

DMWorks™

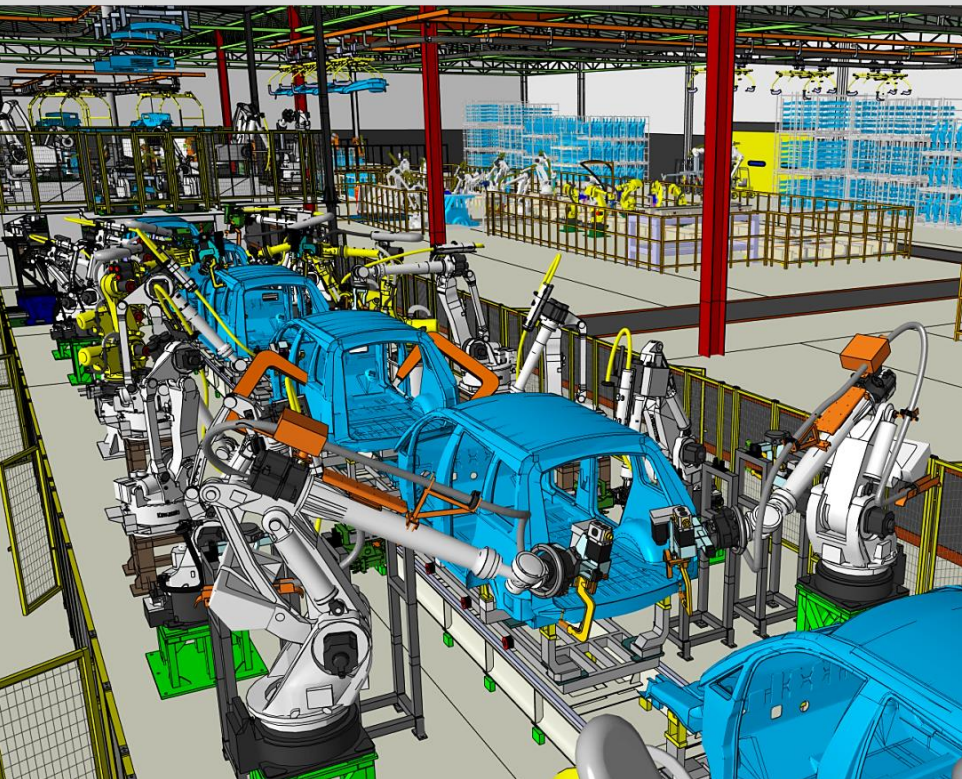
Graphics Motion Simulation Solution for Digital Manufacturing and Robot Off Line Programming

DMWorks (Digital Manufacturing Works) is a new generation of factory simulation software, which covers wide aspects of robotic production environments from developing concepts to commissioning ideas; design, simulate, validate equipment, and finally evaluate task and manufacturing processes for the production line.

The primary goal of digital manufacturing is an arrangement of resources in manufacturing environment to improve the quality, speed, and cost of manufacturing processes.

With DMWorks, the user can easily build full-action mockups of a complete manufacturing factory to validate and optimize resources, product, and manufacturing processes prior to implementation. It enables to flawlessly introduce manufacturing processes to the shop floor by allowing virtually validate manufacturing concepts upfront.

DMWorks creates, manipulates, and simulates the detailed motions of devices and their logical sequences for the whole production line, including Robotic Simulations, Station Process Simulation, Transportation Simulations (Conveyor/EMS/Forklift), and Robot Off-Line Programming (OLP).



Features

- ✓ Large-scale Factory Simulation
- ✓ Robotics Simulation
- ✓ Station Process Simulation
- ✓ Transportation Simulation
- ✓ Human Simulation
- ✓ Robot Off-Line Programming
- ✓ 3D Scan Data Application
- ✓ Robot remote control & Monitoring

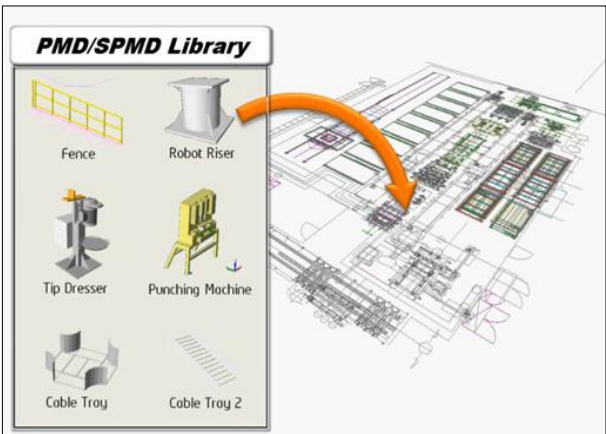
✓ Multi-CAD Data Type Import and Powerful Data Reduction

DMWorks can import major CAD files as well as create 3D shapes by native CAD functions. It can read /convert CAD formats (Catia, UG, Solid Works, AutoCad, CGR, JT, etc), and CAD data for simulation software (IGRIP, Robcad). The level of accuracy for the imported CAD data can be controlled by the various converting options. Also, DMWorks's powerful data reduction options allows to control entire factory in virtual environment.

✓ 3D Geometry Creation / Modification and Parametric Model Device(PMD)

DMWorks' native CAD module provides various functions to create and modify 2D/3D geometries (primitive shape, cutting, extruding, sweeping, duct/piping) and Parametric Modelers of typical features such as ducts, piping, safety fences, and shapes that can be standardized (trusses, pillars, beams, etc.) for factory modeling.

The Parametric Modeler allows fast modifications of existing models to reduce design and layout time.



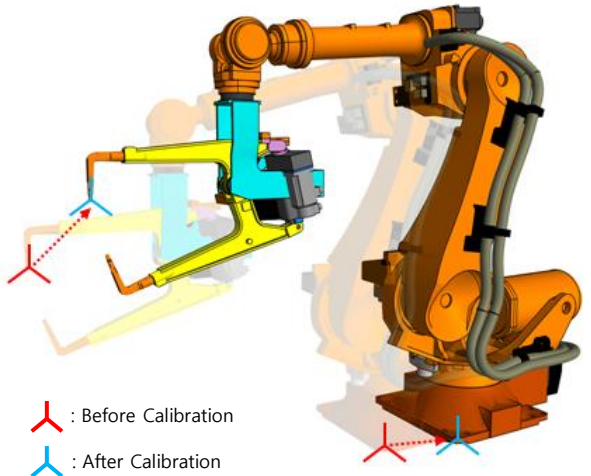
Equipment layout using 2D/3D CAD model and Parametric model.

✓ General Motion Device Building & Easy Kinematics Definition

DMWorks provides easy procedures for modeling general motion devices (general open-loop mechanism) and kinematics definitions. Also, DMWorks provides additional procedures to define general closed-loop planar mechanisms. Using the procedures, users can model most of the motion device types in the manufacturing industries. For fast creation/definition of most industrial robots types and weld guns, easy-to-use modeling templates are provided.

✓ Calibrated Simulation Model by fast Inverse Kinematics Solvers

DMWorks provides fast inverse kinematics solvers for the most standard industrial robots, which enable to minimize position errors between virtual and real world environment. Using the calibration data input, DMWorks rebuilds all the necessary elements of the Workcell in order to reflect the real data of robot positioning, robot link attachments, tool mounting positions, and robot kinematics parameters. The Calibrated Workcell (along with the Calibrated Inverse kinematics solver) allows more realistic positioning simulation of robots and more accurate robot OLP.

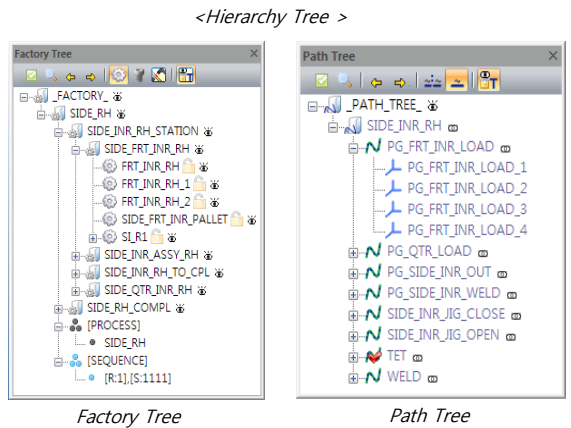


Robot Calibration: aligning virtual robot to real robot

✓ Hierarchical Grouping Structures
for Systematic Factory Data Management

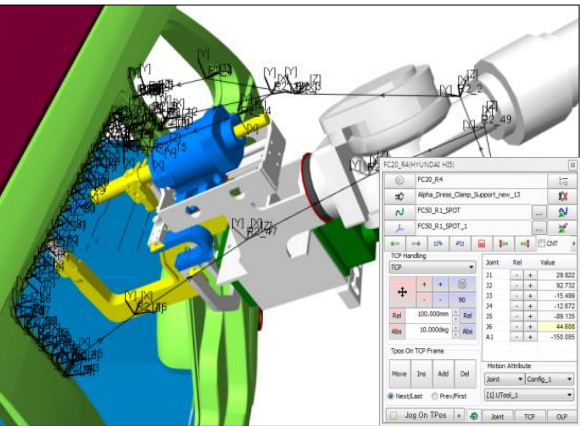
DMWorks provides hierarchy tree structures for different types of data; **Factory Tree, Path Tree**

For example, by using the Factory tree, all entities in the WorkCell can be grouped into cells, zones, production lines, or a factory, in which the levels of stages and the names of the groups can be defined by users. Also, users can insert a part of the factory from an external application by importing the data into a cell of an existing hierarchy tree, and vice versa.



✓ Intuitive [Motion Dialog] for Creating & Examining Motions of Robots with Multi-Tools

DMWorks provides the users with an easy-to-use dialog box to create and manipulate the motions of robots with multi-tools and auxiliary devices. Using the [Motion Dialog], a robot path and behavior of tool / auxiliary device at each Tpos can be created, simulated, and modified.



Robot program (Path/Tpos) creation using [Motion Dialog]

✓ Task Creation and Motion Simulation
of Devices including Robots

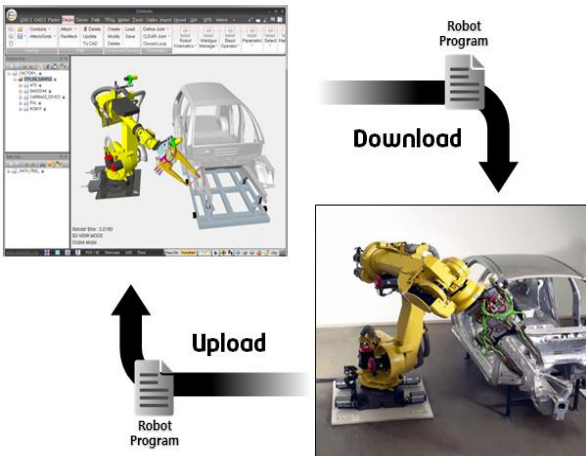
Standard Attributes of Path/Tpos can be easily created by using the [Motion Dialog]. More detailed task can be defined by the application dependent task templates. Users can utilize both [Motion Dialog] and the task templates to describe the detailed motions of a device. The dialog and templates include the motions, I/O signal handling, tool behavior and the application dependent attributes (spot welding, handling, conveyer/EMS, etc.). Through the task simulation, cycle time of the task can be estimated as well as the collision check in motion. Advanced users may use the WSL to develop special task templates for their own applications.

Tpos Name	Interpolation	Speed Mode	Speed		Speed Val	CNT Flag	Accuracy		
			Speed (%)	Speed			Accuracy Mode	Accuracy (%)	Accuracy
FC50_R1_SPOT_1	JOINT	PERCENT	80.000	100.000	TRUE	PERCENT	80.000	100	
FC50_R1_SPOT_2	JOINT	PERCENT	80.000	100.000	TRUE	PERCENT	80.000	100	
FC50_R1_SPOT_3	JOINT	PERCENT	80.000	100.000	TRUE	PERCENT	80.000	100	
FC50_R1_SPOT_4	JOINT	PERCENT	80.000	100.000	TRUE	PERCENT	80.000	100	
FC50_R1_SPOT_5	JOINT	PERCENT	60.000	100.000	TRUE	PERCENT	60.000	100	
FC50_R1_SPOT_6	LINEAR	PERCENT	40.000	100.000	FALSE	PERCENT	80.000	100	
FC50_R1_SPOT_7	LINEAR	PERCENT	40.000	100.000	FALSE	PERCENT	80.000	100	
FC50_R1_SPOT_8	LINEAR	PERCENT	40.000	100.000	FALSE	PERCENT	80.000	100	
FC50_R1_SPOT_9	LINEAR	PERCENT	40.000	100.000	FALSE	PERCENT	80.000	100	
FC50_R1_SPOT_10	LINEAR	PERCENT	40.000	100.000	FALSE	PERCENT	80.000	100	
FC50_R1_SPOT_11	LINEAR	PERCENT	40.000	100.000	FALSE	PERCENT	80.000	100	
FC50_R1_SPOT_12	LINEAR	PERCENT	40.000	100.000	FALSE	PERCENT	80.000	100	
FC50_R1_SPOT_13	JOINT	PERCENT	60.000	100.000	TRUE	PERCENT	60.000	100	
FC50_R1_SPOT_14	JOINT	PERCENT	80.000	100.000	TRUE	PERCENT	80.000	100	
FC50_R1_SPOT_15	JOINT	PERCENT	80.000	100.000	TRUE	PERCENT	80.000	100	
FC50_R1_SPOT_16	JOINT	PERCENT	80.000	100.000	TRUE	PERCENT	80.000	100	
FC50_R1_SPOT_17	JOINT	PERCENT	80.000	100.000	FALSE	PERCENT	80.000	100	

Example of task templates: Standard Attribute

✓ Robot Library and OLP (Off-Line Programming)

DMWorks provides robot libraries for most of industrial robot models, and OLP (Off-Line Programming) environments for most robot languages used in the automotive industries. The robot programs created by DMWorks can be downloaded directly to the shop floor robots of an actual factory. The robot job programs created at the shop floor can be uploaded to DMWorks as well. Each OLP environment is specially designed for the corresponding robot language.



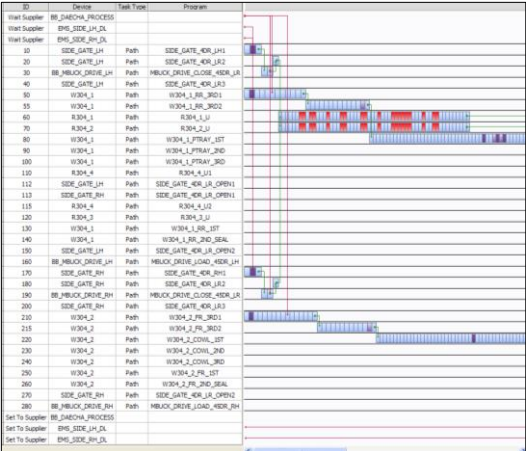
✓ **Process Creation and Simulation**

DMWorks provides 2 different types of process definition tool;
Station Process and Transportation Process

For easy creation of **Station Process**, P.E.P(Position Based Event Driven Process) chart is provided to define the logical sequence of tasks by using various events.

In PEP chart;

- Station Process can be created by arranging devices and their tasks(Path/Tpos).
- Sequence of operations can be controlled by both external and internal events.
- Activation of station process is controlled by user selected external events.



PEP chart for defining of Station Process

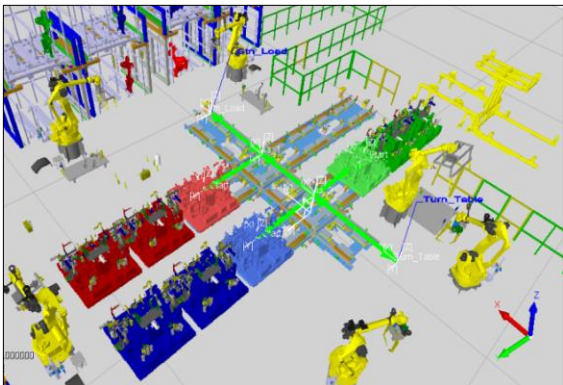
In order to control the logical sequences of the tasks and processes, DMWorks provides various kind of events & I/O signals for a station process;

- External Events : Events from connected Process including Transportation Process.
- Internal Events : Task End, I/O Signals, etc.

These events enable the users to easily define and simulate complicated processes. Also, advanced users may use the WSL to develop special processes for their own applications.

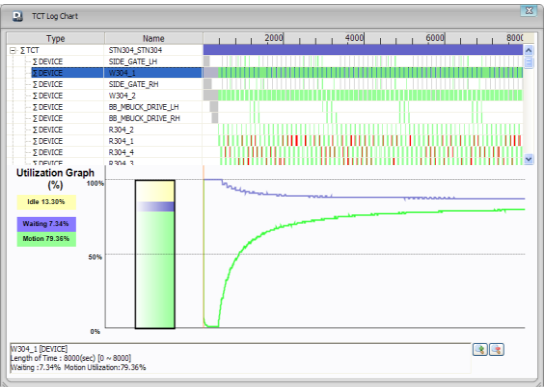
Transportation Process is for motion simulation of devices which moves through more than 2 stations such as Conveyor/ Overhead Carrier, Shuttle, Fork Lift, Turn Table, etc. DMWorks provides different procedures for creating Conveyor, shuttle, fork lift, and turn table processes

Each Conveyor Process, for example, can be controlled by Sequence Order, Conveyor Operation Type, Routes for each product model, and Number of Conveyors/Linked Stations for each Route.



Transportation process simulation

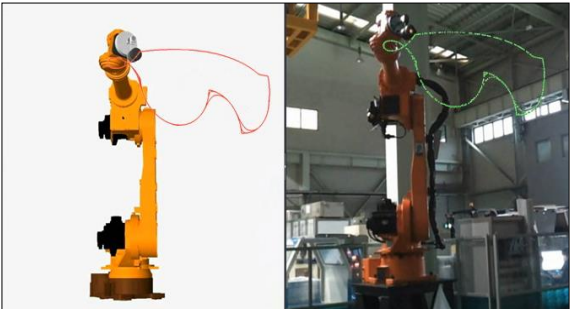
After the process simulation, simulation results such as UPH(Utilization per Hour), cycle time, and number of parts remaining in buffer, are displayed. Also, utilization rate of each device/station is displayed as a graph, so the users can easily verify bottlenecks, and wait/ideal time for each station.



Utilization graph of each device

✓ **RRS(Realistic Robot Simulation)**

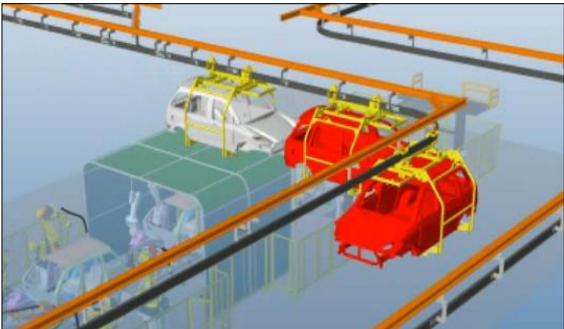
The RRS which is based on the motion planning of actual robot controller. Once the RRS is applied to RCS(Robot Controller Simulation) of DMWorks, it allows to simulate extremely accurate robot trajectory path and cycle time calculation.



Comparison of Robot trajectory path between virtual and real robot

✓ **Collision Detection**

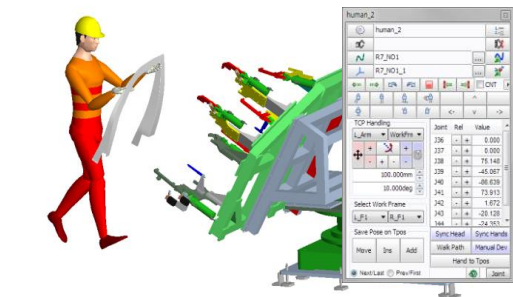
The collision detection allows to detect collisions among the selected devices during any type of simulations to prevents and protects equipment from damaging.



Collision simulation for Overhead Conveyer

✓ **Ergonomics Simulation**

DMWorks provides easy control of Redundant DOF Kinematics for Human Model. Human device has special [Motion Dialog] for posture creation/control and automatically generates walking path and standard walking postures.



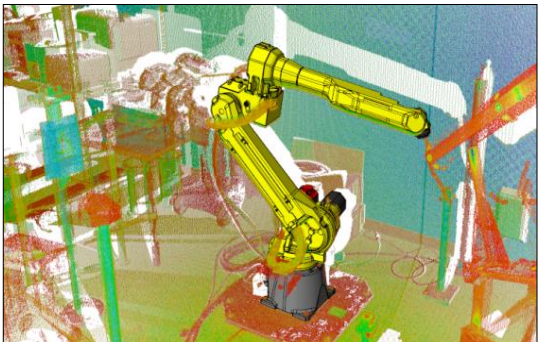
Ergonomics simulation and its [Motion Dialog]

✓ **Cable Simulation**

DMWorks provides simple procedure to define physically realistic cable. The cable simulation enables to prevent and protect robot cable from tangling.

✓ **3D Scan Data**

DMWorks can import and display point cloud data that scanned from 3D Scanners. It allows more accurate layout of equipment, collision detection, and efficient simulation by utilizing both 3D workcell and 3D Scanned environment.



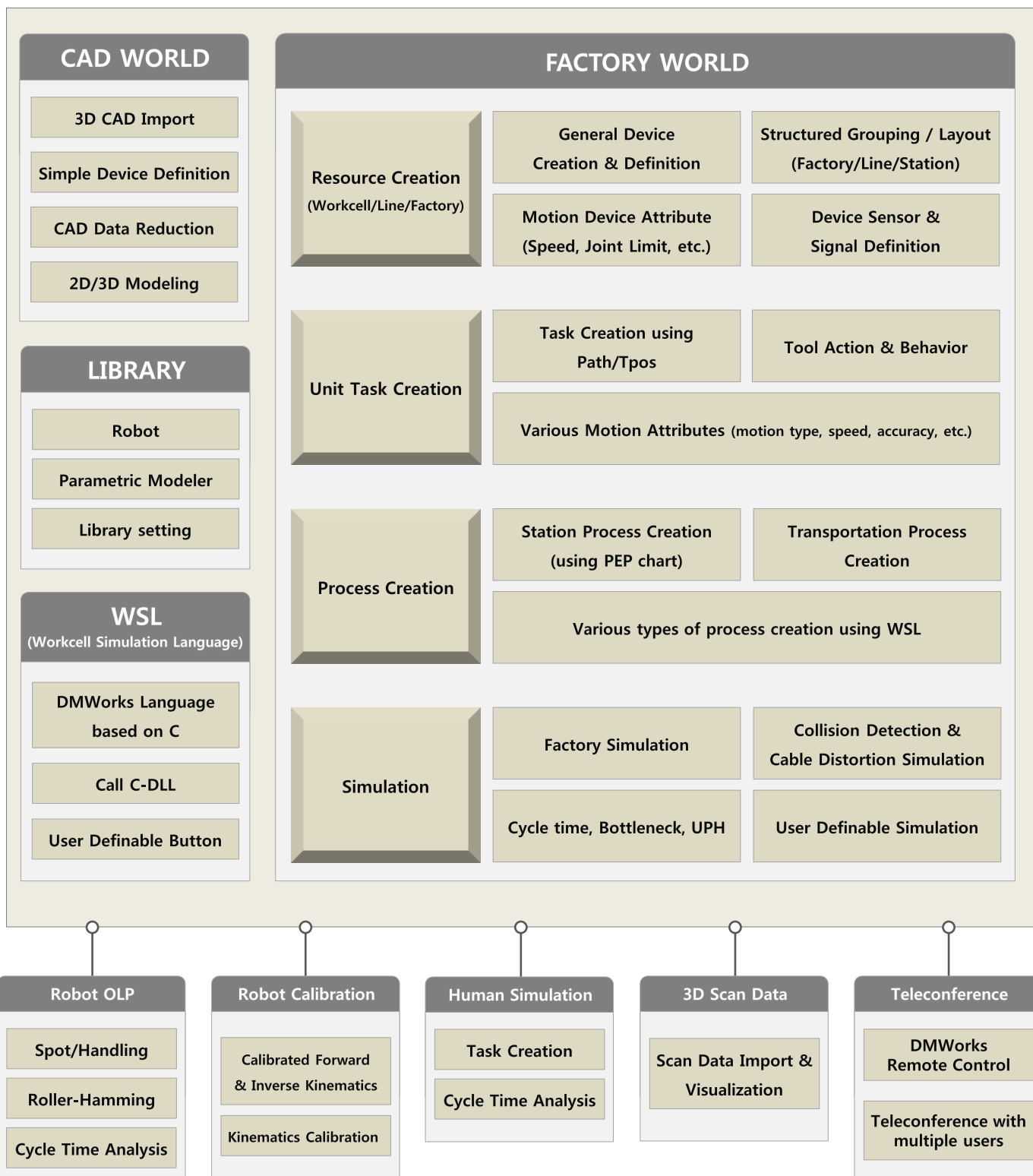
Simulation with both 3D Scan data and 3D CAD data

✓ **Open Development Environment with WSL (WorkCell Simulation Language)**

The **WSL (Workcell Simulation Language)** is a structured and procedural programming language of the C style. In addition to the C language, WSL provides various Simulation Commands as follows :

- To create/manipulate/control Entities of WorkCell
- To create/manipulate/control motions, tasks and processes
- To create/manipulate the user interfaces
- To create/control the simulation environments with a User Customizable Menu/Button System.
- WSL can call external C DLL made by users

The WSL Program can be Loaded to a Device, station, group of stations, or User created Button.
With the WSL, users can develop their own customized simulation environment for any scientific and engineering purpose.



Contact

EZROBOTICS CO.,LTD.
Digital Manufacturing System Laboratory

+82-31-695-3500 | www.ezrobotics.com