README

Model language: OWL (Web Ontology Language)

The model refers to the UML model represented in the file named "OFM-UML.pdf".

The Manufacturing Systems Ontology (MSO) is a structured representation of the domain of manufacturing systems and logistics systems, based on the object-oriented methodology. The modelling method defines the system by addressing four main different aspects separately: the physical aspect, the technological aspect, the control aspect and the visualization aspect.

THE PHYSICAL ASPECT

The Physical aspect contains the material definition of the system including workers, production facilities, material-handling and transportation equipment, storage and other supplementary devices. The main concept on which the physical aspect is based on is the 'subsystem', i.e. an aggregation of resources. Subsystems can be composed either of smaller subsystems or of 'components'. Components have an ID as attribute, i.e. a code that allows its unique identification in the system, and can be specialised in different types. Each of the following subclasses of components is linked with the 'father class' component with a hierarchical inheritance: they present the same attributes and relationships of the component class. Specifically:

- **Processors class** identifies entities performing a manufacturing process function by using an energy source and/or an operator activity; the processor class is specialized in two sub-classes whether the processor belongs to the discrete manufacturing (Discrete Processor class) or to the process production (Flow Processor class);

- **Transporters class** identifies entities performing a transportation function, like moving material between different points of the manufacturing process; the transporter class is specialized in two sub-classes, whether the transporter equipment is provided for operation in the discrete manufacturing (Discrete Transporter class) or in the process production area (Flow Transporter class);

- **Storages class** identifies entities performing a storage function; the storage class is specialized into Flow and Discrete storage;

- **Container class** comprises the unit loads that are used for handling items; they can be made in different sizes / materials determined by the size, weight, geometry, and environmental requirements etc. of the handled item;

- **Tools class** comprises the tools that are entities used by a processor to perform an operation on a product;

- **Fixtures class** comprises those entities that are used to position, hold, support, locate and clamp the product in a three-dimensional space;

- **Controllers class** contains any decisional element performing functions of production planning and control in a manufacturing system;

- **Operators class** identifies workers that perform activities in the manufacturing system and interact with other components. The Operator class is divided in Process Operator (further specialized in transportation, manufacture and assembly operator) and Control Operator (a supervisor, manager, quality control operator);

- **Sensors class** identifies sensing devices used for capture the status of a physical variable. Sensors can be of different types: Photocell, Barcode Scanner, Temperature Sensor, Conductivity Sensor, Moisture Sensor, Tank Level Sensor, Pres- sure Sensor, Flow Meter.

THE TECHNOLOGICAL ASPECT

Technological aspect defines the transformational (functional) view of the system, considering the conversion processes (i.e. manufacture and assembly) and the routing that products must undergo within the manufacturing system, following a process plan within the manufacturing system itself.

We can distinguish two types of routing:

- Transportation routing: is made of a linear sequence of visits to workstations in each of which a manufacturing or assembly operation is performed

- Process routing: is a more detailed version of the transportation routing in which each operation is composed by tasks, which are performed into each workstation.

This formal description allows to cover two different industrial engineering situations:
- Product to workstation (with equipment already assigned to the workstations): the product has to travel among workstations to be processed and finds all necessary equipment ready to do so in the workstations
- Equipment to workstation (with products already assigned to the workstations): the equipment (such as tools and fixtures) travels among workstations to process/assemble products, that are assigned to workstations.

THE CONTROL ASPECT

The control aspect stores data and describes the relationships among concepts that are needed to perform the production system control.

THE VISUALIZATION ASPECT

The visualisation aspect represents and stores data for the visualisation interfaces for human users, such as screens and visual devices.