

Smart Production Domain Model

Smart Factory / Smart Warehouse Domains

Revision history

Version	Date	Author	Description
1.0	25-06-2024	AEF SML	Updated domain model from previous document.
1.1	21-08-2024	AEF	Added Automated Storage Model.
1.2	23-09-2024	AEF	Updated Manufacturing Model.
1.3	17-10-2024	SML	Updated Topology Model.
1.4	28-05-2025	KHU, NNG	Updated titles, headlines and terminology throughout the document for more consistent use of terms model and concepts.
	26-05-2025	PDA	Release

Review history

Version	Date	Reviewer	Notes / description
1.0	26-06-2024	AEF SML	Review
1.1	21-08-2024	SML	Review
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1 Introduction

This document covers the following three main components of the domain model:

- Descriptions of the roles and responsibilities of users intended to interact with the software and supporting services of the integration- and control platform, as well as a description of the interactions themselves.
- A dictionary/glossary containing descriptions of terminologies necessary to read and comprehend the domain model and the relations between the terms used.
- The graphical representation of the domain model in the format of several images.

1.1 References

ID	Document	Description
[1]	GS1 Identification Keys in Transport & Logistics - GS1 Guideline	GS1 Guideline. Contains key concepts for Transportation and Logistics.
[2]	ISA-88 and ISA-95 - standards for batch control and enterprise - control system integration	ISA-88 and 95 provide a set of best practice models for industrial information systems in charge of manufacturing execution and business logistics.
[3]	ISA 80, -88, and -95 standards	Same as [2].
[4]	Editable Domain Model (StarUML-file)	The StarUML model that contains all the diagrams in this document.

More references will be used throughout the document; please refer to the footer of the relevant page.

1.2 Copyright and right to use under Apache License 2.0

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The reference architecture, designs and the included open standard integration interfaces are open and free to use under Apache License 2.0. For details please see

<https://www.apache.org/licenses/LICENSE-2.0>.

1.3 Background / 5G-Robot



Parts of this document / release was made in the **5G-Robot** project also known under the long name **5G-ENABLED AUTONOMOUS MOBILE ROBOTIC SYSTEMS** - the largest innovation project that has been launched under the Innovation Fund Denmark's (IFD) Grand Solutions program.

The groundbreaking project united Denmark’s leading robot, automation and factory digitalization companies as technology vendors, research partners and industry-leading end-user companies.



Illustration: Project partner logos.

The aim of the project was to revolutionize manufacturing - paving the way to smart production and smart factories and the application of a number of new technologies in production and manufacturing including 5G wireless communication, cloud and edge computing and digital twin.

Intelligent Systems played a leading role in the project, providing the glue that ties the robotic solutions of the partners together making the work as one - i.e. one connected integrated intelligent manufacturing system.

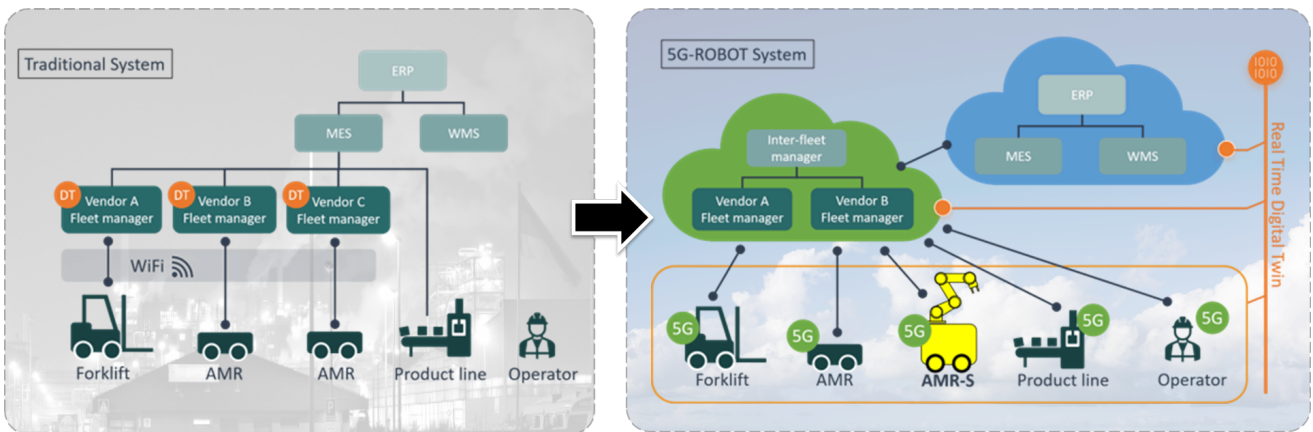


Illustration: The aim is to revolutionize manufacturing paving the way to smart production and smart factories.

Read more about the 5G-Robot project here: <https://www.5gsmartproduction.aau.dk/5g-robot>

2 User archetypes

The two user archetypes encompass respectively: The customer interacting with the ecosystem and accompanying supporting services of our SaaS-business, and the end user interacting with the control- and integration software itself.

Archetype users:

- Factory/warehouse director
- System designer
- Production planner
- Supervisor
- Operator

2.1 Customers

Description of customer's interaction with the product / service.

2.2 Users

There are two types of general users for the Intelligent Systems' control- and integration platform: *Direct users* of the control- and monitoring functionalities of the software, and the *System administrators*.

2.2.1 Direct Users

Users include direct and indirect users of platform product - and various degrees of direct and indirect use.

Direct users of the software include different types of users, each with their own job roles, purposes and goals of use.

2.2.1.1 Planner

The production planner is responsible for the accuracy and timeliness of the production process. Duties include a specific focus on the materials and goods required in the production phase and ensuring the working space is properly maintained for optimal performance.

Their interaction with our control and integration software will be through planning utilities, which allow them to create production plans and maintain an overview of planned output.

2.2.1.2 Supervisor

The supervisor's responsibilities include setting daily/weekly/monthly objectives and communicating them to employees, organizing workflow by assigning responsibilities and preparing schedules, and keeping track of production output and checking if it meets specifications in a production environment.

Their interaction with our control- and integration software will be through monitoring utilities that allow them to monitor statuses and conditions related to facility or warehouse productivity within their specific area(s) of responsibility.

2.2.1.3 Operator

The operator, or worker, is responsible for carrying out the orders defined by the planner, though he will most likely take direction from the supervisor to whom they answer to.

Their interaction with our control- and integration software will be through Human-Machine Interfaces (HMI) that are part of controlling automated and semi-automated facility- or warehouse processes — e.g., pressing a button that will call an autonomous mobile robot to pick up a pallet or individual item.

2.2.2 System Administrator

Systems administrators are conventionally responsible for installing, upgrading and monitoring software and hardware as well as assisting with data backup and recovery. Smaller companies may have a single systems administrator whereas larger companies usually have several systems administrators focused on specific areas.

Within the context of the Intelligent Systems control- and integration software, the System Administrator can access and make changes to the whole system and setup pertaining to the company's ("*Cloud Control*") account. They hold every possible right a user can have, including creating additional users and specifying the rights of those users.

They are typically responsible for defining the system composition in the system builder and setting up workflows in the workflow builder, as well as configuring devices and mobile robot units connected to the system.

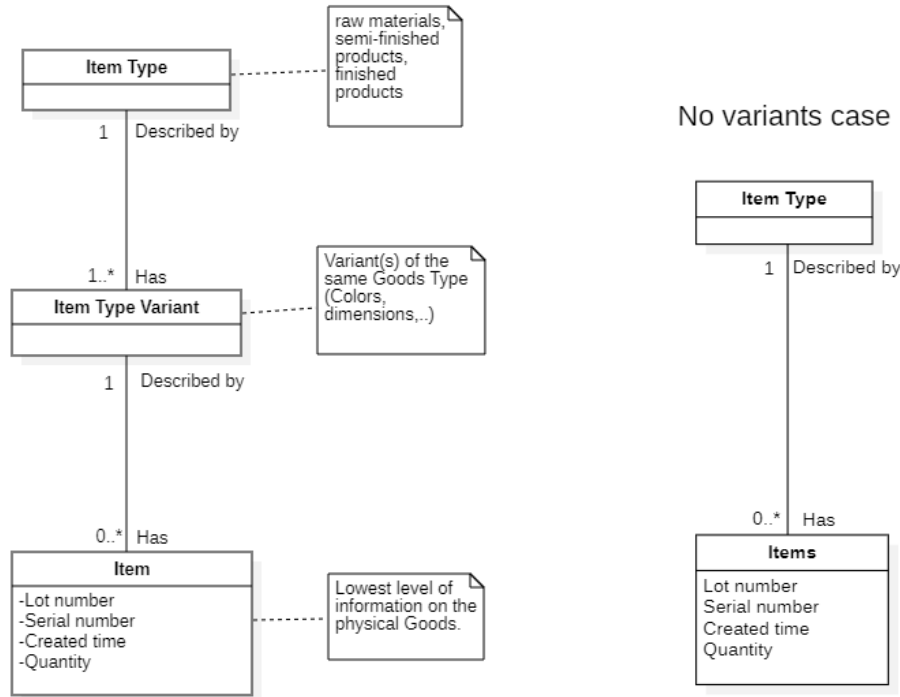
3 Models

The domain model contains the following models:

- [Items Model](#) - models materials, products and goods that are used in a smart warehouse/factory.
- [Item Reservation Model](#) - ensures that items are set aside for specific processes like manufacturing or fulfilling customer purchase orders, preventing their use by other processes.
- [Order Model](#) - directs item movement or production in the system, categorized as inbound, outbound, or internal, with detailed order lines specifying the items involved.
- [Topology Model](#) - defines locations and areas (and specializations of these) to model the physical layout and connectivity of a smart warehouse or factory, enabling precise placement and tracking of items, equipment, and mobile robots.
- [Area View Model](#) - provides a visualization of a specific area, highlighting its locations and equipment.
- [Demand Model](#) - specifies internal requirement for items needed to fulfill a delivery or production order, with demand lines detailing the type and quantity of items to be moved.
- [Container Model](#) - describes units used for transporting or storing items, including returnable and non-returnable containers, with compartments specifying sections within them for item placement.
- [Manufacturing Model](#) - provides a logical grouping of personnel, equipment, goods, and operations required to produce a product.
- [Production Order Model](#) - defines an internal order specifying the item type variant and quantity to be produced.
- [Operation Model](#) - defines work performed by equipment or an operator within a set time, consisting of detailed phases with specific capabilities to complete tasks.
- [Connection Model](#) - details how the HLC can interface to external systems such as message brokers or host/ERP systems.
- [Equipment Model](#) - defines equipment that service locations and complete operations, described by profiles containing instance-specific configuration, properties, and capabilities.
- [Mobile Robot Model](#) - defines mobile robots that are used for material handling, transportation, and logistics.
- [Interfleet Model](#) - defines how the HLC communicates with external fleet managers and ensures their interoperability and execution of operations.
- [Palletizing Model](#) - defines how palletizing cells can build pallets from containers, slip sheets and more.
- [System Overview Model](#) - defines how the system's state can be monitored by users of the system.
- [Automated Storage Model](#) - defines how automated storage solutions can store containers.

3.1 Item Model

The item model provides a model for describing the raw materials, semi-finished, and finished products that are part of a smart warehouse/factory and their internal relationship. These items are what can be ordered in the system and are used in production of new products.



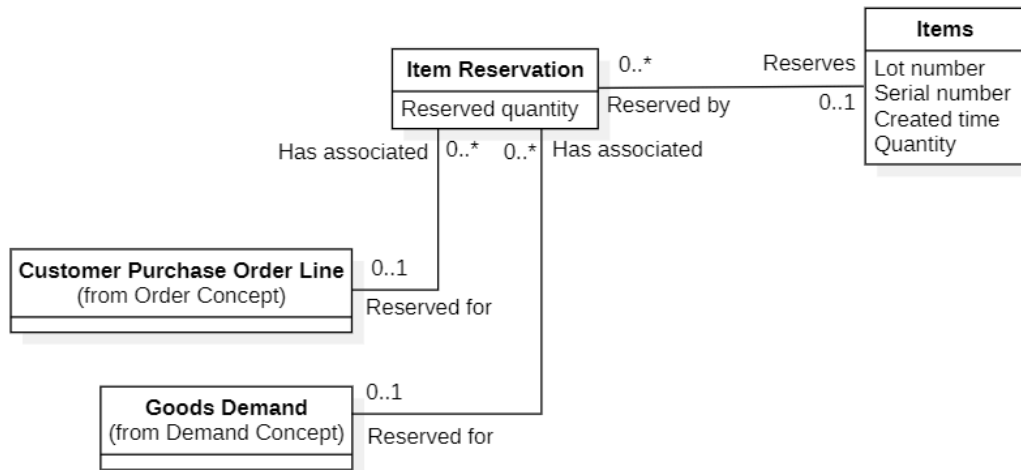
Term	Alternative terms	Description
Item Type	<ul style="list-style-type: none"> - Goods Type - Material Type - Product Type - Supply Type - Article Property (ISA 88 Batch) - Item Info - Item Property 	<p>Item Type describes anything from merchandise, supplies, raw materials to semi-finished and already completed products.</p> <p>It describes information, such as e.g. Name, Description, Unique ID, ABC¹ Classification etc.</p>
Item Type Variant	<ul style="list-style-type: none"> - Goods Type Variant - Material Type Variant - Product Type Variant - Supply Type Variant - Article Type Variant - Item Info Variant - Item Property Variant 	<p>Item Type Variants is a concept used to describe multiple variants of the same Item Type.</p> <p>It can e.g. be variants like different physical dimensions and/or colors.</p>
Item	<ul style="list-style-type: none"> - Goods - Material 	<p>Item is the primary inventory entity and is the lowest level of information on the physical Item.</p>

¹ https://en.wikipedia.org/wiki/ABC_analysis

	<ul style="list-style-type: none"> - Product - Supply - Article (ISA_88_Batch) 	<p>It describes a distinct physical object (or a number of physical objects that are indistinguishable). Alternative terms can be used to specify the intended use case, such as "Materials" for items that are to be used in manufacturing.</p>
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3.1.1 Item Reservation Model

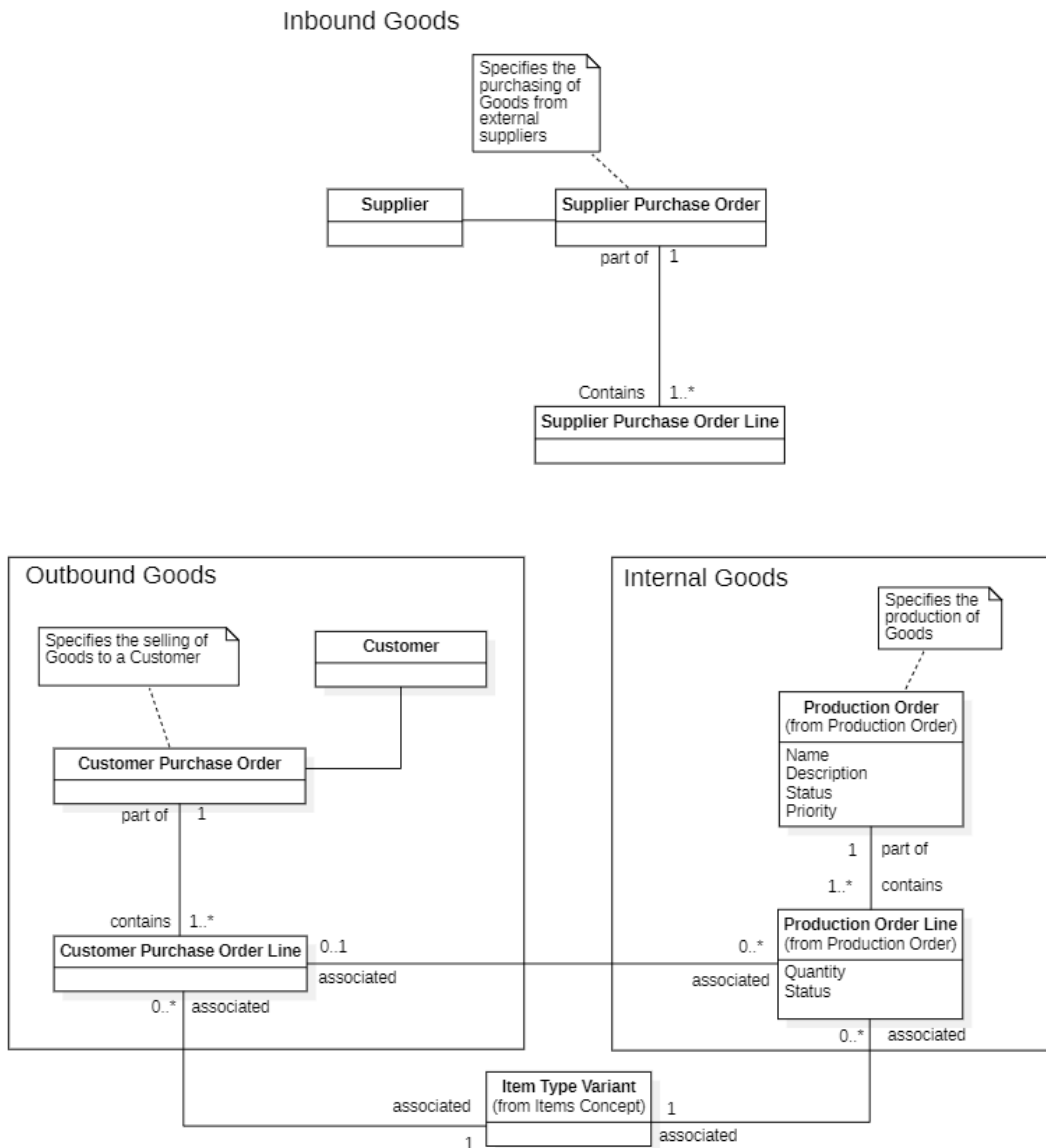
The item reservations model ensures that goods are set aside for specific processes such as manufacturing or fulfilling orders, preventing their use by other processes.



Term	Alternative terms	Description
Item Reservation	- Goods reservation	<p>Item reservations are used to ensure certain processes, such as manufacturing or fulfilling customer purchase orders, can occur without the items being used by another process.</p> <p>The HLC can find items in storage and reserve them for future use.</p> <p>Each reservation is for a single group of items, and can either reserve a part of the items or the entire group. If more items are required for e.g. a customer purchase order, multiple reservations can be used.</p>

3.2 Order Model

An order directs the system to perform specific tasks involving item movement or production. Orders are categorized as inbound (Supplier Purchase Orders), outbound (Customer Purchase Orders), or internal (Production Orders). Each order consists of detailed order lines specifying the items to be moved or produced.



Term	Alternative terms	Description
Order		An Order describes how some items are needed, e.g. purchased by a customer, needed for production, or to be moved to a new location. The items must be handled according to the type of order. Naturally there can be many different types of orders, but a way to organize and distinguish them could be based on the flow i.e., inbound, outbound and

Term	Alternative terms	Description
		internal item flows. The order can be created from the HLC, or be retrieved from external systems such as host/ERP systems.
Order Line ²	- Line Item	As the term suggests, this is highly correlated with an order. The order line is what describes in more detail the type of items and quantity to be moved, produced, etc.. There can be multiple order lines on the same order.
Supplier Purchase Order ³ (Inbound Items)	- Supplier Order - Supply/Material Purchase order	This concept is used to describe the expected delivery of items from an external supplier/system. "Purchase orders are documents sent from you, as the buyer, to a supplier with a request for Items." "A purchase order is a commercial document and first official offer issued by a buyer to a seller indicating types, quantities, and agreed prices for products or services. It is used to control the purchasing of products and services from external suppliers."
Customer		A customer is a person or company that the customer order is intended for.
Customer Purchase Order (Outbound Goods)	- Customer Order - Sales Order	A purchase order that is received from a customer to indicate a purchase of goods.
Delivery Order ⁴	- Movement Order	This concept is used to describe the requested delivery of Goods from this system to a Customer or external system. According to the Uniform Commercial Code (UCC) a delivery order refers to an order given by an owner of Items to a person in possession of them (the carrier or warehouseman) directing that person to deliver the items to a person named in the order.
Production Order ⁵	- Make Order - Manufacturing Order	A production order is an order issued within a company to produce a specific quantity of Items within a certain

² <https://instoredoes.com/help/how-are-order-lines-calculated/>
<https://dba.stackexchange.com/questions/242232/what-is-the-difference-between-order-and-order-line>

³ https://en.wikipedia.org/wiki/Purchase_order <https://planerqv.com/blog/everything-you-need-to-know-about-purchase-orders/>
<https://corporatefinanceinstitute.com/resources/knowledge/other/purchase-order/>
https://www.tutorialspoint.com/sap_mm/sap_mm_purchase_order_types.htm

⁴ <https://www.globalnegotiator.com/international-trade/dictionary/delivery-order/>
https://en.wikipedia.org/wiki/Delivery_order
<https://dictionary.cambridge.org/dictionary/english/delivery-order>

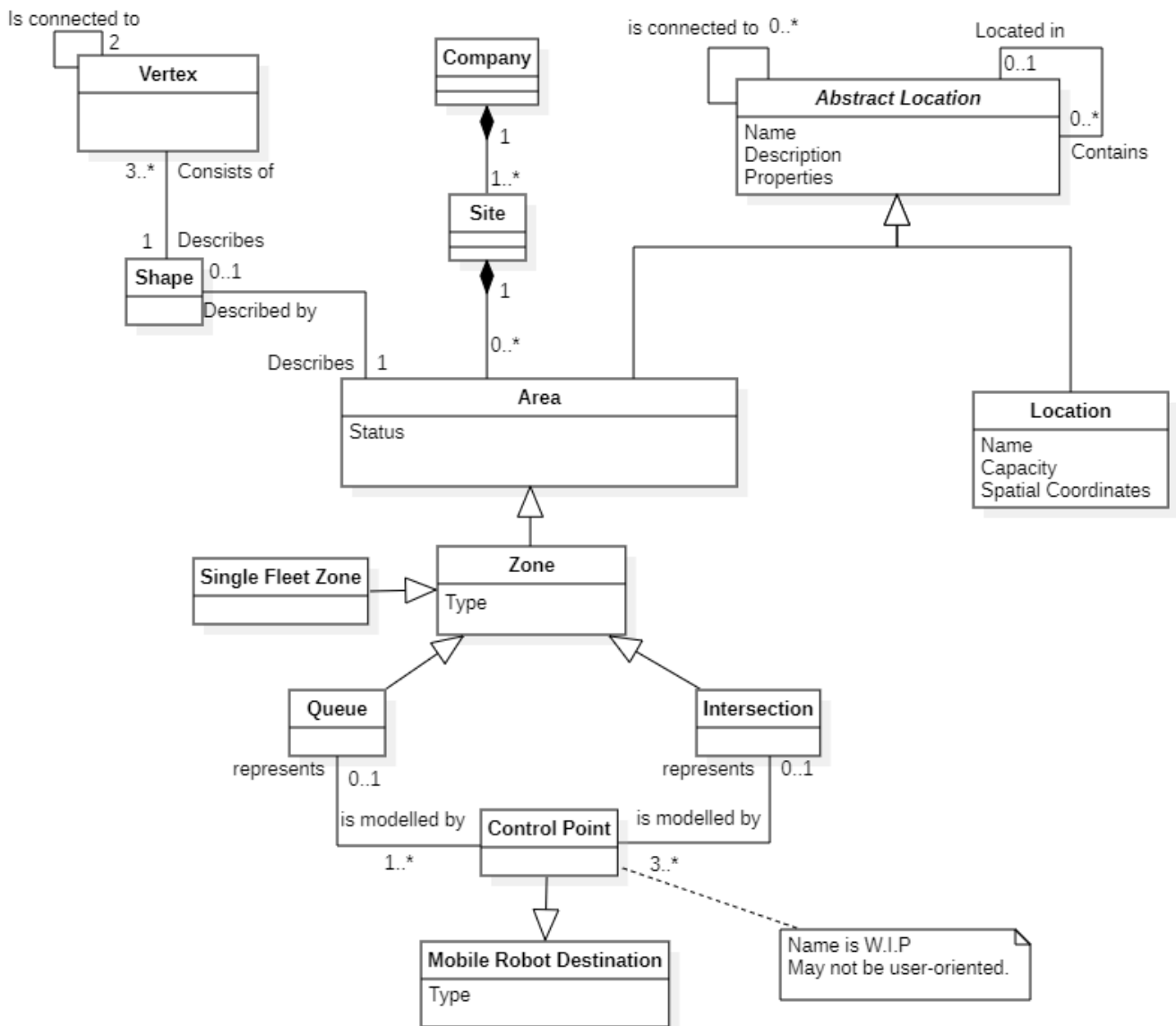
⁵ <https://www.accountingtools.com/articles/2019/1/4/production-order>
https://en.wikipedia.org/wiki/Production_order
https://www.tutorialspoint.com/sap_pp/sap_pp_production_orders.htm

Term	Alternative terms	Description
(Internal Items)		timeframe. A production order may be issued pursuant to a Customer Purchase Order. See Manufacturing Model and Production Order Model .

3.3 Topology Model (Area & Location Model)

The topology model defines a model that covers the concepts locations, areas, and zones that enable modeling the physical layout and connectivity of a smart warehouse or factory. The model can be used to specific placement of items, equipment, mobile robots, etc. in the physical world. Examples include modeling a warehouse’s inventory layout and track goods via. storage location or send mobile robots to predefined destinations.

3.3.1 Areas

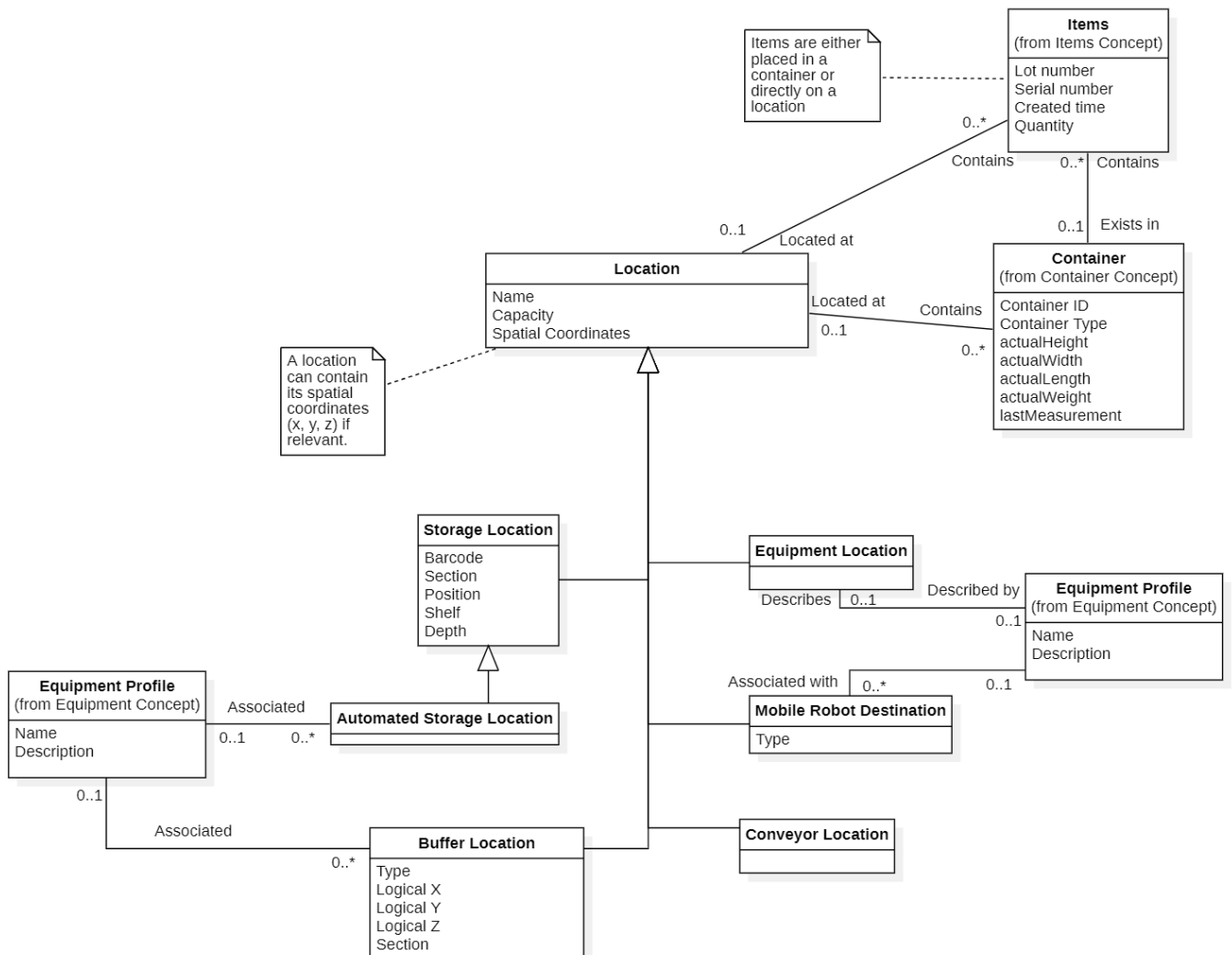


Term	Alternative terms	Description
Abstract Location		An abstract location defines a location either in a physical/spatial (coordinates) or logical (ID point) manner. Areas and location derive from this model.

Term	Alternative terms	Description
Area ⁶ (S88/S95)	- Section	A bounded part of the space on a surface i.e. a bounded part of a warehouse. Area is used to describe a group of Locations within that aArea, and other aAreas within that aArea.
Shape		An area has a shape that defines that contour and location of the area. This shape is defined via a set of vertices.
Vertex	- Corner - Coordinate	A vertex is a coordinate in the physical space.
Site	- Company - Building	A site is a specialization of an area.
Zone		A specialization of areas but is subject to specific requirements. Zones can have specific properties, e.g., being a pedestrian zone or low speed zone resulting in certain requirements that must be considered in production planning and respected by equipment.
Single Fleet Zone		A specialization of zones. Used to enforce restrictions on that only robots from a single fleet can be in the zone at a given time. This allows the fleet to internally solve traffic issues.
Queue		A specialization of zones. Queues can be used to manage traffic and to ensure that only one robot is at a destination at a time. A queue can contain a given number of robots. Queues have a control point for every queuing location. The queue's physical area is defined by the area covered by the control points in the queue.
Intersection		A specialization of zones. Intersections can be used to manage traffic in areas of the site where multiple robots may run into a deadlock or collide due to crossing traffic, narrow passages, etc. An intersection has a given number of control points that can be considered entry/exit points to the intersection. The intersection's physical area is defined by the area covered by the control points in the intersection.
Control Point		A specialization of Mobile Robot Destination (see Locations). A control point is a destination that can only be occupied by a single robot at a time. Control points are used to model queues and intersections. The interfleet uses these control points to monitor and control AMR traffic.

⁶ <https://www.thefreedictionary.com/area>

3.3.2 Locations



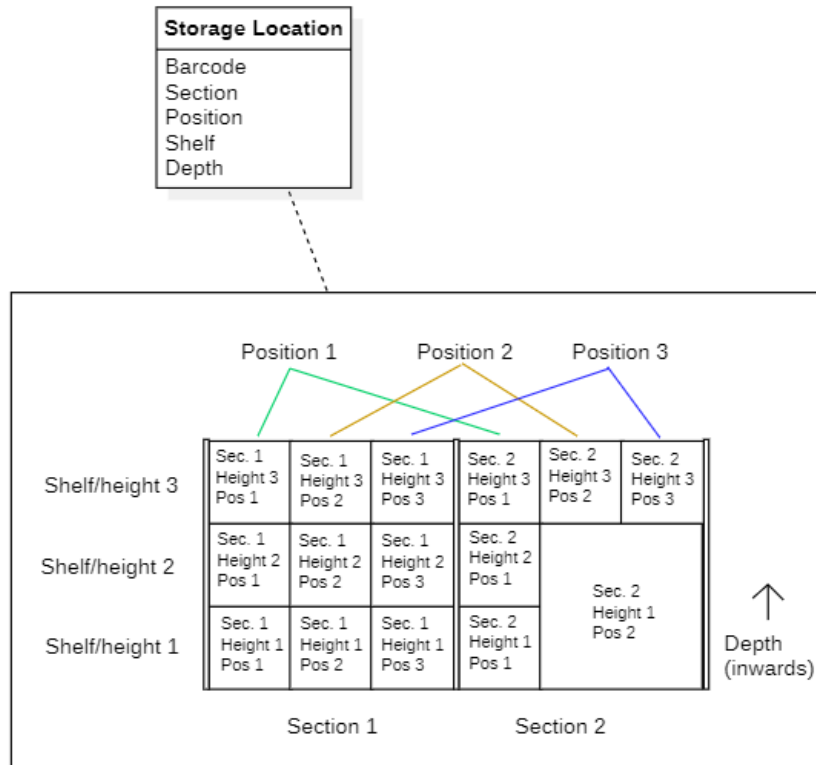
Term	Alternative terms	Description
Location ⁷ (S88/S95)	- Placement - Locality	A (concrete) location is the place where a particular point or object exists. It is the lowest level of information where a point or object exists, and it describes a distinct physical point in three-dimensional space.
Storage Location		Locations that are intended for storage of items, either short- or long-term.
Automated Storage		Storage locations that are controlled by automated

⁷ <https://www.nationalgeographic.org/encyclopedia/location/>
<https://en.wikipedia.org/wiki/Location>

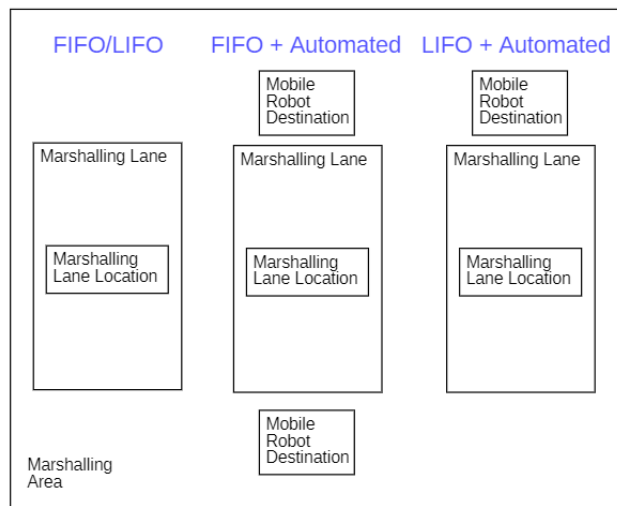
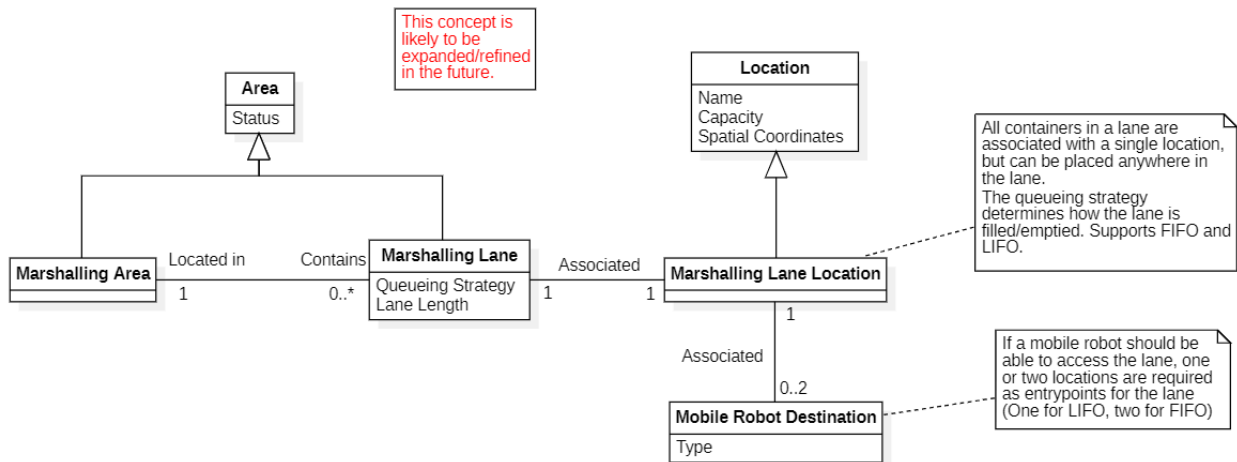
Term	Alternative terms	Description
Location		storage equipment. These are typically not accessible by any actors other than that equipment.
Buffer Location		Locations that are intended to temporarily contain items or containers, such as the edges of equipment. A buffer location has a type property to describe its purpose. Examples: - Interaction points between two pieces of equipment - An infeed/outfeed buffer for a production cell - Input/output for automated storage
Equipment Location		Describes where the equipment is located. The size, shape and purpose of the equipment is described by its Equipment Profile. See Equipment Model
Mobile Robot Destination	- Robot waypoint	A destination that a mobile robot can drive to. The destination can have different types that affects how the robot should approach the destination or what its intended use case is, such as: - Staging (parking while idle) - Charging - Marker (for precision docking)
Conveyor Location		...

3.3.3 Storage Location

The following image describes the logical ordering of storage locations for storage racks.



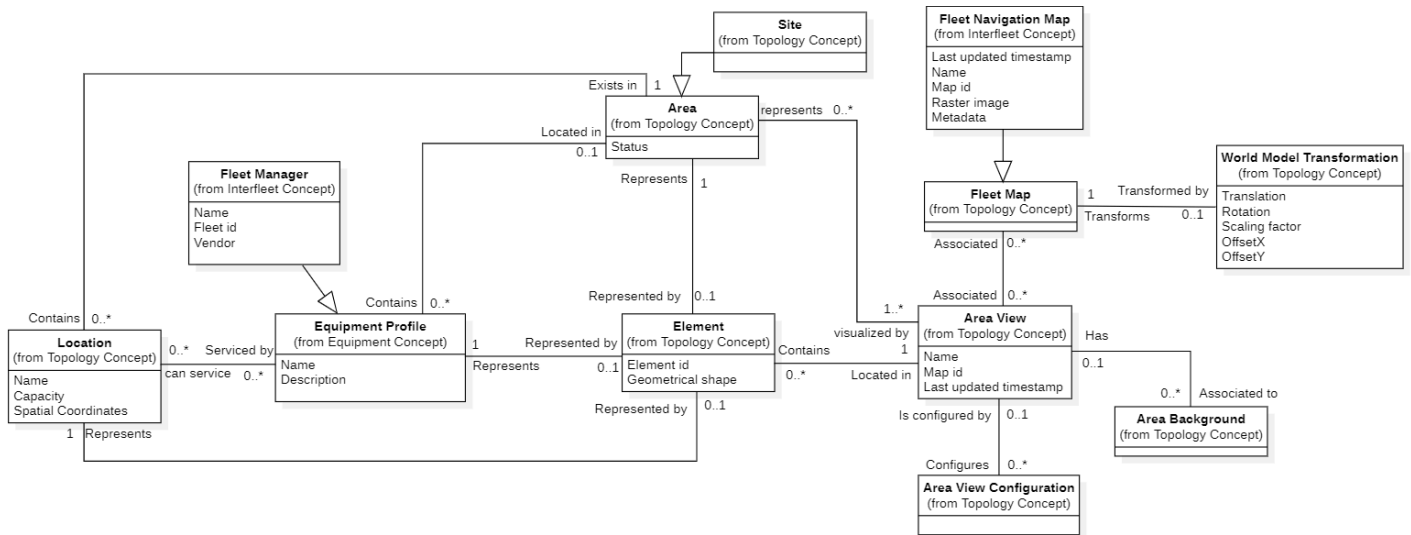
3.3.4 Marshalling Lane



Term	Alternative terms	Description
Marshalling Area		An area designated for marshalling lanes.
Marshalling Lane		A lane that can contain pallets. The ordering of the pallets are intended to be First-In-First-Out (FIFO) or Last-In-First-Out (LIFO). This also specifies how any mobile robots should access the marshalling lane, if applicable.
Marshalling Lane Location		All pallets are stored on the same logical location, but can be placed anywhere in the marshalling lane (following the ordering).

3.4 Area View Model

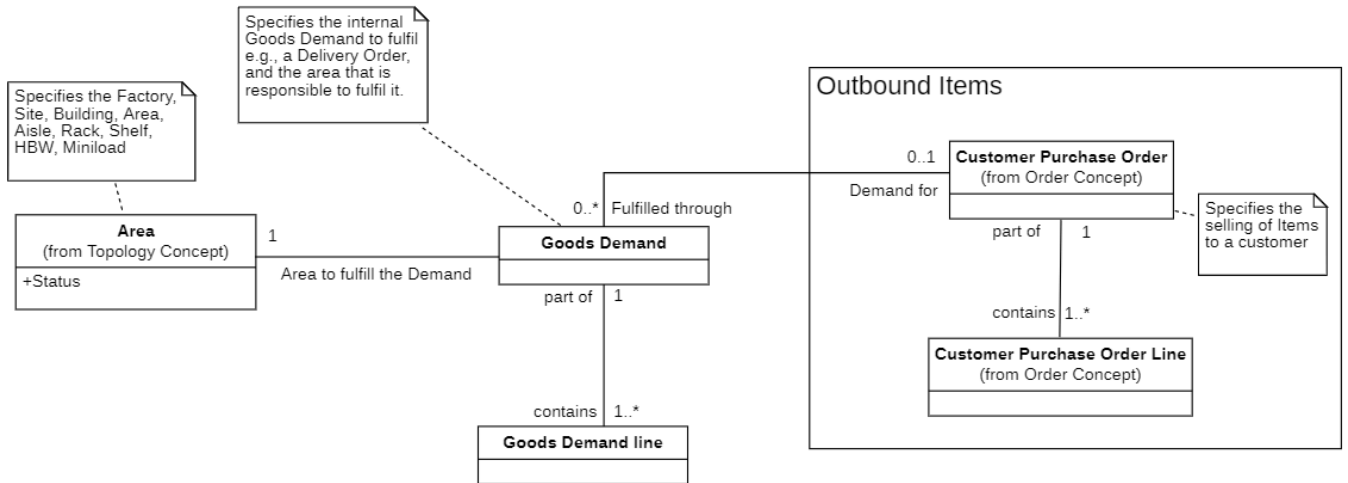
The area view model provides a visualization of a specific area. The visualization focuses on providing the user with a view of the locations residing inside the area and the equipment and fleets operating in the area.



Term	Alternative terms	Description
Element	- View Element	An element represents a physical entity such as locations, areas, equipment on the Area View.
Area View		The Area View is the view which is presented to the user in the System Builder. The shown Area View is based on the Area selected by the user.
Area View Configuration		The Area View Configuration is a configuration of what is shown to the user in the Area View. This configuration defines the elements which should be shown (i.e. locations, equipment, etc.) and the zoom on the view.
Area Background		The Area View Background sets the background for the Area View. The image that the user uploads and can use as a background image for the site. The background can be dimensionally accurate.

3.5 Demand Model

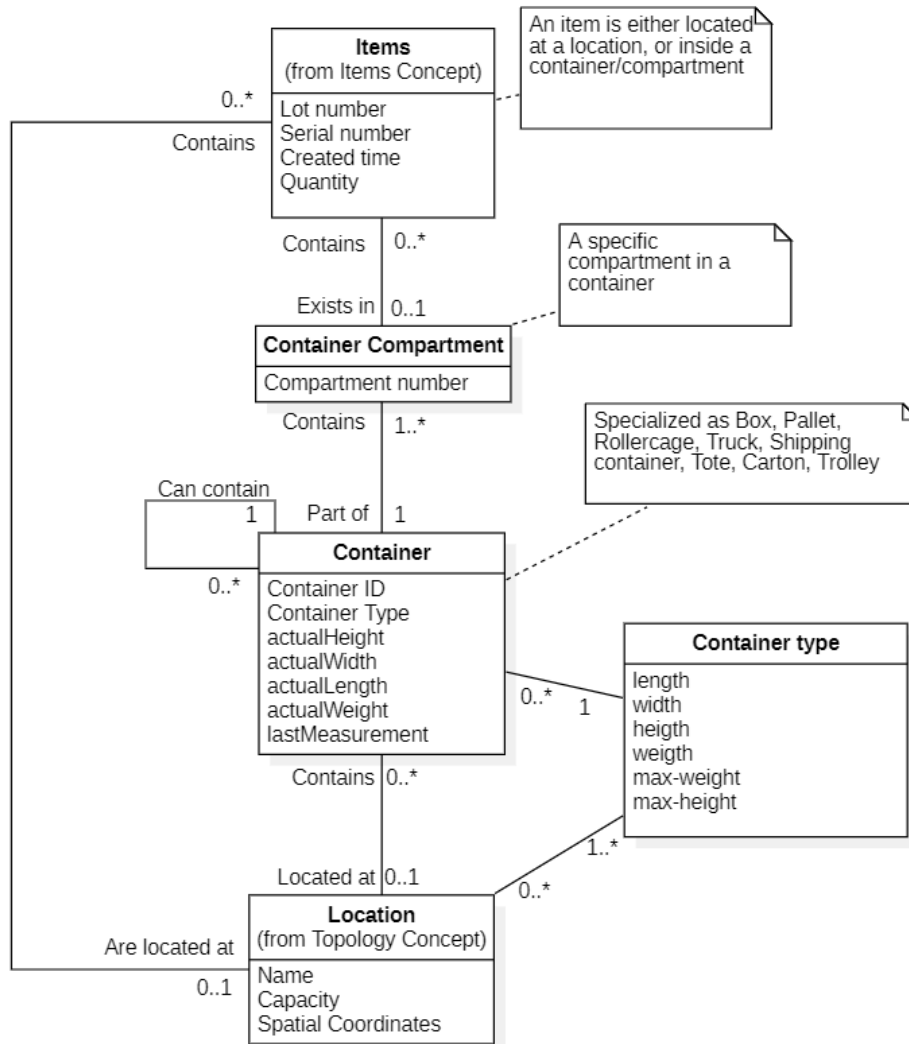
Demand specifies the internal requirement for items needed to fulfill a delivery or production order. A demand line details the type and quantity of items to be moved with multiple demand lines possible for the same demand.



Term	Alternative terms	Description
Demand	<ul style="list-style-type: none"> - Goods Demand - Items Demand - Request - Requirement 	<p>Specifies the internal Items demand required to fulfill e.g. a Delivery or a Production Order.</p> <p>A Demand is similar to an Order, but more an allocation of which Area is requested to provide what Goods.</p> <p>There can be multiple Item Demands for a single Order, depending on the number of Areas, Locations of the Items and configured Business Rules for selecting Areas/Goods for the specific Order.</p>
Demand Line	<ul style="list-style-type: none"> - Goods Demand Line - Items Demand Line 	<p>Same as the Order Line, it describes in more detail the type and quantity of Items to be moved. There can be multiple Demand Lines on the same Demand.</p>

3.6 Container Model

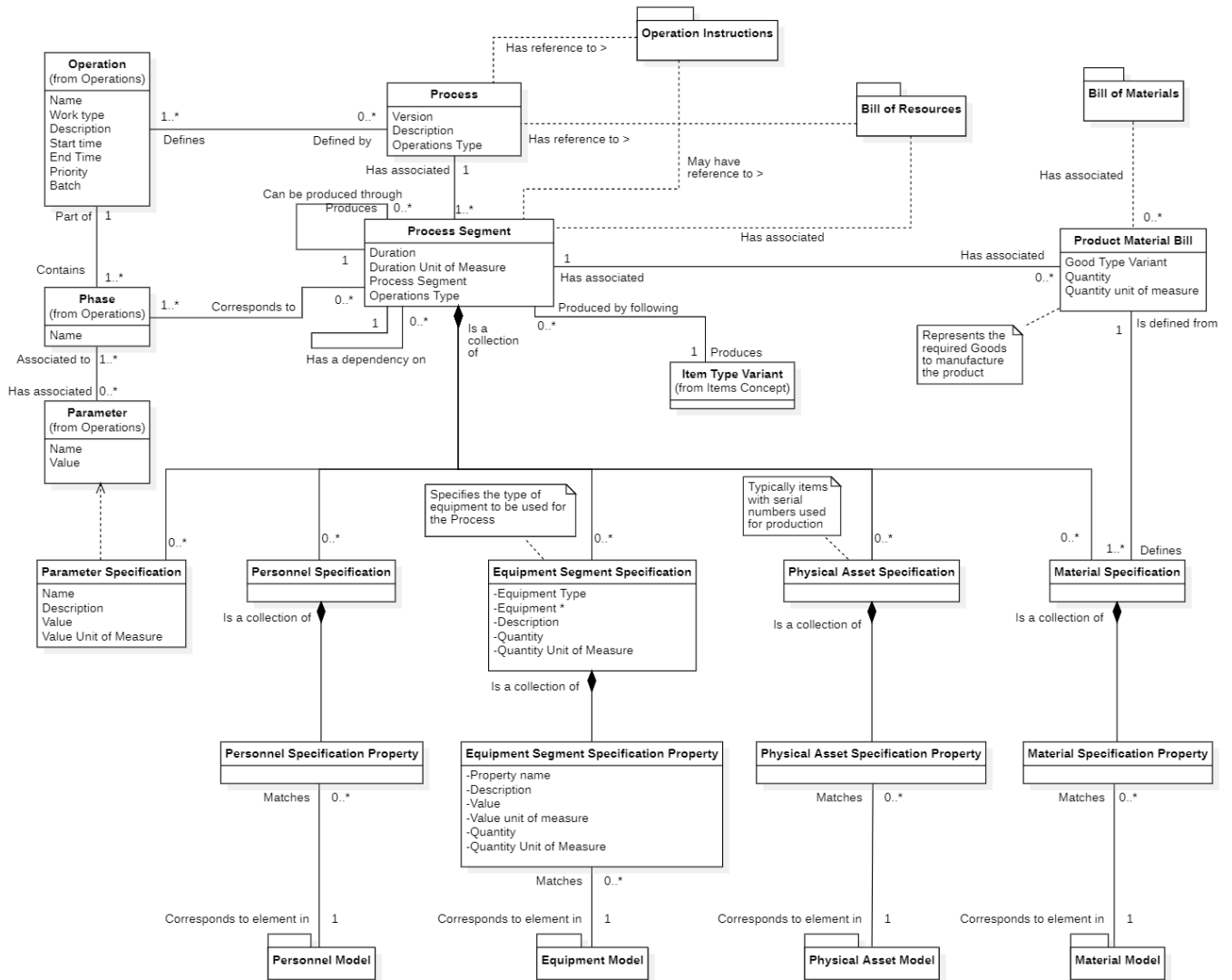
The container model describes units used for the carriage, transportation, or storage of items, which can be loaded or unloaded. It includes general returnable assets and non-returnable shipping containers. A compartment specifies a section within/on a container. Items are located inside these compartments.



Term	Alternative terms	Description
Container	<ul style="list-style-type: none"> - Transport Unit - Vessel - Holder - Logistics Unit (GS1) 	Concept used to describe something used for the carriage, transportation or storage of Items (whether loaded or unloaded). This could be what is in GS1 terms referred to as a General Returnable Asset (GRAI). A container can also be used for shipping orders and thus not necessarily being returnable.
Container Compartment		Concept used to describe a specific compartment of a Container. Items can be located in a compartment.

3.7 Manufacturing Model

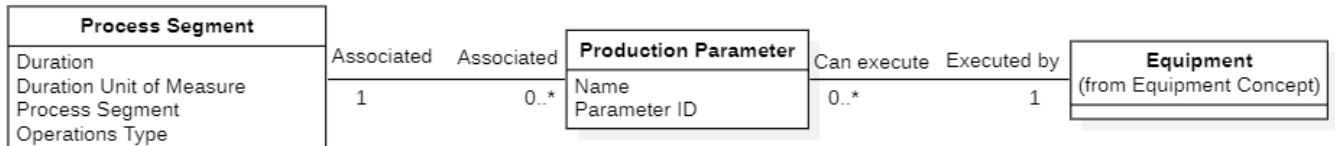
The manufacturing model provides a logical grouping of personnel, equipment, goods, and operations required to produce a product. It includes Processes, which are specific groupings of these resources needed to produce a particular item type variant.



Term	Alternative terms	Description
Process	- Operation Definition - Product Definition - Work Process	A logical group of personnel resources, equipment requested, and goods required to produce a product.
Process Segment	- Operation Definition Segment - Product Definition Segment - Work Process Segment	Process segments are logical grouping of personnel, equipment, and Item resources required to carry out a manufacturing operation step.
Bill of Material	- Product Material Bill - Work Material Bill	This describes in detail the item type variants and quantity that another item type variant consists of.

Term	Alternative terms	Description
		There can be multiple Work Material Bills required for the same Work Process Segment. E.g, the following materials are required to manufacture a product.
Personnel Specification		Specifies the personnel that is required for a given segment.
Equipment Specification		Specifies the equipment that is required for a given segment.
Asset Specification		Specifies the assets that are required for a given segment.
Parameter Specification		A set of parameters that can be used to fully parameterize a phase in an operation. E.g., various pieces of equipment may require different instructions to complete the same phase. Hence for a given product recipe segment with this specific equipment, the phase should be parameterized with the following parameter.

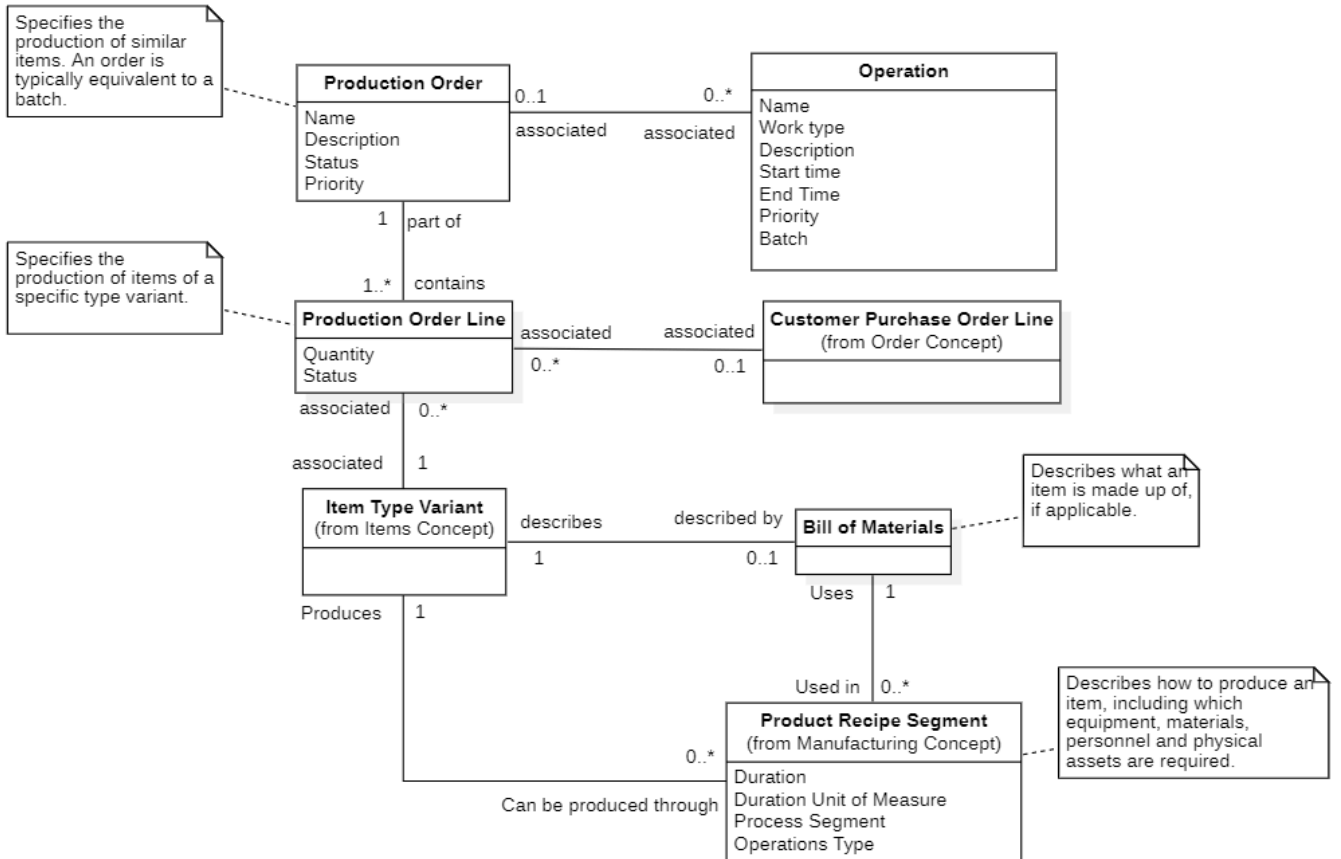
3.7.1 Production Parameter



Term	Alternative terms	Description
Production Parameter	- Product Cell Recipe	Contains the instructions for some equipment for how to follow a given product segment. This can e.g. be the program to run for a specific type of production cell to produce some finished goods. This will likely be expanded in the future to include a list of parameters instead of just a single value.

3.8 Production Order Model

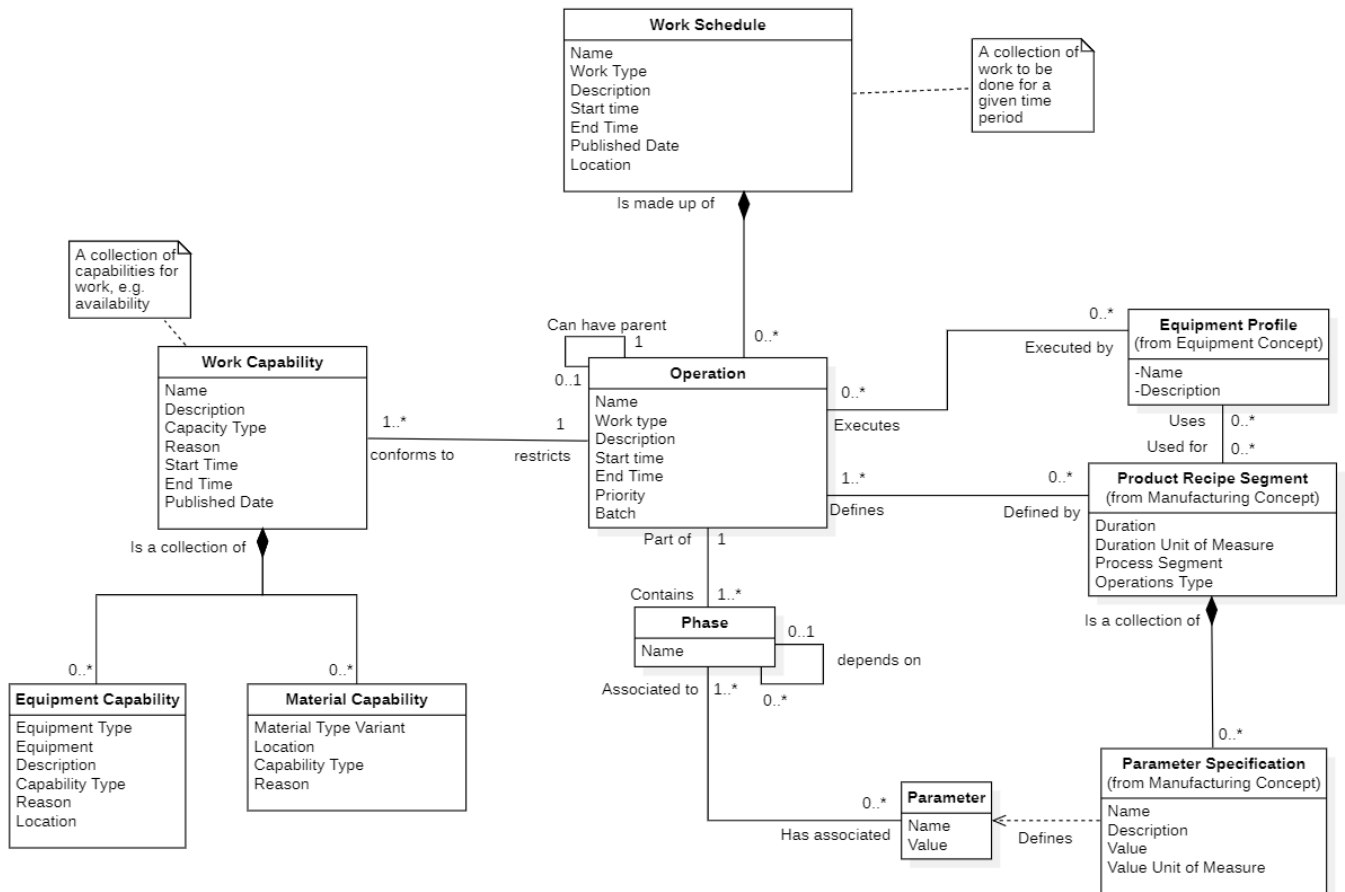
A production order is an internal order that specifies the item type variant and quantity to be produced. It can be directly associated with one or more customer order lines.



Term	Alternative terms	Description
Production Order		The production order that is to be produced. See order model
Production Order Line		The item type variant and quantity that is to be produced. A production order line can be directly associated with one or more customer order lines.

3.9 Operation Model

An operation is a specific job to be performed by equipment or an operator within a given time period, consisting of a set of phases which are lower-level instructions detailing the steps required to complete the task. Operations can include tasks like moving a container or performing specific operator instructions, and they require a collection of capabilities to be successfully completed.

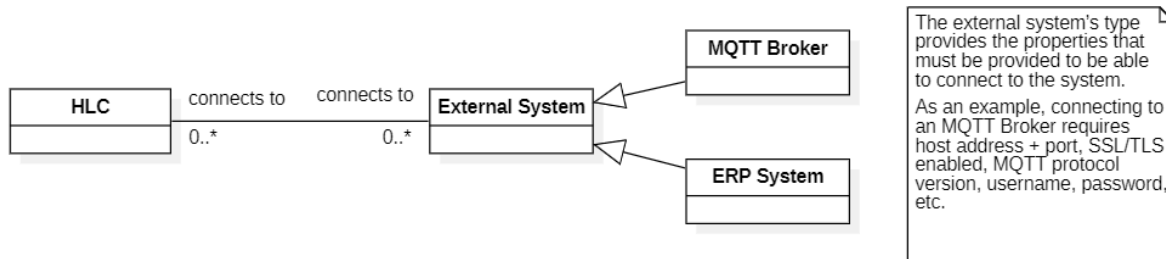


Term	Alternative terms	Description
Work Schedule		A collection of work that must be done within a given time period. E.g., a set operation can be scheduled for one day whereas another set for the next day.
Operation		A specific job to be performed by equipment or operator. An operation can be a job to move a container from A to B, an instruction for an operator to perform a specific task, etc. An operation consists of a set of phases.
Phase		Phases are specific lower level instructions for the work that is to be done in an operation. Typically, these phases are the steps that are required in the operation. E.g., go to this destination, wait, go to another

Term	Alternative terms	Description
		destination.
Work Capability		A collection of capabilities that are required to successfully complete an operation.

3.10 Connection Model

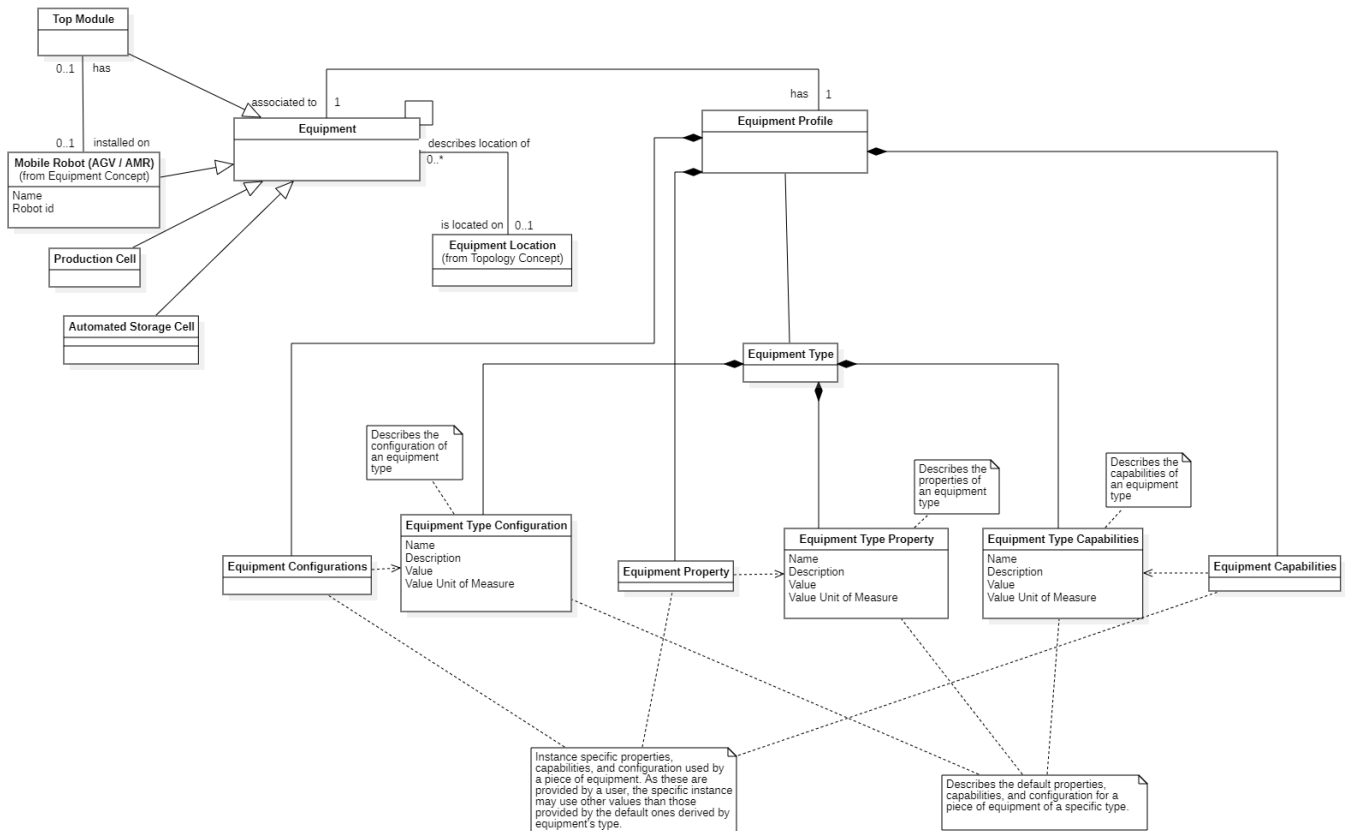
The connection model describes how the HLC can be connected to other external systems. Examples of connections are to a broker that enables the HLC to communicate with other clients like equipment or a host system that holds master data and customer / production orders.



Term	Alternative terms	Description
High-level Control	HLC	The High-Level Control system is a general designation for systems in the high-level control and integration layers (layer 2 and 3 of the ISA-95 model). The HLC can also be a single system, consisting of a combination of WCS, WMS and MES.
External System		An external system is a system that is connected to the HLC, e.g., an ERP system, MQTT broker, or Kafka Message Queue.

3.11 Equipment Model

Equipment refers to a piece or group of equipment capable of servicing locations and completing operations, such as production cells, storage systems, mobile robots, and top modules. This equipment is described by profiles that contain instance-specific information about a piece of equipment's configuration, properties, and capabilities.



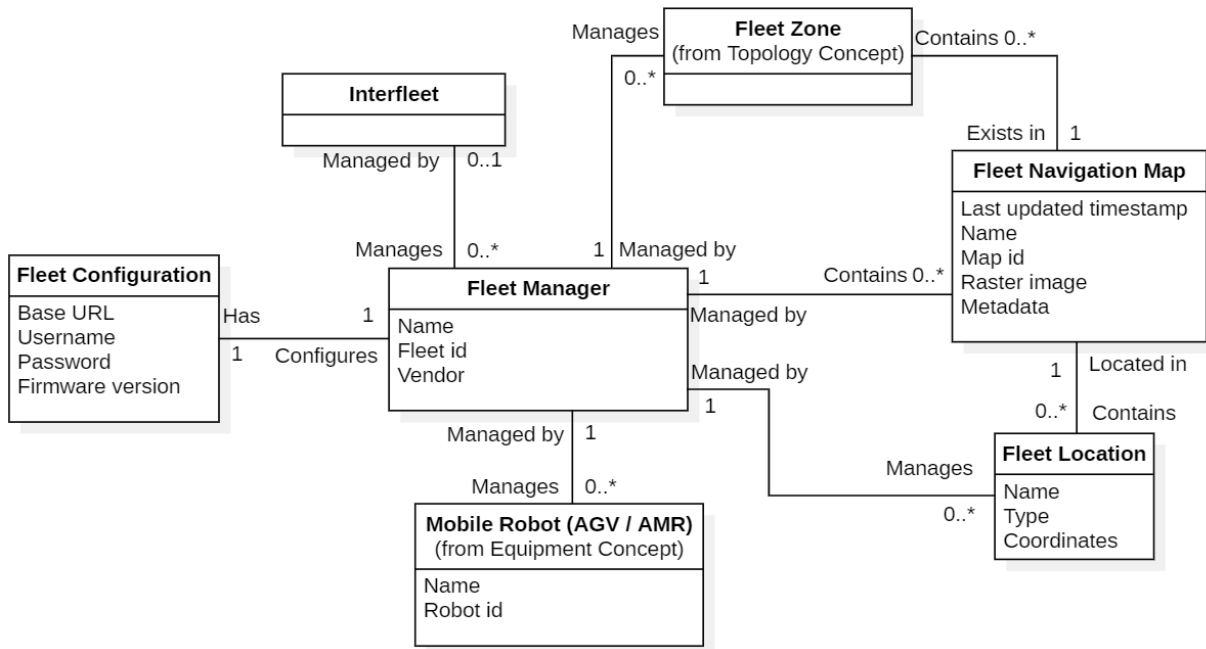
Term	Alternative terms	Description
Equipment		A piece of or a group of equipment that can service a set of locations and has the capabilities to complete a set of operations. Examples of equipment are: - Production Cells - Storage Systems - Mobile Robots - Top Modules
Equipment Profile		A profile is the instance specific information that encapsulates a piece of equipment's configuration, properties and capabilities.
Equipment Type	- Equipment Class	Grouping of equipment with similar characteristics.
Equipment Property		A property describing the equipment. The properties are defined as Equipment Type Properties, while the values

Term	Alternative terms	Description
Top Module		An extension mounted onto a mobile robot. This can be a piece of equipment such as a robot arm, or be a simple construction to allow for storing items/containers, such as a rack.
Robot Type		A mobile robot has a type, e.g., AMR, AGV, etc.
Robot Capabilities		A mobile robot has a set of capabilities that defines the work it can do. These capabilities are defined by the mobile robot and the top module mounted on if (if any)
Robot Status		A mobile robot has a status that indicates what it is currently doing.

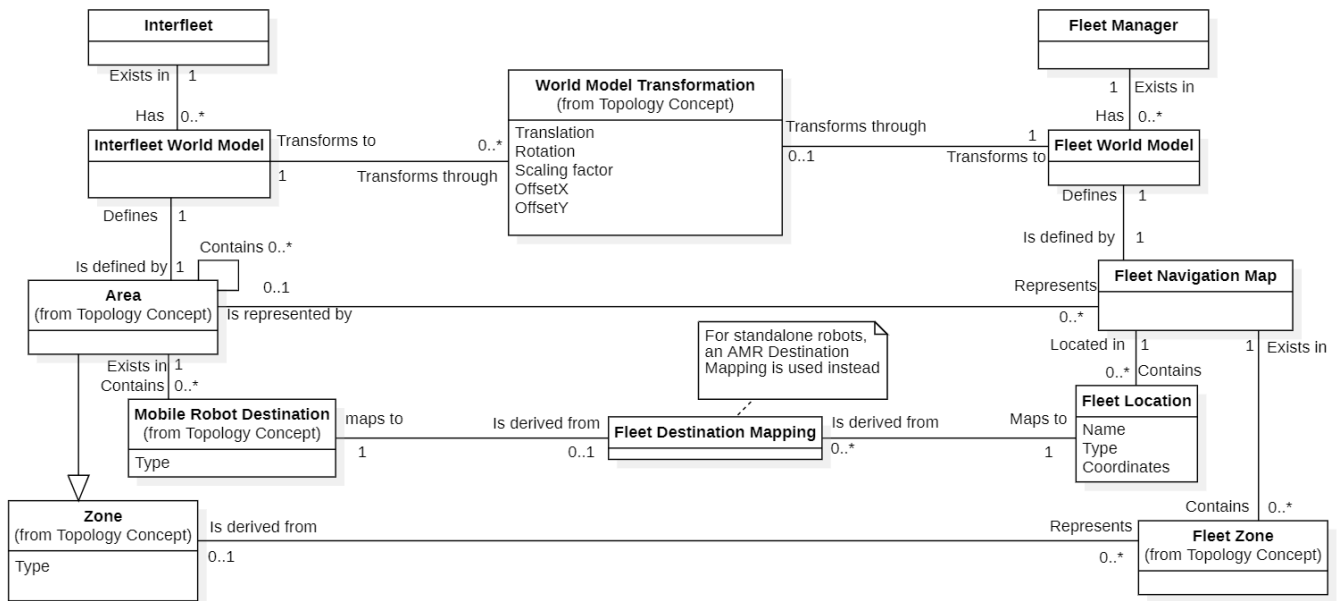
3.12.1 Interfleet Model

The Interfleet model ensures interoperability and coordination between Fleet Managers and mobile robots within the HLC. It manages operations, synchronizes fleets, and handles configurations, navigation maps, locations, destination mappings, zones, and world model transformations.

Interfleet Manager and Fleet Manager Relation



Interfleet World Model to Fleet World Model Relation

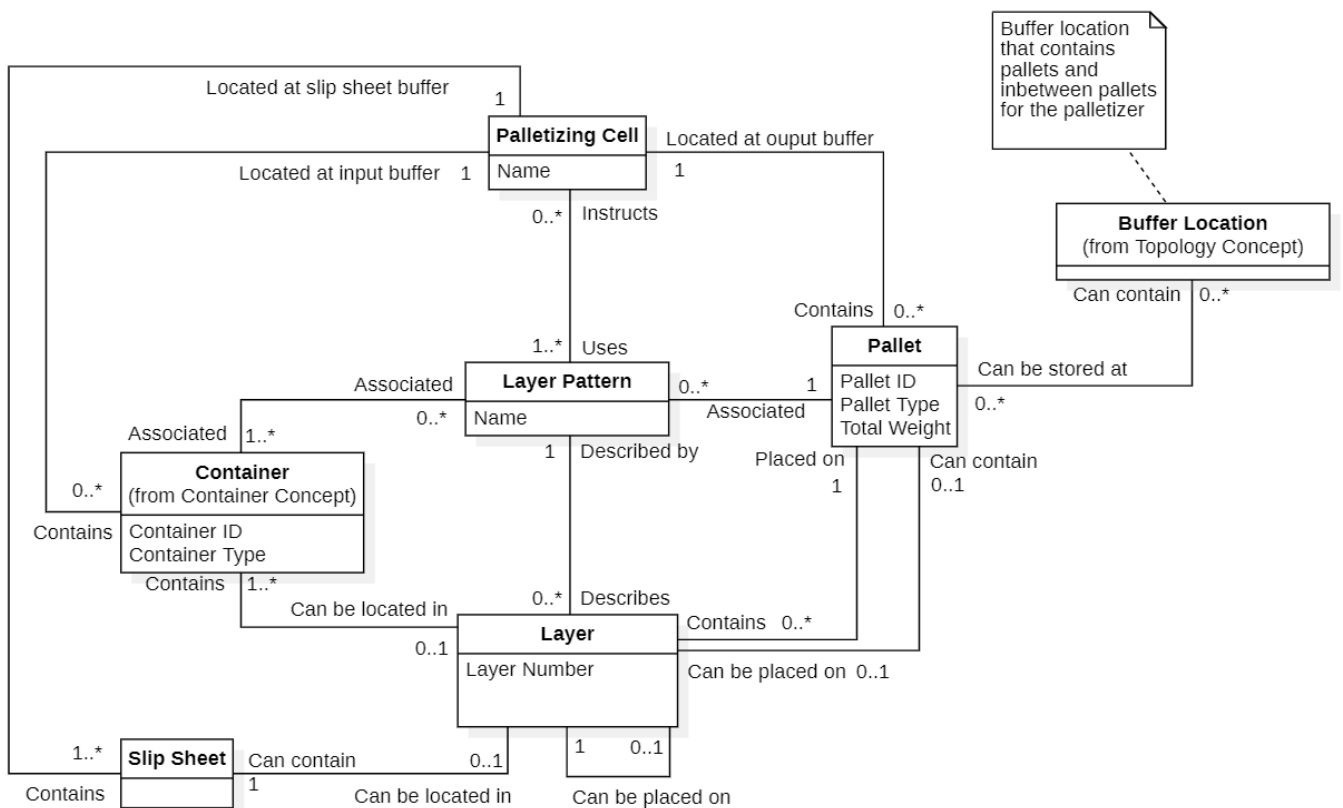
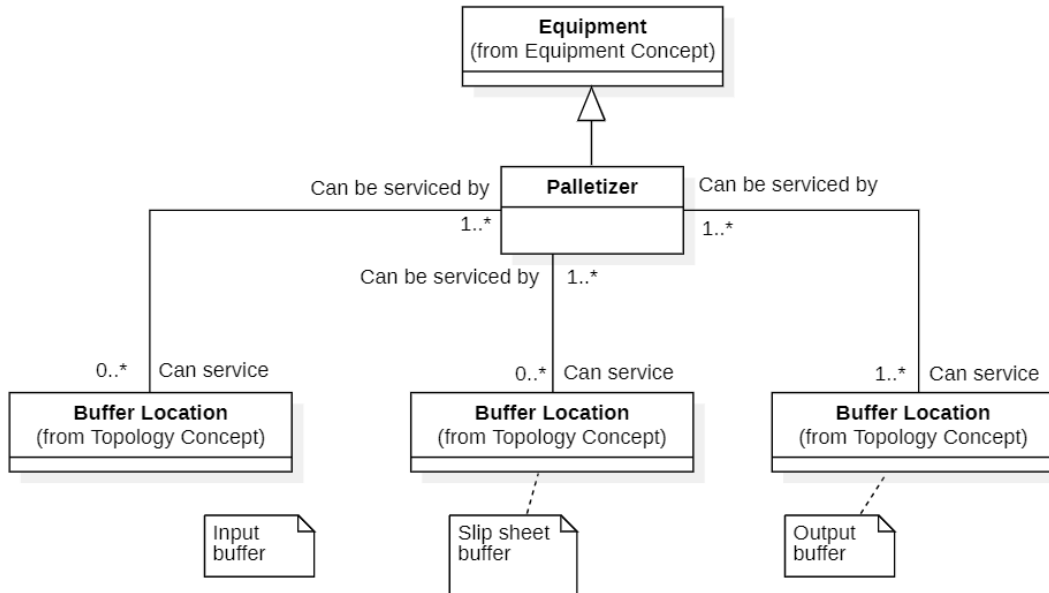


Term	Alternative terms	Description
Interfleet	- Interfleet Manager	The interfleet is a service in the HLC which is responsible for ensuring interoperability between Fleet Managers. Some of the key responsibilities of the interfleet is to coordinate operations with mobile robots and ensure that connected Fleet Managers are in-sync.
Fleet Manager	- Fleet - Fleet System - Fleet Controller	The fleet manager is a specialization of equipment. A fleet is responsible for managing/controlling a group of other equipment, namely connected mobile robots. See Interfleet Model
Fleet Configuration		The configuration details for a fleet is used by the interfleet manager to connect to and communicate with the fleets via. their APIs.
Fleet Navigation Map	- Navigation Map	A map which is a 2D representation of a given environment. The map is used by equipment to navigate the represented environment. This map may not be dimensionally accurate since it is used by proprietary software which may have another view of the environment.
Fleet Location		A physical location in a site that a mobile robot in the fleet can drive to.
Fleet Destination Mapping		A mapping between a mobile robot destination (interfleet world) and a fleet location (fleet world).
Fleet Zone		An area of a navigation map that is subject to specific traffic limitations. Examples are zones restricting access to or imposing traffic directions to parts of fleet navigation maps. See Zone for further description.
World Model		A World Model Transformation defines how to map

Term	Alternative terms	Description
Transformation		between the Interfleet World Model and the Fleet World Model, e.g., with translation, scale, and orientation. The transformation can be used to go both ways, i.e., from master to fleet model or vice versa.
Interfleet World Model		The Interfleet World Model describes how the world is seen by the interfleet / HLC. A world model has its own coordinate system, scale ratio, etc.
Fleet World Model		The Fleet World Model describes how the world is seen by the fleet. A world model has its own coordinate system, scale ratio, etc.

3.13 Palletizing Model

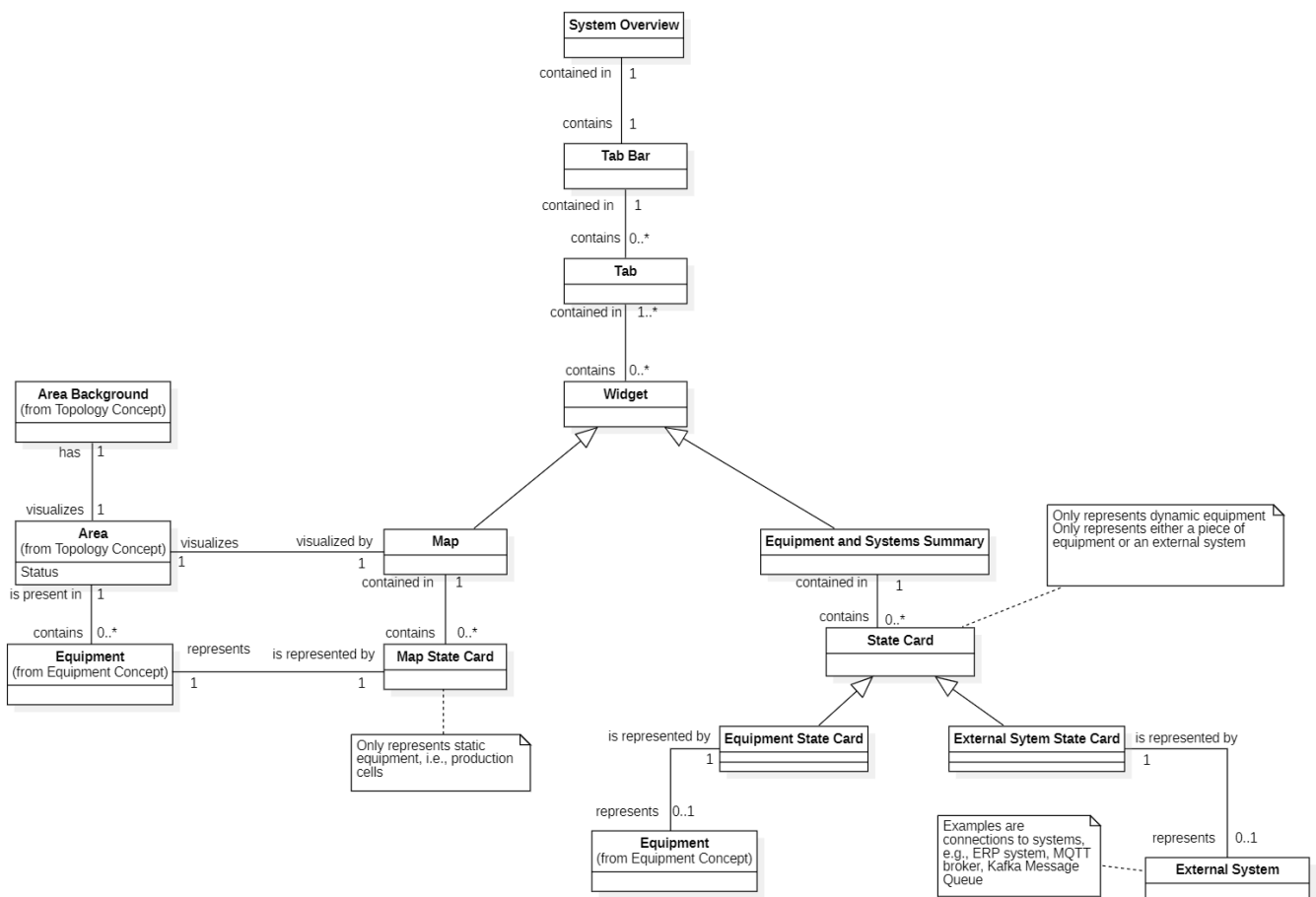
The palletizing model defines a model that is used to model a palletizing that consumes items to palletize via its input buffer and produces containers with palletized goods in its output buffer.



Term	Alternative terms	Description
Palletizer	- Palletizing Cell	A palletizing cell is a piece of equipment that can palletize a set of item variant types. The palletized item variant types and materials required for the process are fed to the equipment via input buffers. The resulting items palletized in a container are removed from the palletizer via an output buffer.
Layer Pattern	- Layer Pattern Configuration	Describes how the containers should be placed in a given layer on a pallet.

3.14 System Overview Model

The system overview component provides a model that is used to make a SCADA for users of the system. The system overview consists of multiple tabs with widgets that can be used to monitor the system.

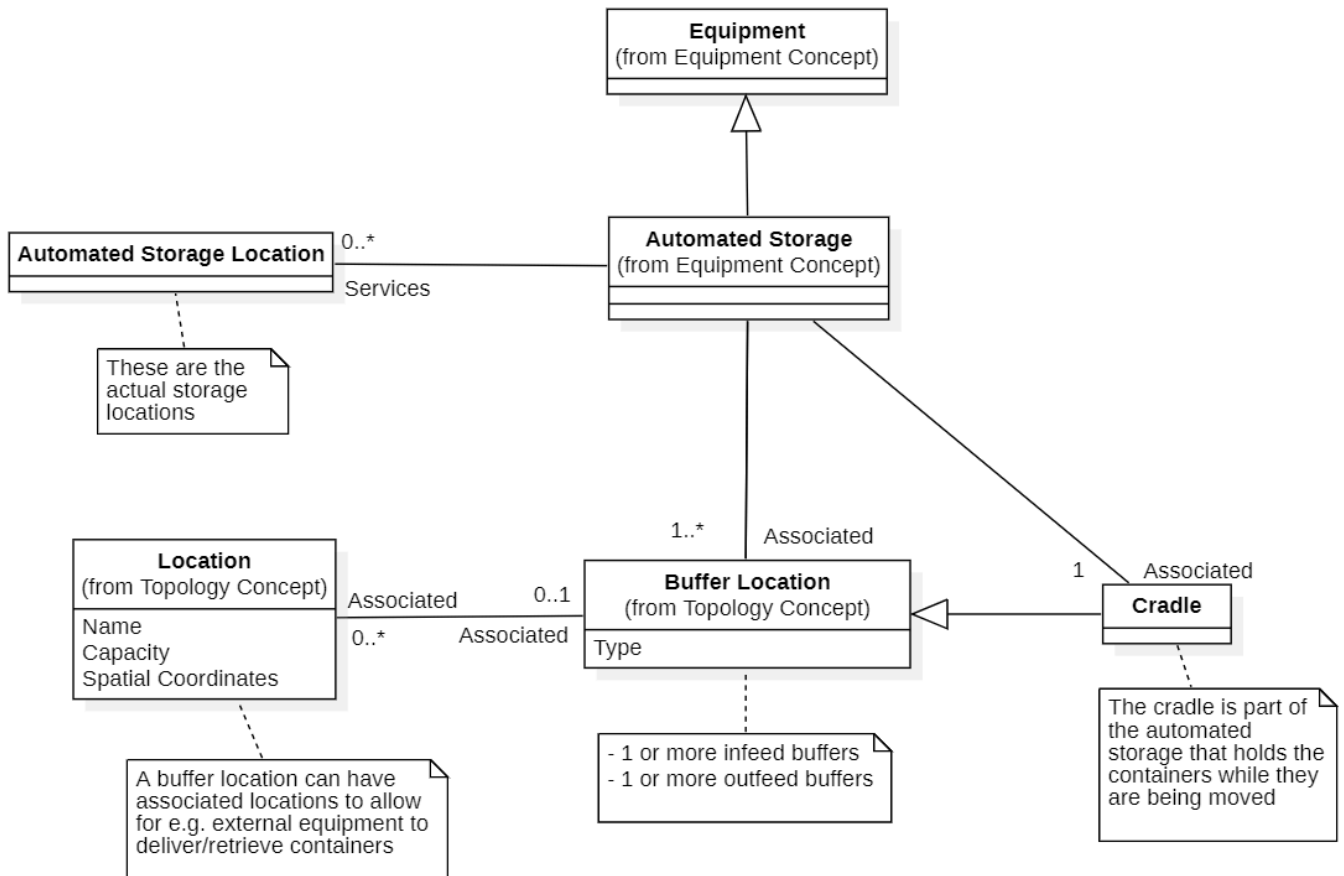


Term	Alternative terms	Description
System Overview	SCADA	Provides an overview of the system's state via a set of tabs that include widgets.

Term	Alternative terms	Description
Tab Bar		A header that contains a set of tabs where one is selected and shown to the user.
Tab		A view that shows a set of widgets to the user.
Widget		A view with widget specific behavior.
Map		A widget that provides a visualization of an area and its static equipment.
Map State Card		Visualizes the state of static equipment.
Equipment and Systems Summary		A widget that provides a visualization of state cards.
State Card		Visualizes the state of mobile equipment and external systems.

3.15 Automated Storage Model

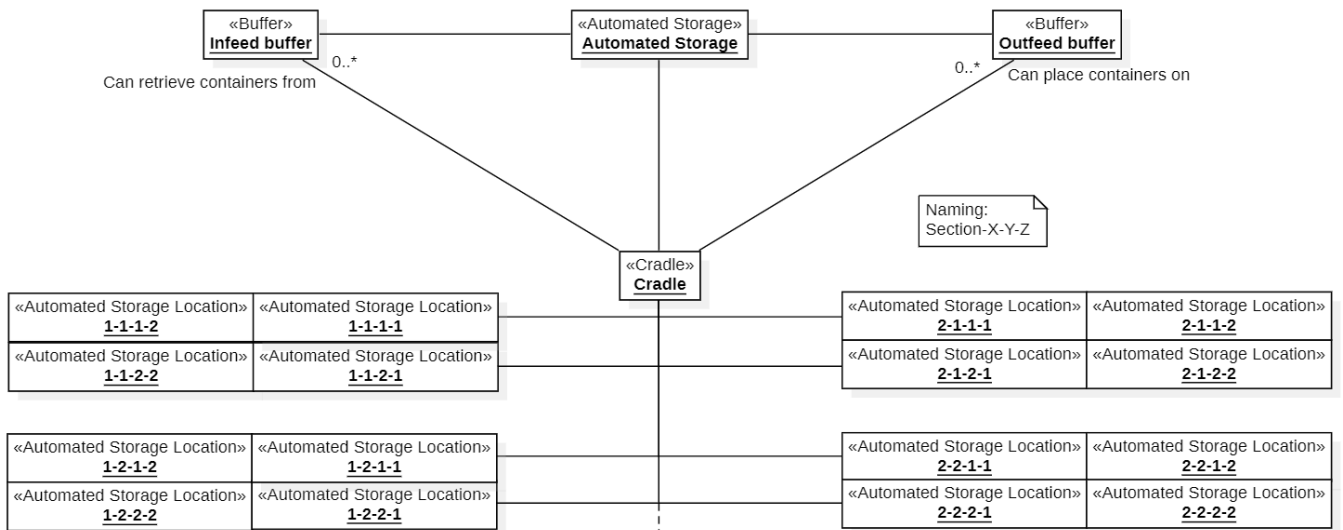
The automated storage model defines a model that is used for automatic storage cells. Containers enter the automated storage through input buffers, and leave through the output buffers. Movements inside the cell are executed through operations and phases from the HLC.



Term	Alternative terms	Description
Automated Storage Solution		A cell that is capable of moving containers to/from automated storage locations. It receives tasks (jobs) from e.g. a HLC.
Crane	Shuttle Miniload	The part of the cell that has actual access to all locations (storage and buffers). It could be considered as the moving part of an automated storage system. Depending on the type of solution, this can e.g. be a crane or a miniload, but is in general referred to as a crane.
Cradle		The part of the crane that holds the containers while they are being moved.

Term	Alternative terms	Description
Buffer Location		There are two types of buffers used for the automated storage system: Infeed: Used for delivering containers to the crane of the cell from external sources. Outfeed: Used for delivering containers from the crane of the cell to external sources
Job	Task	Can correspond to a phase in an operation (see Operation Model). Describes a segment of work to be done by the equipment, typically the movement of containers.

The figure below demonstrates a simple object model for an automated storage solution.



3.15.1 Types of Automated Storage Solutions

Type Name	Alternate Names	Description
Automated Storage & Retrieval System - ASRS	Stacker Crane Storage	Stacking of containers in a rack in a closed area.
	Miniload crane	Stacking of boxes in a rack in a closed area.
	Pallet crane	Stacking of pallets in a rack in a closed area
Carousel	Horizontal Carousel Vertical Carousel Paternoster	Movement of a physical rack with a number of shelves. The racks are placed in a chain and all racks in either direction when requesting a specific rack.
Vertical Lift		Storing shelves vertically and moving entire shelves between storage location and opening

Intelligent Vertical Storage		Storing containers vertically in X columns and, instead of moving shelves, it is then a cradle that can have X containers.
Mobile Shelving	Mobile racks	Racks are placed on a rail and may be moved left or right. There is only one opening between 2 racks, otherwise the racks are placed next to each other.