

CLAIMS

What is claimed is:

1. A supply chain system (200) comprising a plurality of interconnected entities for executing a supply chain workflow using transportable and continuously trackable storage bins (224), the plurality of interconnected entities comprising:

a network of node facilities (10, 12, 14, 16) distributed throughout a geographical region, wherein each of the node facilities (10, 12, 14, 16) comprises ~~an facility-based~~ array of facility-based indexed storage locations and a facility management subsystem (204), said network of node facilities (10, 12, 14, 16) further comprising at least one nano facility (16);

a fleet of inter-nodal transport vehicles (215a, 215b, 215c) for transporting ~~a plurality of~~ inventory items contained in the storage bins (224) between the node facilities (10, 12, 14, 16), wherein each of the inter-nodal transport vehicles (215a, 215b, 215c) ~~comprises and said~~ at least one nano facility (16) comprise bin carousels (222a, 222b, 222c) installed thereon, and wherein each of the inter-nodal transport vehicles (215a, 215b, 215c) further comprises an ~~vehicle-based~~ array of vehicle-based indexed storage locations and a vehicle management subsystem (216);

a plurality of robotic handlers (208) operable at each of the node facilities (10, 12, 14, 16), each of said plurality of robotic handlers (208) configured to navigate the storage bins (224) through the facility-based indexed storage locations of the node facilities (10, 12, 14, 16);

and wherein said vehicle management subsystem (216) is configured to identify, during unloading of the storage bins (224) from a corresponding inter-nodal transport vehicle (215a, 215b, 215c) onto one of the node facilities (10, 12, 14, 16):

whether downstream-headed single compartment storage (DSCS) bins (224a) are located on multiple bin carousels (222a) of said inter-nodal transport vehicle (215a, 215b, 215c);

in an event said DSCS bins (224a) are located on said multiple bin carousels (222a), said vehicle management subsystem (216) configured to prioritize selection of a DSCS bin (224a) on a bin carousel (222a) onto which an upstream-headed single compartment storage (USCS) bin (224a) was just loaded, said vehicle management subsystem (216) further configured to prioritize said DSCS bins (224a) located on carousel platforms (1002) closest to a loading/unloading position of said bin carousel (222a), and thereby

minimize bin carousel (222a) movements and robotic handler (208) movements for optimal loading/unloading efficiency;

and wherein said vehicle management subsystem (216) is further configured to identify, during unloading of the storage bins (224) from said inter-nodal transport vehicle (215a, 215b, 215c) to said nano facility (16), whether at least one bin carousel (222b) of said inter-nodal transport vehicle (215a, 215b, 215c) incorporates a plurality of downstream-headed finished order (DFO) bins (224d) on a sequential series of carousel platforms (1801) thereof;

and wherein said facility management subsystem (204) of said nano facility (16) is configured to determine whether a bin carousel (222c) of said nano facility (16) incorporates a plurality of upstream-headed finished order (UFO) bins (224d) on a sequential series of carousel platforms (2106) thereof;

in an event said bin carousel (222b) of said inter-nodal transport vehicle (215a, 215b, 215c) and said bin carousel (222c) of said nano facility (16) are determined as incorporating said DFO bins (224d) and UFO bins (224d) on said sequential series of respective carousel platforms (1801, 2106), said vehicle management subsystem (216) and said facility management subsystem (204) configured respectively to:

drive said bin carousel (222b) of said inter-nodal transport vehicle (215a, 215b, 215c) and said bin carousel (222c) of said nano facility (16) incrementally in an indexed manner and thereby cause corresponding carousel platforms (1801, 2106) to advance one-by-one and in an alternating manner past loading/unloading positions of respective bin carousels (222b, 222c), such that an empty carousel platform (1801) on said bin carousel (222b) of said inter-nodal transport vehicle (215a, 215b, 215c) coincides with a bin-occupied carousel platform (2106) on said bin carousel (222c) of said nano facility (16), and said bin carousels (222b, 222c) are loaded/unloaded simultaneously;

and wherein said vehicle management subsystem (216) is further configured to trigger automated bin handlers (223) provided within said inter-nodal transport vehicle (215a, 215b, 215c) to perform physical hand-off and deposit of said DFO bins (224d) and said UFO bins (224d) respectively, at a bin carousel pair formed by said bin carousels (222b, 222c).

~~a plurality of storage bins storable within the network of node facilities and transportable between the node facilities by the inter-nodal transport vehicles, wherein each of the storage bins is of a standardized size and is configured to receive one or more of a plurality of eaches of the inventory items, and wherein the each of the storage bins is of a configuration compatible with the facility-based array of indexed storage locations and the vehicle-based~~

~~array of indexed storage locations for selective storage and continuous tracking of any one of the storage bins at any one of the node facilities, in any one of the inter-nodal transport vehicles, and between the any one of the node facilities and the any one of the inter-nodal transport vehicles; and~~

~~a computerized supply chain management system communicatively coupled to the network of node facilities, the fleet of inter-nodal transport vehicles, and the storage bins, the computerized supply chain management system comprising at least one processor and non-transitory, computer-readable storage media communicatively coupled to the at least one processor, wherein the non-transitory, computer-readable storage media comprise one or more databases configured to store bin data comprising bin identifiers assigned to the storage bins and to store location identifiers of the indexed storage locations of the storage bins within the facility-based array and the vehicle-based array and dynamic storage locations of the storage bins, and wherein the non-transitory, computer-readable storage media is configured to store computer program instructions, which when executed by the at least one processor, cause the at least one processor to update the location identifiers as the storage bins are transferred between the indexed storage locations of the facility-based array and the vehicle-based array while traversing the network of node facilities and the fleet of inter-nodal transport vehicles of the supply chain system, and wherein the network of node facilities, the fleet of inter-nodal transport vehicles, and the plurality of storage bins, in operable communication with the computerized supply chain management system, are configured to provide a complete traceability of the one or more of the eaches from their input into the supply chain system to fulfillment of orders.~~

2. The supply chain system (200) according to claim 1, wherein the plurality of storage bins is further configured to contain one or more of the plurality of inventory items owned by one or more of a plurality of vendors supply chain system (200) comprises a computerized supply chain management system (201, 204, 216) communicably coupled to the network of node facilities (10, 12, 14, 16), the inter-nodal transport vehicles (215a, 215b, 215c), and the storage bins (224), the computerized supply chain management system (201, 204, 216) further comprising at least one processor and non-transitory, computer-readable storage media communicatively coupled to the processor, wherein the computer-readable storage media comprise one or more databases (203, 207, 220) configured to:

store bin data comprising bin identifiers assigned to each of the storage bins (224), and location identifiers corresponding to location of each of the storage bins (224) within the

facility-based indexed storage locations, the vehicle-based indexed storage locations, and dynamic storage locations;

and wherein the computer-readable storage media is further configured to store computer program instructions, which when executed by the processor, cause the processor to update the location identifiers as the storage bins (224) are transferred between the facility-based indexed storage locations and the vehicle-based indexed storage locations, while traversing the network of node facilities (10, 12, 14, 16) and the inter-nodal transport vehicles (215a, 215b, 215c) of the supply chain system (200).

3. The supply chain system (200) according to claim 1 or 2, wherein the ~~non-transitory~~, computer-readable storage media is further configured to store additional computer program instructions, which when executed by the ~~at least one~~ processor, cause the ~~at least one~~ processor to receive and process the bin data and commands from ~~the~~ each of the storage bins (224) while the ~~each of the storage bins (224) traverses~~ traverse the network of node facilities (10, 12, 14, 16) and the ~~fleet of~~ inter-nodal transport vehicles (215a, 215b, 215c) of the supply chain system (200) in a forward direction and a reverse direction.
4. The supply chain system (200) according to claim 1 or 2, wherein the ~~non-transitory~~, computer-readable storage media is further configured to store additional computer program instructions, which when executed by the ~~at least one~~ processor, cause the ~~at least one~~ processor to automatically record and link, in the one or more databases (203, 207, 220), the bin identifiers of each of the storage bins (224) to the location identifiers of the indexed storage locations in the facility-based array and the vehicle-based array and the dynamic storage locations, to item identifiers of the inventory items contained in each of the storage bins (224), and to vendor identifiers of a plurality of vendors whose inventory items are contained in each of the storage bins (224) in the one or more databases.
5. ~~The supply chain system according to claim 1, wherein the non-transitory, computer-readable storage media is further configured to store additional computer program instructions, which when executed by the at least one processor, cause the at least one processor to generate task-based instructions for facilitating filling actions and order fulfillment actions at one or more of the node facilities based on the bin data.~~
- 6 5. The supply chain system (200) according to claim 1 or 2, ~~further comprising one or more wherein the robotic handlers (208) operable at the each of the node facilities, wherein each of the one or more robotic handlers is configured to navigate any one of the storage bins through the facility-based array of indexed storage locations and~~ are further configured to selectively deposit the any

~~one of the storage bins (224) thereto~~ into the facility-based indexed storage locations and extract ~~the any one of the storage bins (224) therefrom,~~ and wherein ~~the each of the one or more robotic handlers (208) is~~ are further configured to provide a ~~the~~ dynamic storage locations to ~~the each of the storage bins (224),~~ and wherein ~~the each of the one or more robotic handlers (208) is~~ assigned a unique identifier configured to indicate ~~one of the dynamic storage locations of the storage bins (224) carried thereon,~~ and to allow real-time tracking of the storage bins (224).

7.6. The supply chain system (200) according to claim 1 ~~or 4,~~ wherein ~~any one or more of~~ at least some of the storage bins (224) ~~comprises~~ comprise a plurality of compartments configured to accommodate the inventory items of a ~~the~~ plurality of vendors ~~in the any one or more of the storage bins,~~ wherein each of the compartments is identified by a compartment identifier ~~and configured to accommodate one or more of the inventory items owned by a corresponding one of the vendors,~~ and wherein the computerized supply chain management system (201, 204, 216) is further configured to automatically record and link the compartment identifiers of a respective ~~one of the compartments~~ to the item identifiers of the ~~one or more of the~~ inventory items contained in the ~~any one or more of the~~ storage bins (224) and to the vendor identifiers of the vendors whose inventory items are contained in the ~~any one or more of the~~ storage bins (224).

8.7. The supply chain system (200) according to claim 1, wherein the storage bins (224) are categorized into first category storage bins (224a) containing unmixed inventory items of a matching item type, second category storage bins (224b) containing mixed inventory items of a non-matching item type, and third category storage bins (224) configured as order bins (224c, 224d) for fulfilling the orders, and wherein the network of node facilities (10, 12, 14, 16) is a hierarchical network comprising:

at least one mega facility (10) configured to store the first category storage bins (224a);

at least one macro facility (12) configured to receive ~~one or more of~~ the first category storage bins (224a) transported from the at least one mega facility (10) and fill a predefined number of the second category storage bins (224b) with different inventory items from ~~the~~ received ~~one or more of the~~ first category storage bins (224a) to meet one of actual inventory needs and predictive inventory needs of ~~another one or more of the~~ other node facilities (10, 12, 14, 16); and

at least one micro facility (14) configured to receive ~~one or more of~~ the second category storage bins (224b) transported from the at least one macro facility (12) and fill a predefined number of the order bins (224c, 224d) with the different inventory items from ~~the~~ received ~~one or more of the~~ second category storage bins (224b) to fulfill the orders.

- ~~9. The supply chain system according to claim 8, wherein the network of node facilities further comprises at least one nano facility configured to receive one or more of the order bins filled with the orders for pickup by one of customers and delivery personnel.~~
- ~~10. Supply chain system according to claim 8, wherein the at least one micro facility is configured to fulfill the orders based on one of: proximity of the at least one micro facility to at least one nano facility and a customer preference of at least one nano facility.~~
- ~~11~~ 8. The supply chain system (200) according to ~~claim 8~~ claim 1 or 7, wherein the order bins (224c, 224d) comprise finished-order bins (224d), and wherein the finished-order bins (224d) are ~~of a different standardized size and configuration from other of the storage bins (224), and are filled with one or more of the inventory items of individual orders after extraction thereof from the facility-based array indexed storage locations of the at least one micro facility (14), and wherein the finished-order bins (224d) of the different standardized size and configuration are configured to be compatible with the facility-based array of indexed storage locations of the at least one nano facility (16) and with the vehicle-based array of indexed storage locations in a node-to-terminal transport vehicle (215a, 215b, 215c).~~
- ~~12. Supply chain system according to claim 11, wherein the inventory items owned by the vendors are packed into respective vendor-branded packages, and the respective vendor-branded packages are filled in the finished-order bins.~~
- ~~13~~ 9. The supply chain system (200) according to ~~claim 13~~ claim 1 or 7, wherein the order bins (224c, 224d) comprise picked-order bins (224c) of the same standardized size and configuration as the storage bins (224), and ~~are filled with one or more of the inventory items of multiple orders at the at least one micro facility (14) and inducted into the facility-based array indexed storage locations of the at least one micro facility (14).~~
- ~~14. The supply chain system according to claim 8, wherein the orders are fulfilled at one or more of the at least one macro facility and the at least one micro facility.~~
- ~~15~~ 10. The supply chain system (200) according to claim 1 or 2, further comprising a mobile data storage device (226) with a computer-readable memory operably coupled to ~~the~~ each of the storage bins (224), and wherein the mobile data storage device (226) is configured to store ~~a unique the bin identifiers of a respective corresponding to each of the respective storage bins (224), and the bin data associated with the inventory items contained in the respective each of the storage bins (224).~~

~~16~~ 11. The supply chain system (200) according to claim ~~1~~ 2, wherein the bin data further comprises ~~at least one of~~:

an inventory catalogue;

inventory item data comprising an item identifier, a quantity, and attributes of each of the inventory items contained in ~~the~~ each of the storage bins (224);

destination data associated with a destination of the ~~contained~~ inventory items contained in each of the storage bins (224);

timing data associated with a timeline within which ~~and an urgency with which~~ the inventory items contained in ~~the~~ each of the storage bins (224) are to be conveyed through the supply chain system (200) towards the destination;

inventory customization data associated with value-added service actions to be performed on the inventory items contained in ~~the~~ each of the storage bins (224);

inventory handling data associated with routing, handling, and/or packing requirements for the inventory items contained in ~~the~~ each of the storage bins (224); and

environmental data associated with environmental requirements for the inventory items contained in ~~the~~ each of the storage bins (224).

~~17~~ 12. The supply chain system (200) according to claim ~~1~~ 2, wherein the non-transitory, computer-readable storage media is further configured to store additional computer program instructions, which when executed by the ~~at least one~~ processor, cause the ~~at least one~~ processor to generate task-based instructions for triggering loading actions and unloading actions at ~~one or more of~~ the node facilities (10, 12, 14, 16) based on the bin data, wherein the loading actions and the unloading actions comprise:

unloading incoming storage bins (224) from any one of the inter-nodal transport vehicles (215a, 215b, 215c) into any one of the node facilities (10, 12, 14, 16) and reloading outgoing storage bins (224) from ~~the~~ said any one of the node facilities (10, 12, 14, 16) to ~~the~~ said any one of the inter-nodal transport vehicles (215a, 215b, 215c); ~~wherein the incoming storage bins and the outgoing storage bins are exchanged in a one-to-one correspondence between the any one of the inter-nodal transport vehicles and the any one of the node facilities to allow an equivalent flow of the storage bins in a forward direction and a reverse direction through the supply chain system;~~

reading ~~a unique~~ the bin identifier of each of the outgoing storage bins (224) loaded from ~~the~~ said any one of the node facilities (10, 12, 14, 16) onto ~~the~~ said any one of the inter-nodal

transport vehicles (215a, 215b, 215c) and updating the one or more databases (203, 207, 220) of the computerized supply chain management system (201, 204, 216) with the unique bin identifiers to record a transfer of the each of the outgoing storage bins (224) to the any one of the inter-nodal transport vehicles (215a, 215b, 215c); and

reading a unique the bin identifier of each of the incoming storage bins (224) unloaded from the said any one of the inter-nodal transport vehicles (215a, 215b, 215c) into the said any one of the node facilities (10, 12, 14, 16) and updating the one or more databases (203, 207, 220) with the unique bin identifiers to record a transfer of the each of the incoming storage bins (224) to the any one of the node facilities (10, 12, 14, 16).

~~18. The supply chain system according to claim 17, wherein at least one of the outgoing storage bins is an empty storage bin.~~

~~19. The supply chain system according to claim 17, wherein at least one of the outgoing storage bins is a non-empty storage bin containing at least one of the inventory items.~~

~~20. The supply chain system according to claim 19, wherein the non-empty storage bin contains one of required inventory items and customer returns.~~

~~21. The supply chain system according to claim 17, wherein the incoming storage bins and the outgoing storage bins are of the same standardized size and configuration as the storage bins.~~

~~22. The supply chain system according to claim 1, further comprising at least one sensor operably coupled to the each of the storage bins, wherein the at least one sensor is configured to detect movement of the each of the storage bins, and in response to the detected movement, initiate positional tracking of the each of the storage bins through the supply chain system.~~

~~23. The supply chain system according to claim 1, further comprising a mobile indoor positioning device operably coupled to the each of the storage bins and an indoor positioning system installed at the each of the node facilities, wherein the mobile indoor positioning device is configured to operably communicate with the indoor positioning system to determine and report a position of the each of the storage bins within the each of the node facilities for real-time tracking of the each of the storage bins.~~

24 13. The supply chain system according to claim 1, further comprising a positioning unit and a wireless communications unit operably coupled to the each of the inter-nodal transport vehicles (215a, 215b, 215c), wherein the positioning unit is configured to determine a location of the each of the inter-nodal transport vehicles (215a, 215b, 215c) and ~~in turn~~ thereby determine a location of the ~~any one of the~~ storage bins (224) being transported in the each of the inter-nodal transport

vehicles (215a, 215b, 215c), and wherein the wireless communications unit is configured to communicate the location of ~~the~~ each of the inter-nodal transport vehicles (215a, 215b, 215c) and the location of the ~~any one of the~~ storage bins (224) ~~transported thereon~~ to the computerized supply chain management system (201, 204, 216) ~~during transport of the storage bins between the node facilities.~~

- 25 ~~14.~~ The supply chain system according to claim ~~1~~ 2 or 10 or 11, wherein at least one of the node facilities (10, 12, 14, 16) comprises a plurality of environmentally distinct storage zones among which the facility-based ~~array of~~ indexed storage locations ~~is~~ are distributed, and wherein the storage bins (224) are selectively deposited into the facility-based ~~array of~~ indexed storage locations among the environmentally distinct storage zones based on the environmental data, and wherein the environmental data is retrieved from at least one of ~~respective the~~ mobile data storage devices (226) embodied within each of the storage bins (224) and the computerized supply chain management system (201, 204, 216);

and wherein said facility management subsystem (204) is configured to communicate with the mobile data storage devices (226) embodied within each of the storage bins (224) for at least one of:

reading the bin data stored thereon;

updating the bin data stored thereon;

generating commands for actions to be performed on the storage bins (224), based at least partly on the bin data;

controlling automated handling equipment at each of the node facilities (10, 12, 14, 16), based at least partly on generated commands;

providing worker-guidance instructions for directing performance of the actions; and

executing transfer of the storage bins (224) to the facility-based indexed storage locations distributed among the environmentally distinct storage zones, based on the environmental data read from the mobile data storage devices (226) embodied within each of the storage bins (224);

and wherein the facility management subsystem (204) is further configured to communicate with the vehicle management subsystems (216) embodied within each of the inter-nodal transport vehicles (215a, 215b, 215c).

- ~~26. The supply chain system according to claim 1, wherein the computerized supply chain management system further comprises respective facility management subsystems at the node~~

~~facilities communicatively coupled to each other, and wherein the respective facility management subsystems are configured to communicate with respective mobile data storage devices of the storage bins for at least one of:~~

~~reading the bin data stored thereon;~~

~~updating the bin data stored thereon;~~

~~generating commands for actions to be performed on the storage bins, based at least partly on the bin data;~~

~~controlling handling equipment at the node facilities, based at least partly on the generated commands;~~

~~providing worker guidance instructions for directing performance of the actions; and~~

~~executing transfer of the storage bins to environmentally distinct storage zones in the facility-based array based on environmental data read from the respective mobile data storage devices of the storage bins.~~

27 15. The supply chain system according to claim 26 14, wherein the ~~computerized supply chain management system further comprises~~ respective vehicle management subsystems (216) at the inter-nodal transport vehicles, and wherein the respective vehicle management subsystems are configured to communicate with the respective facility management subsystems at the node facilities subsystem (204) of each of the node facilities (10, 12, 14, 16) and the respective mobile data storage devices (226) embodied within each of the storage bins (224), and record for recording transfers transfer of each of the storage bins (224) from the node facilities (10, 12, 14, 16) to the inter-nodal transport vehicles (215a, 215b, 215c) and vice versa from the inter-nodal transport vehicles (215a, 215b, 215c) to the node facilities (10, 12, 14, 16).

28. The supply chain system according to claim 1, wherein the fleet of inter-nodal transport vehicles ~~comprises dedicated service transport vehicles, each respectively assigned to at least one of service a specific pair of the node facilities, service a limited subset of the node facilities, and service a limited service area containing two or more of the node facilities.~~

29 16. A method for executing a supply chain workflow using transportable and continuously trackable storage bins (224), the method comprising:

communicatively connecting a plurality of entities in a supply chain system (200), the plurality of entities comprising:

a network of node facilities (10, 12, 14, 16), including at least one nano facility (16),

distributed throughout a geographical region, wherein each of the node facilities (10, 12, 14, 16) comprises an array of facility-based ~~array of~~ indexed storage locations and a facility management subsystem (204);

a fleet of inter-nodal transport vehicles (215a, 215b, 215c) for transporting ~~a plurality of~~ inventory items contained in storage bins (224) between the node facilities (10, 12, 14, 16), wherein each of the inter-nodal transport vehicles (215a, 215b, 215c) comprises an array of vehicle-based ~~array of~~ indexed storage locations and a vehicle management subsystem (216), and wherein at least some of said inter-nodal transport vehicles (215a, 215b, 215c) and said at least one nano facility (16) comprise bin carousels (222a, 222b, 222c) installed thereon;

a plurality of robotic handlers (208) operable at each of the node facilities (10, 12, 14, 16) and configured to navigate each of the storage bins (224) through the facility-based indexed storage locations;

~~a plurality of storage bins storable within the network of node facilities and transportable between the node facilities by the inter-nodal transport vehicles, wherein each of the storage bins is of a standardized size and is configured to receive one or more of a plurality of eaches of the inventory items; and~~

triggering said vehicle management subsystem (216) to identify, during unloading of the storage bins (224) from an inter-nodal transport vehicle (215a, 215b, 215c) onto one of the node facilities (10, 12, 14, 16), whether downstream-headed single compartment storage (DSCS) bins (224a) are located on multiple bin carousels (222a) of said inter-nodal transport vehicle (215a, 215b, 215c);

in an event said DSCS bins (224a) are located on said multiple bin carousels (222a), triggering said vehicle management subsystem (216) to prioritize selection of a DSCS bin (224a) on a bin carousel (222a) onto which an upstream-headed single compartment storage (USCS) bin was just loaded, and further triggering said vehicle management subsystem (216) to prioritize said DSCS bins (224a) located on carousel platforms (1002) closest to a loading/unloading position of said bin carousel (222a), and thereby minimizing bin carousel (222a) movements and robotic handler (208) movements for optimal loading/unloading efficiency;

triggering said vehicle management subsystem (216) to determine, during unloading of the storage bins (224) from said inter-nodal transport vehicle (215a, 215b, 215c) to said nano facility (16), whether at least one bin carousel (222b) of said inter-nodal transport vehicle (215a, 215b, 215c) incorporates a plurality of downstream-headed finished order (DFO) bins

(224d) on a sequential series of the carousel platforms (1801) thereof;

triggering said facility management subsystem (204) of said nano facility (16) to determine whether a bin carousel (222c) of said nano facility (16) incorporates a plurality of upstream-headed finished order (UFO) (224d) bins on a sequential series of carousel platforms (2106) thereof;

in an event said bin carousel (222b) of said inter-nodal transport vehicle (215a, 215b, 215c) and said bin carousel (222c) of said nano facility (16) are determined to respectively incorporate said DFO bins (224d) and said UFO bins (224d) on said sequential series of carousel platforms (1801, 2106) thereof, triggering said facility management subsystem (204) and said vehicle management subsystem (216) to:

respectively drive said bin carousel (222b) of said inter-nodal transport vehicle (215a, 215b, 215c) and said bin carousel (222c) of said nano facility (16) incrementally in an indexed manner, and thereby cause corresponding carousel platforms (1801, 2106) to advance one-by-one and in an alternating manner past a loading/unloading position of bin carousels (222b, 222c) of said inter-nodal transport vehicle (215a, 215b, 215c) and said nano facility (16) respectively, such that an empty carousel platform (1801) on said bin carousel (222b) of said inter-nodal transport vehicle (215a, 215b, 215c) coincides with a bin-occupied carousel platform (1601) on said bin carousel (222c) of said nano facility (16), and said bin carousels (222b, 222c) are loaded/unloaded simultaneously; and

activate automated bin handlers (223) provided in said inter-nodal transport vehicle (215a, 215b, 215c) and perform a physical hand-off and deposit of DFO bins (224d) and UFO bins (224d) respectively between said inter-nodal transport vehicle (215a, 215b, 215c) and said nano facility (16), at a bin carousel pair formed by said bin carousels (222b, 222c).

~~a computerized supply chain management system communicatively coupled to the network of node facilities, the fleet of inter-nodal transport vehicles, and the storage bins;~~

~~assigning a unique bin identifier to the each of the storage bins by the computerized supply chain management system;~~

~~storing, in one or more databases of the computerized supply chain management system, bin data and the unique bin identifier of the each of the storage bins;~~

~~storing, in the one or more databases of the computerized supply chain management system, location identifiers of the indexed storage locations of the storage bins within the facility~~

~~based array and the vehicle-based array and dynamic storage locations of the storage bins;
and~~

~~updating, in the one or more databases of the computerized supply chain management system, the location identifiers as the storage bins are transferred between the indexed storage locations of the facility-based array and the vehicle-based array while traversing the network of node facilities and the fleet of inter-nodal transport vehicles of the supply chain system, wherein the network of node facilities, the fleet of inter-nodal transport vehicles, and the plurality of storage bins, in operable communication with the computerized supply chain management system, are configured to provide a complete traceability of the one or more of the eaches from their input into the supply chain system to fulfillment of orders.~~

17. The method as claimed in claim 16, wherein the method further includes the following steps:

storing each of the storage bins (224) within the network of node facilities (10, 12, 14, 16) and transporting the storage bins (224) between the node facilities (10, 12, 14, 16) by the inter-nodal transport vehicles (215a, 215b, 215c);

configuring each of the storage bins (224) to receive one or more of a plurality of eaches of the inventory items, the inventory items owned by at least one vendor selected from amongst a plurality of vendors;

communicably coupling a computerized supply chain management system (201, 204, 216) with the network of node facilities (10, 12, 14, 16), the fleet of inter-nodal transport vehicles (215a, 215b, 215c), and each of the storage bins (224);

interlinking bin identifiers corresponding to each of the storage bins (224), with:

location identifiers corresponding to the facility-based indexed storage locations and the vehicle-based indexed storage locations;

unique identifiers indicative of dynamic storage locations of each of the storage bins (224), and wherein said dynamic storage locations are indicative of the robotic handlers carrying each of the storage bins (224);

item identifiers corresponding to the inventory items contained within each of the storage bins (224); and

vendor identifiers identifying the vendors for the inventory items contained in each of the storage bins (224);

storing bin data in at least one database (203, 207, 220) of the computerized supply chain

management system (201, 204, 216), the bin data comprising at least the bin identifiers assigned to each of the storage bins (224) and indicating the inventory items contained in each of the storage bins.

~~30. The method according to claim 29, wherein the plurality of storage bins is further configured to contain one or more of the plurality of inventory items owned by one or more of a plurality of vendors.~~

~~31~~18. The method according to claim ~~29~~ 17, further comprising:

assigning the bin identifiers to each of the storage bins (224), by the computerized supply chain management system (201, 204, 216);

storing, in the database (203, 207, 220) of the computerized supply chain management system (201, 204, 216), the bin identifiers assigned to each of the storage bins;

storing, in the database (203, 207, 220) of the computerized supply chain management system (201, 204, 216), the location identifiers corresponding to the facility-based indexed storage locations and the vehicle-based indexed storage locations;

updating, in the database (203, 207, 220) of the computerized supply chain management system (201, 204, 216), the location identifiers as the storage bins (224) are transferred between the facility-based indexed storage locations and the vehicle-based indexed storage locations, while traversing the network of node facilities (10, 12, 14, 16) and the fleet of inter-nodal transport vehicles (215a, 215b, 215c);

configuring the network of node facilities (10, 12, 14, 16), the fleet of inter-nodal transport vehicles (215a, 215b, 215c), the storage bins (224), and the computerized supply chain management system (201, 204, 216) to provide a complete traceability of each of the storage bins (224) from their input into the supply chain system (201, 204, 216) to order fulfillment; and

receiving and processing the bin data and commands from the each of the storage bins (224) while the each of the storage bins (224) traverses the network of node facilities (10, 12, 14, 16) and the fleet of inter-nodal transport vehicles (215a, 215b, 215c) of the supply chain system (200) in a forward direction and a reverse direction.

~~32~~ 19. The method according to claim ~~29~~ 16 or 17, further comprising:

automatically recording and linking, by the computerized supply chain management system (201, 204, 216), the bin identifiers of the storage bins to, the location identifiers of the indexed storage locations in the facility-based array and the vehicle-based array and the

~~dynamic storage locations, to the item identifiers of corresponding inventory items contained in the storage bins, the unique identifiers, and to the vendor identifiers of a plurality of vendors whose inventory items are contained in the storage bins, and interlinking therebetween in the one or more databases database (203, 207, 220);~~

~~generating instructions, by the computerized supply chain management system (201, 204, 216), for facilitating filling actions and order fulfillment actions at each of the node facilities (10, 12, 14, 16) based on the bin data, wherein the instructions are configured to:~~

~~activate the robotic handlers (208) operable at each of the node facilities (10, 12, 14, 16), and wherein each of the robotic handlers (208) is configured to carry the storage bins (224) through the array of facility-based indexed storage locations and selectively deposit the storage bins (224) thereto, and extract the storage bins (224) therefrom.~~

~~33. The method according to claim 29, further comprising generating task-based instructions, by the computerized supply chain management system, for facilitating filling actions and order fulfillment actions at one or more of the node facilities based on the bin data, wherein one or more of the task-based instructions are configured to:~~

~~activate one or more robotic handlers operable at the each of the node facilities, and wherein each of the one or more robotic handlers is configured to navigate any one of the storage bins through the facility-based array of indexed storage locations and selectively deposit the any one of the storage bins thereto, and extract the any one of the storage bins therefrom and wherein the each of the one or more robotic handlers is further configured to provide a dynamic storage location to the each of the storage bins, and wherein the each of the one or more robotic handlers is assigned a unique identifier configured to indicate one of the dynamic storage locations of the storage bins and to allow real-time tracking of the storage bins.~~

~~34. The method according to claim 29, wherein any one or more of the storage bins comprises a plurality of compartments configured to accommodate the inventory items of a plurality of vendors in the any one or more of the storage bins, wherein each of the compartments is identified by a compartment identifier and configured to accommodate one or more of the inventory items owned by a corresponding one of the vendors, and wherein the computerized supply chain management system is further configured to automatically record and link the compartment identifier of a respective one of the compartments to the item identifiers of the one or more of the inventory items contained in the any one or more of the storage bins and to the vendor identifiers of the vendors whose inventory items are contained in the any one or more of the storage bins, in the one or more databases.~~

35 ~~20~~. The method according to claim ~~29~~ 17, further comprising:

~~storing the unique bin identifiers of the each of the~~ assigned to respective storage bins (224)
~~and the bin data associated with~~ indicative of the inventory items contained in the each of the
respective storage bins (224), in a mobile data storage device (226) with a computer-readable
~~memory~~ operably coupled to the each of the storage bins (224);

unloading incoming storage bins from any of the inter-nodal transport vehicles into any of the
node facilities and reloading outgoing storage bins from said any of the node facilities to said
any of the inter-nodal transport vehicles;

reading the bin identifiers corresponding to the outgoing storage bins and updating the
database of the computerized supply chain management system with said bin identifiers to
record a transfer of each of the outgoing storage bins to said any of the inter-nodal transport
vehicles;

reading the bin identifiers corresponding to the incoming storage bins and updating the
database with said bin identifiers to record a transfer of each of the incoming storage bins to
said any of the node facilities;

determining, by a positioning unit operably coupled to each of the inter-nodal transport
vehicles, a location of each of the inter-nodal transport vehicles and a location of the storage
bins transported in the inter-nodal transport vehicles; and

communicating, by a wireless communications unit operably coupled to each of the inter-
nodal transport vehicles, the location of each of the inter-nodal transport vehicles and the
location of the storage bins transported thereon, to the computerized supply chain
management system.

36. The method according to claim ~~29~~, wherein the bin data comprises at least one of:

~~an inventory catalogue;~~

~~inventory item data comprising an item identifier, a quantity, and attributes of each of the~~
~~inventory items contained in the each of the storage bins;~~

~~destination data associated with a destination of the contained inventory items;~~

~~timing data associated with a timeline within which and an urgency with which the inventory~~
~~items contained in the each of the storage bins are to be conveyed through the supply chain~~
~~system toward the destination;~~

~~inventory customization data associated with value-added service actions to be performed~~

~~on the inventory items contained in the each of the storage bins;~~

~~inventory handling data associated with routing, handling, and/or packing requirements for the inventory items contained in the each of the storage bins; and~~

~~environmental data associated with environmental requirements for the inventory items contained in the each of the storage bins.~~

37. The method according to claim 29, further comprising:

~~unloading incoming storage bins from any one of the inter-nodal transport vehicles into any one of the node facilities and reloading outgoing storage bins from the any one of the node facilities to the any one of the inter-nodal transport vehicles, wherein the incoming storage bins and the outgoing storage bins are exchanged in a one-to-one correspondence between the any one of the inter-nodal transport vehicles and the any one of the node facilities to allow an equivalent flow of the storage bins in a forward direction and a reverse direction through the supply chain system;~~

~~reading a unique bin identifier of each of the outgoing storage bins loaded from the any one of the node facilities onto the any one of the inter-nodal transport vehicles, and updating the one or more databases of the computerized supply chain management system with the unique bin identifier to record a transfer of the each of the outgoing storage bins to the any one of the inter-nodal transport vehicles; and~~

~~reading a unique bin identifier of each of the incoming storage bins unloaded from the any one of the inter-nodal transport vehicles into the any one of the node facilities and updating the one or more databases with the unique bin identifiers to record a transfer of the each of the incoming storage bins to the any one of the node facilities.~~

38. The method according to claim 29, further comprising detecting movement of the each of the storage bins by at least one sensor operably coupled to the each of the storage bins, and in response to the detected movement, initiating positional tracking of the each of the storage bins through the supply chain system.

39. The method according to claim 29, further comprising determining and reporting a position of the each of the storage bins within the each of the node facilities by a mobile indoor positioning device operably coupled to the each of the storage bins, in operable communication with the indoor positioning system installed at the each of the node facilities, for real-time tracking of the each of the storage bins.

40. The method according to claim 29, further comprising:

determining a location of the each of the inter-nodal transport vehicles and in turn determining a location of the storage bins being transported in the each of the inter-nodal transport vehicles, by a positioning unit operably coupled to the each of the inter-nodal transport vehicles; and

communicating the location of the each of the inter-nodal transport vehicles and the location of the any one of the storage bins to the computerized supply chain management system by a wireless communications unit operably coupled to the each of the inter-nodal transport vehicles during transport of the storage bins between the node facilities.

41. The method according to claim 29, wherein the computerized supply chain management system further comprises respective facility management subsystems at the node facilities communicatively coupled to each other, and wherein the respective facility management subsystems are configured to communicate with respective mobile data storage devices of the storage bins for at least one of:

reading the bin data stored thereon;

updating the bin data stored thereon;

generating commands for actions to be performed on the storage bins based at least partly on the bin data;

controlling handling equipment at the node facilities based at least partly on the generated commands;

providing worker guidance instructions for directing performance of the actions; and

executing transfer of the storage bins to environmentally distinct storage zones in the facility-based array based on environmental data read from the respective mobile data storage devices of the storage bins.

42. The method according to claim 41, wherein the computerized supply chain management system further comprises respective vehicle management subsystems at the inter-nodal transport vehicles, and wherein the respective vehicle management subsystems are configured to communicate with the respective facility management subsystems at the node facilities and the respective mobile data storage devices of the storage bins for recording transfers of the storage bins from the node facilities to the inter-nodal transport vehicles and vice versa.