS) test bed using mtconnect, Web Page. URL <https://smstestbed.nist.gov/qdr>.
- [11] Hedberg Jr T, Helu M, Barnard Feeney A (2016, Last Accessed 6/28/2017) Technical data packages (TDPs) from the smart manufacturing systems (SMS) test bed, Web Page. URL <https://smstestbed.nist.gov/tdp>.

Appendix A. XML Instances of Manufacturing Lab Resources

Listing A.1. MTConnect Probe Listing for the Manufacturing Lab Resources in the SMS Test Bed

```

1 <?xml version="1.0" encoding="UTF-8"?>
2 <?xml-stylesheet type="text/xsl" href="/styles/Devices.xsl"?>
3 <MTConnectDevices xmlns:m="urn:mtconnect.org:MTConnectDevices:1.3" xmlns="urn:mtconnect.
   org:MTConnectDevices:1.3" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:
   schemaLocation="urn:mtconnect.org:MTConnectDevices:1.3 /schemas/MTConnectDevices_1.3.
   xsd">
4 <Header creationTime="2017-06-28T16:31:49Z" sender="95427d753b45" instanceId="
   1498573777" version="1.3.0.17" assetBufferSize="1024" assetCount="0" bufferSize="
   1048576"/>
5 <Devices>
6 <Device id="GFAGie01" name="GFAGie01" uuid="mtc_adapter001">
7 <Description manufacturer="Agie Charmilles" model="HPM600U">Agie Mikron HPM600U - GF
   Agie Charmilles HPM600U</Description>
8 <DataItems>
9 <DataItem category="EVENT" id="GFAGie01-dtop_1" name="avail" type="AVAILABILITY"/>
10 <DataItem category="EVENT" id="GFAGie01-dtop_2" name="estop" type="EMERGENCY_STOP"
   />
11 <DataItem category="CONDITION" id="GFAGie01-dtop_3" name="system" type="SYSTEM"/>
12 <DataItem category="EVENT" id="GFAGie01_asset_chg" type="ASSET_CHANGED"/>
13 <DataItem category="EVENT" id="GFAGie01_asset_rem" type="ASSET_REMOVED"/>
14 </DataItems>
15 <Components>
16 <Axes id="GFAGie01-axes_1" name="axes">
17 <Components>
18 <Linear id="GFAGie01-X_1" name="X">
19 <DataItems>
20 <DataItem category="SAMPLE" id="GFAGie01-X_2" name="Xposition" nativeUnits=
   "MILLIMETER" subType="ACTUAL" type="POSITION" units="MILLIMETER"/>
21 </DataItems>
22 </Linear>
23 <Linear id="GFAGie01-Y_1" name="Y">
24 <DataItems>
25 <DataItem category="SAMPLE" id="GFAGie01-Y_2" name="Yposition" nativeUnits=
   "MILLIMETER" subType="ACTUAL" type="POSITION" units="MILLIMETER"/>
26 </DataItems>
27 </Linear>
28 <Linear id="GFAGie01-Z_1" name="Z">
29 <DataItems>
30 <DataItem category="SAMPLE" id="GFAGie01-Z_2" name="Zposition" nativeUnits=
   "MILLIMETER" subType="ACTUAL" type="POSITION" units="MILLIMETER"/>
31 </DataItems>
32 </Linear>
33 <Rotary id="GFAGie01-C_1" name="C">
34 <DataItems>
35 <DataItem category="SAMPLE" id="GFAGie01-C_2" name="Cposition" nativeUnits=
   "DEGREE" subType="ACTUAL" type="ANGLE" units="DEGREE"/>
36 </DataItems>

```

```

37     </Rotary>
38     <Rotary id="GFAGie01-A_1" name="A">
39         <DataItems>
40             <DataItem category="SAMPLE" id="GFAGie01-A_2" name="Aposition" nativeUnits=
41                 "DEGREE" subType="ACTUAL" type="ANGLE" units="DEGREE"/>
42         </DataItems>
43     </Rotary>
44 </Components>
45 </Axes>
46 <Controller id="GFAGie01-controller_basic_1" name="controller_basic">
47     <DataItems>
48         <DataItem category="EVENT" id="GFAGie01-controller_basic_2" name="Fovr"
49             nativeUnits="PERCENT" subType="OVERRIDE" type="PATH_FEEDRATE_OVERRIDE"
50             units="PERCENT"/>
51         <DataItem category="EVENT" id="GFAGie01-controller_basic_3" name="Sovr"
52             nativeUnits="PERCENT" type="ROTARY_VELOCITY_OVERRIDE" units="PERCENT"/>
53         <DataItem category="CONDITION" id="GFAGie01-controller_basic_4" name="servo"
54             type="ACTUATOR"/>
55         <DataItem category="CONDITION" id="GFAGie01-controller_basic_5" name="comms"
56             type="COMMUNICATIONS"/>
57         <DataItem category="CONDITION" id="GFAGie01-controller_basic_6" name="
58             pneumatic" type="COMMUNICATIONS"/>
59         <DataItem category="CONDITION" id="GFAGie01-controller_basic_7" name="
60             hydraulic" type="COMMUNICATIONS"/>
61         <DataItem category="CONDITION" id="GFAGie01-controller_basic_8" name="logic"
62             type="LOGIC_PROGRAM"/>
63         <DataItem category="CONDITION" id="GFAGie01-controller_basic_9" name="motion"
64             type="MOTION_PROGRAM"/>
65         <DataItem category="CONDITION" id="GFAGie01-controller_basic_10" name="
66             cnc_temp" type="TEMPERATURE"/>
67     </DataItems>
68     <Components>
69         <Path id="GFAGie01-path_basic_1" name="path_basic">
70             <DataItems>
71                 <DataItem category="EVENT" id="GFAGie01-path_basic_2" name="execution" type=
72                     "EXECUTION"/>
73                 <DataItem category="EVENT" id="GFAGie01-path_basic_3" name="mode" type="
74                     CONTROLLER_MODE"/>
75                 <DataItem category="EVENT" id="GFAGie01-path_basic_4" name="program" type="
76                     PROGRAM"/>
77                 <DataItem category="EVENT" id="GFAGie01-path_basic_5" name="line" type="
78                     LINE"/>
79                 <DataItem category="EVENT" id="GFAGie01-path_basic_6" name="move" type="x:
80                     MOTION"/>
81                 <DataItem category="SAMPLE" id="GFAGie01-path_basic_7" name="path_pos"
82                     nativeUnits="MILLIMETER_3D" type="PATH_POSITION" units="MILLIMETER_3D"/
83                 >
84             </DataItems>
85         </Path>
86     </Components>
87 </Controller>

```

```
70     </Components>
71 </Device>
72 <Device id="Mazak01" name="Mazak01" uuid="mtc_adapter002">
73   <Description manufacturer="Mazak" model="Integrex" serialNumber="M7303290458">Mazak
       Integrex 100-IV</Description>
74   <DataItems>
75     <DataItem category="EVENT" id="Mazak01-dtop_1" name="avail" type="AVAILABILITY"/>
76     <DataItem category="EVENT" id="Mazak01_asset_chg" type="ASSET_CHANGED"/>
77     <DataItem category="EVENT" id="Mazak01_asset_rem" type="ASSET_REMOVED"/>
78   </DataItems>
79   <Components>
80     <Axes id="Mazak01-base" name="base">
81       <DataItems>
82         <DataItem category="CONDITION" id="Mazak01-base_1" name="servo_cond" type="
           ACTUATOR"/>
83       </DataItems>
84       <Components>
85         <Linear id="Mazak01-X" name="X">
86           <DataItems>
87             <DataItem category="SAMPLE" coordinateSystem="MACHINE" id="Mazak01-X_1"
               name="Xabs" nativeUnits="MILLIMETER" subType="ACTUAL" type="POSITION"
               units="MILLIMETER"/>
88             <DataItem category="CONDITION" id="Mazak01-X_2" name="Xtravel" type="
               POSITION"/>
89             <DataItem category="SAMPLE" id="Mazak01-X_3" name="Xload" nativeUnits="
               PERCENT" type="LOAD" units="PERCENT"/>
90             <DataItem category="SAMPLE" id="Mazak01-X_4" name="Xfrt" nativeUnits="
               MILLIMETER/SECOND" type="AXIS_FEEDRATE" units="MILLIMETER/SECOND"/>
91           </DataItems>
92         </Linear>
93         <Linear id="Mazak01-Y" name="Y">
94           <DataItems>
95             <DataItem category="SAMPLE" coordinateSystem="MACHINE" id="Mazak01-Y_1"
               name="Yabs" nativeUnits="MILLIMETER" subType="ACTUAL" type="POSITION"
               units="MILLIMETER"/>
96             <DataItem category="CONDITION" id="Mazak01-Y_2" name="Ytravel" type="
               POSITION"/>
97             <DataItem category="SAMPLE" id="Mazak01-Y_3" name="Yload" nativeUnits="
               PERCENT" type="LOAD" units="PERCENT"/>
98             <DataItem category="SAMPLE" id="Mazak01-Y_4" name="Yfrt" nativeUnits="
               MILLIMETER/SECOND" type="AXIS_FEEDRATE" units="MILLIMETER/SECOND"/>
99           </DataItems>
100        </Linear>
101        <Linear id="Mazak01-Z" name="Z">
102          <DataItems>
103            <DataItem category="SAMPLE" coordinateSystem="MACHINE" id="Mazak01-Z_1"
              name="Zabs" nativeUnits="MILLIMETER" subType="ACTUAL" type="POSITION"
              units="MILLIMETER"/>
104            <DataItem category="CONDITION" id="Mazak01-Z_2" name="Ztravel" type="
              POSITION"/>
105            <DataItem category="SAMPLE" id="Mazak01-Z_3" name="Zload" nativeUnits="
```

```

106         PERCENT" type="LOAD" units="PERCENT"/>
107     <DataItem category="SAMPLE" id="Mazak01-Z_4" name="Zfrt" nativeUnits="
108         MILLIMETER/SECOND" type="AXIS_FEEDRATE" units="MILLIMETER/SECOND"/>
109 </DataItems>
110 </Linear>
111 <Rotary id="Mazak01-B" name="B">
112     <DataItems>
113         <DataItem category="SAMPLE" id="Mazak01-B_1" name="Bload" nativeUnits="
114             PERCENT" type="LOAD" units="PERCENT"/>
115         <DataItem category="SAMPLE" id="Mazak01-B_2" name="Bfrt" nativeUnits="
116             DEGREE/MINUTE" type="ANGULAR_VELOCITY" units="DEGREE/SECOND"/>
117         <DataItem category="CONDITION" id="Mazak01-B_3" name="Btravel" type="ANGLE"
118             />
119         <DataItem category="SAMPLE" id="Mazak01-B_4" name="Bdeg" nativeUnits="
120             DEGREE" subType="ACTUAL" type="ANGLE" units="DEGREE"/>
121     </DataItems>
122 </Rotary>
123 <Rotary id="Mazak01-C" name="C">
124     <DataItems>
125         <DataItem category="SAMPLE" id="Mazak01-C_1" name="Cload" nativeUnits="
126             PERCENT" type="LOAD" units="PERCENT"/>
127         <DataItem category="SAMPLE" id="Mazak01-C_2" name="Sload" nativeUnits="
128             PERCENT" type="LOAD" units="PERCENT"/>
129         <DataItem category="CONDITION" id="Mazak01-C_3" name="Ctravel" type="ANGLE"
130             />
131         <DataItem category="SAMPLE" id="Mazak01-C_4" name="Cfrt" nativeUnits="
132             DEGREE/MINUTE" type="ANGULAR_VELOCITY" units="DEGREE/SECOND"/>
133         <DataItem category="SAMPLE" id="Mazak01-C_5" name="Srpm" nativeUnits="
134             REVOLUTION/MINUTE" subType="ACTUAL" type="ROTARY_VELOCITY" units="
135             REVOLUTION/MINUTE"/>
136         <DataItem category="EVENT" id="Mazak01-C_6" name="Sovr" nativeUnits="
137             PERCENT" type="ROTARY_VELOCITY_OVERRIDE" units="PERCENT"/>
138         <DataItem category="SAMPLE" id="Mazak01-C_7" name="Stemp" nativeUnits="
139             CELSIUS" type="TEMPERATURE" units="CELSIUS"/>
140         <DataItem category="SAMPLE" id="Mazak01-C_8" name="Cdeg" nativeUnits="
141             DEGREE" subType="ACTUAL" type="ANGLE" units="DEGREE"/>
142         <DataItem category="CONDITION" id="Mazak01-C_9" name="Sload_cond" type="
143             LOAD"/>
144         <DataItem category="CONDITION" id="Mazak01-C_10" name="Stemp_cond" type="
145             TEMPERATURE"/>
146     </DataItems>
147 </Rotary>
148 <Rotary id="Mazak01-C2" name="C">
149     <DataItems>
150         <DataItem category="SAMPLE" id="Mazak01-C2_1" name="S2load" nativeUnits="
151             PERCENT" type="LOAD" units="PERCENT"/>
152         <DataItem category="SAMPLE" id="Mazak01-C2_2" name="S2rpm" nativeUnits="
153             REVOLUTION/MINUTE" subType="ACTUAL" type="ROTARY_VELOCITY" units="
154             REVOLUTION/MINUTE"/>
155         <DataItem category="SAMPLE" id="Mazak01-C2_3" name="S2temp" nativeUnits="
156             CELSIUS" type="TEMPERATURE" units="CELSIUS"/>

```



```

136         <DataItem category="CONDITION" id="Mazak01-C2_4" name="S2load_cond" type="
LOAD"/>
137         <DataItem category="CONDITION" id="Mazak01-C2_5" name="S2temp_cond" type="
TEMPERATURE"/>
138     </DataItems>
139 </Rotary>
140 </Components>
141 </Axes>
142 <Controller id="Mazak01-controller" name="controller">
143     <DataItems>
144         <DataItem category="CONDITION" id="Mazak01-controller_1" name="comms_cond"
type="COMMUNICATIONS"/>
145         <DataItem category="CONDITION" id="Mazak01-controller_2" name="logic_cond"
type="LOGIC_PROGRAM"/>
146         <DataItem category="CONDITION" id="Mazak01-controller_3" name="system_cond"
type="SYSTEM"/>
147         <DataItem category="EVENT" id="Mazak01-controller_4" name="estop" type="
EMERGENCY_STOP"/>
148     </DataItems>
149     <Components>
150         <Path id="Mazak01-path" name="path">
151             <DataItems>
152                 <DataItem category="EVENT" id="Mazak01-path_1" name="program" type="PROGRAM
"/>
153                 <DataItem category="EVENT" id="Mazak01-path_2" name="subprogram" subType="x
:SUB" type="PROGRAM"/>
154                 <DataItem category="EVENT" id="Mazak01-path_3" name="line" type="LINE"/>
155                 <DataItem category="EVENT" id="Mazak01-path_4" name="unitNum" type="x:UNIT
"/>
156                 <DataItem category="EVENT" id="Mazak01-path_5" name="sequenceNum" type="x:
SEQUENCE_NUMBER"/>
157                 <DataItem category="EVENT" id="Mazak01-path_6" name="PartCountAct" type="
PART_COUNT"/>
158                 <DataItem category="SAMPLE" coordinateSystem="WORK" id="Mazak01-path_7"
name="Fact" nativeUnits="FOOT/MINUTE" subType="ACTUAL" type="
PATH_FEEDRATE" units="MILLIMETER/SECOND"/>
159                 <DataItem category="EVENT" id="Mazak01-path_8" name="Frapidovr" nativeUnits
="PERCENT" subType="RAPID" type="PATH_FEEDRATE_OVERRIDE" units="PERCENT
"/>
160                 <DataItem category="EVENT" id="Mazak01-path_9" name="Fovr" nativeUnits="
PERCENT" subType="PROGRAMMED" type="PATH_FEEDRATE_OVERRIDE" units="
PERCENT"/>
161                 <DataItem category="EVENT" id="Mazak01-path_10" name="Tool_number" type="
TOOL_NUMBER"/>
162                 <DataItem category="EVENT" id="Mazak01-path_11" name="Tool_group" type="x:
TOOL_GROUP"/>
163                 <DataItem category="EVENT" id="Mazak01-path_12" name="Tool_suffix" type="x:
TOOL_SUFFIX"/>
164                 <DataItem category="EVENT" id="Mazak01-path_13" name="execution" type="
EXECUTION"/>
165                 <DataItem category="EVENT" id="Mazak01-path_14" name="mode" type="

```



```
166         CONTROLLER_MODE"/>
167     <DataItem category="EVENT" id="Mazak01-path_15" name="program_cmt" type="x:
168         PROGRAM_COMMENT"/>
169     <DataItem category="EVENT" id="Mazak01-path_16" name="subprogram_cmt"
170         subType="x:SUB" type="x:PROGRAM_COMMENT"/>
171     <DataItem category="SAMPLE" id="Mazak01-path_17" name="auto_time" subType="
172         x:AUTO" type="ACCUMULATED_TIME"/>
173     <DataItem category="SAMPLE" id="Mazak01-path_18" name="total_time" subType=
174         "x:TOTAL" type="ACCUMULATED_TIME"/>
175     <DataItem category="SAMPLE" id="Mazak01-path_19" name="cut_time" subType="x
176         :CUT" type="ACCUMULATED_TIME"/>
177     <DataItem category="CONDITION" id="Mazak01-path_20" name="motion_cond" type
178         ="MOTION_PROGRAM"/>
179     <DataItem category="CONDITION" id="Mazak01-path_21" name="path_system" type
180         ="SYSTEM"/>
181 </DataItems>
182 </Path>
183 </Components>
184 </Controller>
185 <Systems id="Mazak01-systems" name="systems">
186     <Components>
187         <Electric id="Mazak01-electric" name="electric">
188             <DataItems>
189                 <DataItem category="EVENT" id="Mazak01-electric_1" name="power" type="
190                     POWER_STATE"/>
191                 <DataItem category="CONDITION" id="Mazak01-electric_2" name="electric_temp"
192                     type="TEMPERATURE"/>
193             </DataItems>
194         </Electric>
195         <Hydraulic id="Mazak01-hydraulic" name="hydraulic">
196             <DataItems>
197                 <DataItem category="CONDITION" id="Mazak01-hydraulic_1" name="hydra_cond"
198                     type="PRESSURE"/>
199             </DataItems>
200         </Hydraulic>
201         <Coolant id="Mazak01-coolant" name="coolant">
202             <DataItems>
203                 <DataItem category="CONDITION" id="Mazak01-coolant_1" name="coolant_pres"
204                     type="PRESSURE"/>
205                 <DataItem category="CONDITION" id="Mazak01-coolant_2" name="coolant_temp"
206                     type="TEMPERATURE"/>
207                 <DataItem category="CONDITION" id="Mazak01-coolant_3" name="coolant_level"
208                     type="LEVEL"/>
209             </DataItems>
210         </Coolant>
211         <Pneumatic id="Mazak01-pneumatic" name="pneumatic">
212             <DataItems>
213                 <DataItem category="CONDITION" id="Mazak01-pneumatic_1" name="pneu_cond"
214                     type="PRESSURE"/>
215             </DataItems>
216         </Pneumatic>

```

```
202     </Components>
203   </Systems>
204 </Components>
205 </Device>
206 <Device id="Mazak03" name="Mazak03" uuid="mtc_adapter004">
207   <Description manufacturer="Mazak" model="QTN">Mazak QuickTurn - Mazak QuickTurn
     Nexus 300</Description>
208   <DataItems>
209     <DataItem category="EVENT" id="Mazak03-dtop_1" name="avail" type="AVAILABILITY"/>
210     <DataItem category="EVENT" id="Mazak03_asset_chg" type="ASSET_CHANGED"/>
211     <DataItem category="EVENT" id="Mazak03_asset_rem" type="ASSET_REMOVED"/>
212   </DataItems>
213   <Components>
214     <Axes id="Mazak03-base_1" name="base">
215       <DataItems>
216         <DataItem category="CONDITION" id="Mazak03-base_2" name="servo_cond" type="
           ACTUATOR"/>
217       </DataItems>
218       <Components>
219         <Linear id="Mazak03-X_1" name="X">
220           <DataItems>
221             <DataItem category="SAMPLE" coordinateSystem="MACHINE" id="Mazak03-X_2"
               name="Xabs" nativeUnits="MILLIMETER" subType="ACTUAL" type="POSITION"
               units="MILLIMETER"/>
222             <DataItem category="CONDITION" id="Mazak03-X_3" name="Xtravel" type="
               POSITION"/>
223             <DataItem category="SAMPLE" id="Mazak03-X_4" name="Xload" nativeUnits="
               PERCENT" type="LOAD" units="PERCENT"/>
224             <DataItem category="SAMPLE" id="Mazak03-X_5" name="Xfrt" nativeUnits="
               MILLIMETER/SECOND" type="AXIS_FEEDRATE" units="MILLIMETER/SECOND"/>
225           </DataItems>
226         </Linear>
227         <Linear id="Mazak03-Z_1" name="Z">
228           <DataItems>
229             <DataItem category="SAMPLE" coordinateSystem="MACHINE" id="Mazak03-Z_2"
               name="Zabs" nativeUnits="MILLIMETER" subType="ACTUAL" type="POSITION"
               units="MILLIMETER"/>
230             <DataItem category="CONDITION" id="Mazak03-Z_3" name="Ztravel" type="
               POSITION"/>
231             <DataItem category="SAMPLE" id="Mazak03-Z_4" name="Zload" nativeUnits="
               PERCENT" type="LOAD" units="PERCENT"/>
232             <DataItem category="SAMPLE" id="Mazak03-Z_5" name="Zfrt" nativeUnits="
               MILLIMETER/SECOND" type="AXIS_FEEDRATE" units="MILLIMETER/SECOND"/>
233           </DataItems>
234         </Linear>
235         <Rotary id="Mazak03-C_1" name="C">
236           <DataItems>
237             <DataItem category="SAMPLE" id="Mazak03-C_2" name="Cload" nativeUnits="
               PERCENT" type="LOAD" units="PERCENT"/>
238             <DataItem category="SAMPLE" id="Mazak03-C_3" name="Cfrt" nativeUnits="
               DEGREE/MINUTE" type="ANGULAR_VELOCITY" units="DEGREE/SECOND"/>
```

```
239     <DataItem category="SAMPLE" id="Mazak03-C_4" name="Cdeg" nativeUnits="
240         DEGREE" subType="ACTUAL" type="ANGLE" units="DEGREE"/>
241     <DataItem category="CONDITION" id="Mazak03-C_5" name="Ctravel" type="ANGLE"
242         />
243     </DataItems>
244 </Rotary>
245 <Rotary id="Mazak03-S_1" name="S" nativeName="S">
246     <DataItems>
247         <DataItem category="SAMPLE" id="Mazak03-S_2" name="Srpm" nativeUnits="
248             REVOLUTION/MINUTE" subType="ACTUAL" type="ROTARY_VELOCITY" units="
249             REVOLUTION/MINUTE"/>
250         <DataItem category="SAMPLE" id="Mazak03-S_3" name="S1load" nativeUnits="
251             PERCENT" type="LOAD" units="PERCENT">
252             <Source>Sload</Source>
253         </DataItem>
254         <DataItem category="SAMPLE" id="Mazak03-S_4" name="Stemp" nativeUnits="
255             CELSIUS" type="TEMPERATURE" units="CELSIUS"/>
256         <DataItem category="CONDITION" id="Mazak03-S_5" name="Sload_cond" type="
257             LOAD"/>
258         <DataItem category="CONDITION" id="Mazak03-S_6" name="Stemp_cond" type="
259             TEMPERATURE"/>
260     </DataItems>
261 </Rotary>
262 <Rotary id="Mazak03-S2_1" name="S2" nativeName="S2">
263     <DataItems>
264         <DataItem category="SAMPLE" id="Mazak03-S2_2" name="S2rpm" nativeUnits="
265             REVOLUTION/MINUTE" subType="ACTUAL" type="ROTARY_VELOCITY" units="
266             REVOLUTION/MINUTE"/>
267         <DataItem category="SAMPLE" id="Mazak03-S2_3" name="S2load" nativeUnits="
268             PERCENT" type="LOAD" units="PERCENT">
269             <Source>S2load</Source>
270         </DataItem>
271         <DataItem category="SAMPLE" id="Mazak03-S2_4" name="S2temp" nativeUnits="
272             CELSIUS" type="TEMPERATURE" units="CELSIUS"/>
273         <DataItem category="CONDITION" id="Mazak03-S2_5" name="S2load_cond" type="
274             LOAD"/>
275         <DataItem category="CONDITION" id="Mazak03-S2_6" name="S2temp_cond" type="
276             TEMPERATURE"/>
277     </DataItems>
278 </Rotary>
279 </Components>
280 </Axes>
281 <Controller id="Mazak03-controller_1" name="controller">
282     <DataItems>
283         <DataItem category="CONDITION" id="Mazak03-controller_2" name="comms_cond"
284             type="COMMUNICATIONS"/>
285         <DataItem category="CONDITION" id="Mazak03-controller_3" name="logic_cond"
286             type="LOGIC_PROGRAM"/>
287         <DataItem category="CONDITION" id="Mazak03-controller_4" name="system_cond"
288             type="SYSTEM"/>
289         <DataItem category="EVENT" id="Mazak03-controller_5" name="pallet_num" type="x
```

```
273         :PALLET_NUMBER"/>
274     </DataItems>
275     <Components>
276         <Path id="Mazak03-path_1" name="path">
277             <DataItems>
278                 <DataItem category="EVENT" id="Mazak03-path_2" name="Sovr" nativeUnits="
279                     PERCENT" type="ROTARY_VELOCITY_OVERRIDE" units="PERCENT"/>
280                 <DataItem category="EVENT" id="Mazak03-path_3" name="program" type="PROGRAM
281                     "/>
282                 <DataItem category="EVENT" id="Mazak03-path_4" name="subprogram" subType="x
283                     :SUB" type="PROGRAM"/>
284                 <DataItem category="EVENT" id="Mazak03-path_5" name="line" type="LINE"/>
285                 <DataItem category="EVENT" id="Mazak03-path_6" name="unitNum" type="x:UNIT"
286                     />
287                 <DataItem category="EVENT" id="Mazak03-path_95" name="sequenceNum" type="x:
288                     SEQUENCE_NUMBER"/>
289                 <DataItem category="EVENT" id="Mazak03-path_96" name="PartCountAct" type="
290                     PART_COUNT"/>
291                 <DataItem category="SAMPLE" id="Mazak03-path_7" name="Fact" nativeUnits="
292                     MILLIMETER/SECOND" subType="ACTUAL" type="PATH_FEEDRATE" units="
293                     MILLIMETER/SECOND"/>
294                 <DataItem category="EVENT" id="Mazak03-path_8" name="Frapidovr" nativeUnits
295                     ="PERCENT" subType="RAPID" type="PATH_FEEDRATE_OVERRIDE" units="PERCENT
296                     "/>
297                 <DataItem category="EVENT" id="Mazak03-path_9" name="Fovr" nativeUnits="
298                     PERCENT" subType="PROGRAMMED" type="PATH_FEEDRATE_OVERRIDE" units="
299                     PERCENT"/>
300                 <DataItem category="EVENT" id="Mazak03-path_10" name="execution" type="
301                     EXECUTION"/>
302                 <DataItem category="EVENT" id="Mazak03-path_11" name="mode" type="
303                     CONTROLLER_MODE"/>
304                 <DataItem category="EVENT" id="Mazak03-path_12" name="program_cmt" type="
305                     PROGRAM_COMMENT"/>
306                 <DataItem category="EVENT" id="Mazak03-path_13" name="subprogram_cmt"
307                     subType="x:SUB_PROGRAM" type="PROGRAM_COMMENT"/>
308                 <DataItem category="SAMPLE" id="Mazak03-path_14" name="auto_time"
309                     nativeUnits="SECOND" subType="x:AUTO" type="ACCUMULATED_TIME" units="
310                     SECOND"/>
311                 <DataItem category="SAMPLE" id="Mazak03-path_15" name="total_time"
312                     nativeUnits="SECOND" subType="x:TOTAL" type="ACCUMULATED_TIME" units="
313                     SECOND"/>
314                 <DataItem category="SAMPLE" id="Mazak03-path_16" name="cut_time"
315                     nativeUnits="SECOND" subType="x:CUT" type="ACCUMULATED_TIME" units="
316                     SECOND"/>
317                 <DataItem category="CONDITION" id="Mazak03-path_17" name="motion_cond" type
318                     ="MOTION_PROGRAM"/>
319                 <DataItem category="CONDITION" id="Mazak03-path_18" name="motion_cond2"
320                     subType="x:MOTION_PROGRAM_2" type="MOTION_PROGRAM"/>
321                 <DataItem category="CONDITION" id="Mazak03-path_19" name="motion_cond3"
322                     subType="x:MOTION_PROGRAM_3" type="MOTION_PROGRAM"/>
323                 <DataItem category="CONDITION" id="Mazak03-path_20" name="motion_cond4"
```

```
298     subType="x:MOTION_PROGRAM_4" type="MOTION_PROGRAM"/>
299     <DataItem category="CONDITION" id="Mazak03-path_21" name="path_system" type
300     ="SYSTEM"/>
301     <DataItem category="CONDITION" id="Mazak03-path_22" name="path_system2"
302     subType="x:SYSTEM_1" type="SYSTEM"/>
303     <DataItem category="CONDITION" id="Mazak03-path_23" name="path_system3"
304     subType="x:SYSTEM_2" type="SYSTEM"/>
305     <DataItem category="CONDITION" id="Mazak03-path_24" name="path_system4"
306     subType="x:SYSTEM_3" type="SYSTEM"/>
307     <DataItem category="EVENT" id="Mazak03-path_25" name="Tool_number" type="
308     TOOL_ASSET_ID"/>
309     <DataItem category="EVENT" id="Mazak03-path_26" name="Tool_group" type="x:
310     TOOL_GROUP"/>
311     <DataItem category="EVENT" id="Mazak03-path_27" name="Tool_suffix" type="x:
312     TOOL_SUFFIX"/>
313   </DataItems>
314 </Path>
315 </Components>
316 </Controller>
317 <Systems id="Mazak03-systems_1" name="systems">
318   <Components>
319     <Electric id="Mazak03-electric_1" name="electric">
320       <DataItems>
321         <DataItem category="EVENT" id="Mazak03-electric_2" name="power" type="
322         POWER_STATE"/>
323         <DataItem category="CONDITION" id="Mazak03-electric_3" name="electric_temp"
324         type="TEMPERATURE"/>
325       </DataItems>
326     </Electric>
327     <Hydraulic id="Mazak03-hydraulic_1" name="hydraulic">
328       <DataItems>
329         <DataItem category="CONDITION" id="Mazak03-hydraulic_2" name="hydra_cond"
330         type="PRESSURE"/>
331       </DataItems>
332     </Hydraulic>
333     <Coolant id="Mazak03-coolant_1" name="coolant">
334       <DataItems>
335         <DataItem category="CONDITION" id="Mazak03-coolant_2" name="coolant_pres"
336         type="PRESSURE"/>
337         <DataItem category="CONDITION" id="Mazak03-coolant_3" name="coolant_temp"
338         type="TEMPERATURE"/>
339         <DataItem category="CONDITION" id="Mazak03-coolant_4" name="coolant_level"
340         type="LEVEL"/>
341       </DataItems>
342     </Coolant>
343     <Pneumatic id="Mazak03-pneumatic_1" name="pneumatic">
344       <DataItems>
345         <DataItem category="CONDITION" id="Mazak03-pneumatic_2" name="pneu_cond"
346         type="PRESSURE"/>
347       </DataItems>
348     </Pneumatic>
```

```
334     </Components>
335   </Systems>
336 </Components>
337 </Device>
338 <Device id="Hurco01" name="Hurco01" uuid="mtc_adapter005">
339   <Description manufacturer="Hurco" model="VMX24">Hurco VMX 24 #1</Description>
340   <DataItems>
341     <DataItem category="EVENT" id="Hurco01-dtop_1" name="avail" type="AVAILABILITY"/>
342     <DataItem category="EVENT" id="Hurco01_asset_chg" type="ASSET_CHANGED"/>
343     <DataItem category="EVENT" id="Hurco01_asset_rem" type="ASSET_REMOVED"/>
344   </DataItems>
345   <Components>
346     <Axes id="Hurco01-axes" name="Axes">
347       <Components>
348         <Rotary id="Hurco01-C" name="C">
349           <DataItems>
350             <DataItem category="SAMPLE" id="Hurco01-C_1" name="Spindle_Speed"
351               nativeUnits="REVOLUTION/MINUTE" subType="ACTUAL" type="ROTARY_VELOCITY"
352               units="REVOLUTION/MINUTE">
353               <Source>spindle_speed</Source>
354             </DataItem>
355             <DataItem category="EVENT" id="Hurco01-C_2" name="Spindle_Override"
356               nativeUnits="PERCENT" type="ROTARY_VELOCITY_OVERRIDE" units="PERCENT">
357               <Source>Sspeed0vr</Source>
358             </DataItem>
359           </DataItems>
360         </Rotary>
361       </Components>
362     </Axes>
363     <Controller id="Hurco01-controller" name="controller">
364       <DataItems>
365         <DataItem category="EVENT" id="Hurco01-controller_1" name="EStop_State" type="
366           EMERGENCY_STOP"/>
367       </DataItems>
368       <Components>
369         <Path id="Hurco01-path" name="Path">
370           <DataItems>
371             <DataItem category="EVENT" id="Hurco01-path_1" name="Block_Number" type="
372               LINE"/>
373             <DataItem category="EVENT" id="Hurco01-path_2" name="Program_Name_Running"
374               type="PROGRAM"/>
375             <DataItem category="EVENT" id="Hurco01-path_3" name="Program_Name_Editing"
376               type="PROGRAM_EDIT_NAME"/>
377             <DataItem category="EVENT" id="Hurco01-path_4" name="Part_Count" subType="
378               ALL" type="PART_COUNT"/>
379             <DataItem category="EVENT" id="Hurco01-path_5" name="Program_Status" type="
380               EXECUTION"/>
381             <DataItem category="EVENT" id="Hurco01-path_6" name="Current_Tool" type="
382               TOOL_NUMBER"/>
383             <DataItem category="SAMPLE" id="Hurco01-path_7" name="
384               Program_Runtime_Seconds" nativeUnits="SECOND" type="ACCUMULATED_TIME"
```



```

        Program_Runtime_Seconds" nativeUnits="SECOND" type="ACCUMULATED_TIME"
        units="SECOND"/>
558     <DataItem category="SAMPLE" id="Hurco05-path_8" name="Spindle_Time"
        nativeUnits="SECOND" type="ACCUMULATED_TIME" units="SECOND"/>
559     <DataItem category="SAMPLE" id="Hurco05-path_9" name="Feed_Rate"
        nativeUnits="MILLIMETER/SECOND" subType="ACTUAL" type="PATH_FEEDRATE"
        units="MILLIMETER/SECOND"/>
560     <DataItem category="SAMPLE" id="Hurco05-path_10" name="Feed_Override"
        nativeUnits="PERCENT" type="PATH_FEEDRATE_OVERRIDE" units="PERCENT"/>
561     <DataItem category="SAMPLE" id="Hurco05-path_11" name="Rapid_Override"
        nativeUnits="PERCENT" subType="RAPID" type="PATH_FEEDRATE_OVERRIDE"
        units="PERCENT"/>
562     </DataItems>
563     </Path>
564     </Components>
565     </Controller>
566     </Components>
567 </Device>
568 <Device id="Hurco06" name="Hurco06" uuid="mtc_adapter010">
569     <Description manufacturer="Hurco" model="VMX64">Hurco VMX 64</Description>
570     <DataItems>
571         <DataItem category="EVENT" id="Hurco06-dtop_1" name="avail" type="AVAILABILITY"/>
572         <DataItem category="EVENT" id="Hurco06_asset_chg" type="ASSET_CHANGED"/>
573         <DataItem category="EVENT" id="Hurco06_asset_rem" type="ASSET_REMOVED"/>
574     </DataItems>
575     <Components>
576         <Axes id="Hurco06-axes" name="Axes">
577             <Components>
578                 <Rotary id="Hurco06-C" name="C">
579                     <DataItems>
580                         <DataItem category="SAMPLE" id="Hurco06-C_1" name="Spindle_Speed"
                            nativeUnits="REVOLUTION/MINUTE" subType="ACTUAL" type="ROTARY_VELOCITY"
                            units="REVOLUTION/MINUTE">
581                             <Source>spindle_speed</Source>
582                         </DataItem>
583                         <DataItem category="EVENT" id="Hurco06-C_2" name="Spindle_Override"
                            nativeUnits="PERCENT" type="ROTARY_VELOCITY_OVERRIDE" units="PERCENT">
584                             <Source>Sspeed0vr</Source>
585                         </DataItem>
586                     </DataItems>
587                 </Rotary>
588             </Components>
589         </Axes>
590     <Controller id="Hurco06-controller" name="controller">
591         <DataItems>
592             <DataItem category="EVENT" id="Hurco06-controller_1" name="EStop_State" type="
                EMERGENCY_STOP"/>
593         </DataItems>
594     <Components>
595         <Path id="Hurco06-path" name="Path">
596             <DataItems>

```

```
597     <DataItem category="EVENT" id="Hurco06-path_1" name="Block_Number" type="
        LINE" />
598     <DataItem category="EVENT" id="Hurco06-path_2" name="Program_Name_Running"
        type="PROGRAM" />
599     <DataItem category="EVENT" id="Hurco06-path_3" name="Program_Name_Editing"
        type="PROGRAM_EDIT_NAME" />
600     <DataItem category="EVENT" id="Hurco06-path_4" name="Part_Count" subType="
        ALL" type="PART_COUNT" />
601     <DataItem category="EVENT" id="Hurco06-path_5" name="Program_Status" type="
        EXECUTION" />
602     <DataItem category="EVENT" id="Hurco06-path_6" name="Current_Tool" type="
        TOOL_NUMBER" />
603     <DataItem category="SAMPLE" id="Hurco06-path_7" name="
        Program_Runtime_Seconds" nativeUnits="SECOND" type="ACCUMULATED_TIME"
        units="SECOND" />
604     <DataItem category="SAMPLE" id="Hurco06-path_8" name="Spindle_Time"
        nativeUnits="SECOND" type="ACCUMULATED_TIME" units="SECOND" />
605     <DataItem category="SAMPLE" id="Hurco06-path_9" name="Feed_Rate"
        nativeUnits="MILLIMETER/SECOND" subType="ACTUAL" type="PATH_FEEDRATE"
        units="MILLIMETER/SECOND" />
606     <DataItem category="SAMPLE" id="Hurco06-path_10" name="Feed_Override"
        nativeUnits="PERCENT" type="PATH_FEEDRATE_OVERRIDE" units="PERCENT" />
607     <DataItem category="SAMPLE" id="Hurco06-path_11" name="Rapid_Override"
        nativeUnits="PERCENT" subType="RAPID" type="PATH_FEEDRATE_OVERRIDE"
        units="PERCENT" />
608     </DataItems>
609     </Path>
610   </Components>
611 </Controller>
612 </Components>
613 </Device>
614 </Devices>
615 </MTConnectDevices>
```