CLAIMS

What is claimed is:

1. A manufacturing system, said manufacturing system comprising:

a storage arrangement, said storage arrangement comprising:

an automated storage and retrieval system (ASRS) structure comprising a three-dimensional array of storage locations distributed throughout a two-dimensional footprint of the ASRS structure at a plurality of storage levels within the ASRS structure;

a supply of workpieces, tool pieces, and workpiece supports stored within the storage locations of the ASRS structure for use in manufacturing goods ~~from the workpieces~~; and

a fleet of robotic storage/retrieval vehicles, wherein each of the robotic storage/retrieval vehicles is navigable within the ASRS structure in three dimensions to access the storage locations in the three-dimensional array, each of the robotic storage/retrieval vehicles configured to carry storage units of compatible size and shape for storage in the storage locations of the ASRS structure, the storage units configured to hold at least the workpieces and the tool pieces;

a plurality of manufacturing cells ~~positioned outside the ASRS structure~~ configured in a continuous arrangement outside the ASRS structure, wherein the storage units are configured to be transferred to and from the storage locations of the ASRS structure and between the manufacturing cells, free of identification or scanning of the storage units, based on the continuous arrangement of the manufacturing cells; and

~~wherein the same fleet of robotic storage/retrieval vehicles navigable within the ASRS structure in the three dimensions is operable to deliver the workpieces to the manufacturing cells.~~

a computerized control system in operable communication with each of the storage/retrieval vehicles, the computerized control system configured to orchestrate movement of the storage/retrieval vehicles on a two-dimensional gridded track structure interconnecting each of the manufacturing cells and the

ASRS structure, the computerized control system further configured to trigger said storage/retrieval vehicles to deliver the storage units just-in-time, grouped based on corresponding work orders, and in specific sequences to the manufacturing cells, instead of linearly with conveyors, thereby facilitating just-in-time manufacturing of subassemblies at any stage of a manufacturing process, and thereby allowing any number of manufacturing processes to be completed multiple times in any order.

~~2. The manufacturing system of claim 1, wherein the workpieces are transportable between each of the manufacturing cells in any order.~~

~~3~~ 2. The manufacturing system of claim 1, wherein each of the manufacturing cells is configured to receive the workpieces a plurality of times for performance of ~~one or more of~~ a plurality of process steps of ~~a~~ the manufacturing process.

~~4~~ 3. The manufacturing system of claim 1 or 2, wherein the workpieces are received at a first one of the manufacturing cells for performance of ~~one or more of~~ a plurality of process steps of ~~a~~ the manufacturing process and subsequently stored in the storage locations of the ASRS structure and retrieved from the storage locations of the ASRS structure for the transfer of the workpieces to a second one of the manufacturing cells.

~~5~~ 4. The manufacturing system of claim 1, further comprising a track structure attached to the ASRS structure and extending beyond the two-dimensional footprint of the ASRS structure to define an extension thereof, wherein the track structure is configured to define ~~one or more~~ travel paths on which the robotic storage/retrieval vehicles are navigable and along which the manufacturing cells are distributed.

~~6~~ 5. The manufacturing system of claim 1, wherein the ~~storage arrangement further comprises a supply of tool pieces for use in manufacturing the goods, wherein the~~ tool pieces are stored within and retrieved from ~~in~~ the ~~same~~ ASRS structure in the storage units ~~as the workpieces~~, ~~and wherein the tool pieces are retrievable from the same ASRS structure~~ and ~~deliverable~~ delivered to the manufacturing cells by the ~~same~~ fleet of robotic storage/retrieval vehicles.

~~7~~ 6.The manufacturing system of claim ~~6~~ 1, wherein ~~the storage arrangement further comprises a supply of storage units of compatible size and shape for storage in the storage locations of the ASRS structure, wherein~~ the storage units are configured

to be carried by the robotic storage/retrieval vehicles for transfer of the storage units to and from the storage locations and to and from the manufacturing cells, and wherein the storage units comprise ~~at least one of~~:

workpiece storage units, each configured to hold ~~one or more of~~ the workpieces; and

tool piece storage units, each configured to hold ~~one or more of~~ the tool pieces.

~~8.The manufacturing system of claim 7, wherein the plurality of manufacturing cells is configured in a continuous arrangement outside the ASRS structure, and wherein the storage units are configured to be transferred to and from the storage locations of the ASRS structure and between the manufacturing cells, free of identification of the storage units, due to the continuous arrangement of the manufacturing cells.~~

~~9~~ 7.The manufacturing system of claim ~~7~~ 6, wherein the workpiece storage units comprise inventory storage units and kit storage units, wherein each of the inventory storage units is configured to contain a collection of inventory workpieces, and wherein each of the kit storage units is configured to contain a kit of mixed workpieces picked from ~~one or more of~~ the inventory storage units according to a manufacturing process to be performed on the mixed workpieces ~~once~~ delivered to one of the manufacturing cells.

~~10~~ 8.The manufacturing system of claim ~~9~~ 7, further comprising at least one kitting workstation configured to accept delivery of the inventory storage units from the ASRS structure by the robotic storage/retrieval vehicles for allowing picking of the inventory workpieces from the inventory storage units at the at least one kitting workstation.

~~11~~ 9. The manufacturing system of claim ~~10~~ 8, wherein the at least one kitting workstation is configured to receive a drop-off of the workpiece storage units and~~/or~~ a travel of the workpiece storage units therethrough ~~the at least one kitting workstation~~, by the ~~same~~ fleet of robotic storage/retrieval vehicles.

~~12~~ 10.The manufacturing system of claim ~~7~~ 6, wherein each of the manufacturing cells comprises at least one workpiece holding area configured to hold the workpieces awaiting processing at ~~the~~ corresponding ~~each of the~~ manufacturing cells, wherein the at least one workpiece holding area is configured to accept placement of one of the workpiece storage units thereon.

~~13~~ 11. The manufacturing system of claim 1, wherein ~~the storage arrangement further comprises a supply of workpiece supports, wherein~~ each of the workpiece supports is configured to hold ~~one or more of~~ the workpieces in predetermined positions during ~~the~~ manufacture of ~~the~~ goods, and wherein the workpiece supports are stored in the ~~same~~ ASRS structure ~~as the workpieces~~, and wherein the workpiece supports are retrievable from the ~~same~~ ASRS structure and deliverable to the manufacturing cells by the ~~same~~ fleet of robotic storage/retrieval vehicles.

~~14~~ 12. The manufacturing system of claim ~~13~~ 11, wherein each of the workpiece supports is of a common footprint of a standardized shape and size as each of ~~a supply of~~ the storage units ~~of compatible size and shape~~ configured to fit within the storage locations of the ASRS structure, and wherein ~~the~~ each of the workpiece supports comprises a base of a standardized shape and size configured to fit within the storage locations of the ASRS structure.

~~15~~ 13. The manufacturing system of claim ~~14~~ 12, wherein ~~the~~ each of the workpiece supports and ~~the~~ each of the storage units are configured to have a matching layout of interface features by which the robotic storage/retrieval vehicles interact with the workpiece supports and the storage units to allow loading and unloading of the workpiece supports and the storage units to and from the robotic storage/retrieval vehicles.

~~16~~ 14. The manufacturing system of claim 1, wherein each of ~~one or more of~~ the manufacturing cells comprises at least one workpiece holding area configured to hold the workpieces awaiting processing therein ~~at the corresponding each of the one or more of the manufacturing cells~~.

~~17~~ 15. The manufacturing system of claim ~~16~~ 14, wherein each of the ~~at least one workpiece holding area~~ manufacturing cells comprises two workpiece holding areas, and wherein each of the two workpiece holding areas is configured to hold a respective set of workpieces required therein ~~at the corresponding each of the one or more of the manufacturing cells~~.

~~18~~ 16. The manufacturing system of claim ~~16~~ 14, wherein the ~~one or more of the~~ manufacturing cells are positioned at a two-dimensional gridded track structure, and wherein the two-dimensional gridded track structure comprises sets of intersecting rails on which the robotic storage/retrieval vehicles are navigable in two dimensions,

and wherein a width of the at least one workpiece holding area in each of the two dimensions is generally equal to a whole number multiple of a distance measured between two adjacent parallel rails of the two-dimensional gridded track structure.

~~19~~ 17. The manufacturing system of claim 16, wherein the ~~one or more of the manufacturing cells are positioned at a gridded track structure, and wherein the gridded track structure comprises sets of intersecting rails on which the robotic storage/retrieval vehicles are navigable in two dimensions, and wherein a~~ width of the at least one workpiece holding area in each of the two dimensions does not exceed a distance measured between the two adjacent parallel rails of the two-dimensional gridded track structure.

~~20~~ 18. The manufacturing system of claim ~~16~~ 14, wherein ~~the~~ each of the ~~one or more of the~~ manufacturing cells comprises at least one robotic picker operable to pick the workpieces from the at least one workpiece holding area, and wherein ~~the~~ each of the ~~one or more of the~~ manufacturing cells further comprises a working area to which ~~the~~ picked workpieces are transferred from the at least one workpiece holding area by the at least one robotic picker.

~~21~~ 19. The manufacturing system of claim 1 or 16, wherein at least a subset of the manufacturing cells is positioned at ~~a~~ the two-dimensional gridded track structure, ~~and wherein the gridded track structure comprises sets of intersecting rails on which the robotic storage/retrieval vehicles are navigable in two dimensions,~~ and wherein each of the manufacturing cells in the subset comprises at least one tool holding area configured to hold the tool pieces required therein ~~at the corresponding each of the manufacturing cells~~, and wherein a width of the at least one tool holding area in each of the two dimensions is ~~generally~~ equal to a distance measured between the two adjacent parallel rails of the two-dimensional gridded track structure.

~~22~~ 20. The manufacturing system of claim ~~1~~ 19, wherein ~~at least a subset of the manufacturing cells is positioned at a gridded track structure, and wherein the gridded track structure comprises sets of intersecting rails on which the robotic storage/retrieval vehicles are navigable in two dimensions, and wherein each of the manufacturing cells in the subset comprises at least one tool holding area configured to hold tool pieces required at the corresponding each of the manufacturing cells, and wherein a~~ the width of the at least one tool holding area in

each of the two dimensions does not exceed a distance measured between the two adjacent parallel rails of the two-dimensional gridded track structure.

~~23~~ 21. The manufacturing system of claim ~~1~~ 19, wherein ~~at least a subset of the manufacturing cells is positioned at a gridded track structure, and wherein the gridded track structure comprises sets of intersecting rails on which the robotic storage/retrieval vehicles are navigable in two dimensions, and wherein~~ each of the manufacturing cells in the subset comprises at least one robotic worker mounted atop a mounting base ~~that is~~ installed on or within the two-dimensional gridded track structure, and wherein a width of the mounting base in each of the two dimensions is generally equal to a whole number multiple of a distance measured between the two adjacent parallel rails of the two-dimensional gridded track structure.

~~24~~ 22. The manufacturing system of claim ~~1~~ 21, wherein ~~at least a subset of the manufacturing cells is positioned at a gridded track structure, and wherein the gridded track structure comprises sets of intersecting rails on which the robotic storage/retrieval vehicles are navigable in two dimensions, and wherein each of the subset of manufacturing cells comprises at least one robotic worker mounted atop a mounting base that is installed on or in the gridded track structure, and wherein a~~ the width of the mounting base in each of the two dimensions does not exceed a distance measured between the two adjacent parallel rails of the two-dimensional gridded track structure.

~~25~~ 23. The manufacturing system of claim ~~1~~ 16, ~~further comprising a gridded track structure on which at least a subset of the manufacturing cells is positioned, wherein the gridded track structure comprises sets of intersecting rails on which the robotic storage/retrieval vehicles are navigable in two dimensions, and~~ wherein the two-dimensional gridded track structure comprises square spots, and wherein each of the square spots is delimited by a first pair of parallel rails of the two-dimensional gridded track structure lying in a first direction and a second pair of parallel rails of the two-dimensional gridded track structure lying in a second direction perpendicular to the first direction, and wherein each of the manufacturing cells occupies a cell space of an area equal to a predetermined number of the square spots.

~~26~~ 24. The manufacturing system of claim ~~25~~ 1 or 23, wherein ~~at least one~~ the cell

space is a square space whose area is divisible into nine square subspaces, and wherein each of the nine square subspaces is equal in area to one of the square spots of the two-dimensional gridded track structure, and wherein four corner subspaces of the nine square subspaces are configured as holding areas for holding supplies needed by the ~~corresponding each of the~~ manufacturing cells, and wherein a first pair of mid-perimeter subspaces positioned between the four corner subspaces at a first pair of opposing perimeter sides of the ~~at least one~~ cell space is occupied by robotic workers, and wherein a central subspace positioned between the robotic workers is configured as a working area to which the workpieces are transferred and ~~at which the workpieces are~~ processed by the robotic workers.

~~27~~ 25. The manufacturing system of claim ~~26~~ 1 or 24, wherein the working area is neighbored by a second pair of mid-perimeter subspaces positioned between the four corner subspaces at a second pair of opposing perimeter sides of the ~~at least one~~ cell space, and wherein at least one of the second pair of mid-perimeter subspaces is an unoccupied open area by which the robotic storage/retrieval vehicles are configured to enter and exit the working area.

~~28~~ 26. The manufacturing system of claim ~~27~~ 25, wherein both of the mid-perimeter subspaces in the second pair are unoccupied open areas, whereby the robotic storage/retrieval vehicles ~~are configured to~~ travel fully through ~~the~~ corresponding ~~each of the~~ manufacturing cells.

~~29~~ 27. The manufacturing system of claim 1, wherein the plurality of manufacturing cells ~~is~~ are configured in a multi-level structure, the multi-level structure comprising a plurality of levels of the manufacturing cells.

~~30~~ 28. The manufacturing system of claim ~~29~~ 16 or 27, wherein: ~~the multi-level structure comprises:~~

~~a gridded track structure at~~ each of the plurality of levels includes the two-dimensional gridded track structure, wherein the two-dimensional gridded track structure comprises the sets of intersecting rails on which the robotic storage/retrieval vehicles are navigable in the two dimensions; and

the multi-level structure comprises upright frame members interconnecting the intersecting rails of the plurality of levels.

~~31~~ 29. The manufacturing system of claim ~~30~~ 1 or 28, wherein ~~one or more of~~ the

upright frame members are configured for traversal of the robotic storage/retrieval vehicles thereon in an ascending direction and~~/or~~ a descending direction to transition between the plurality of levels.

~~32~~ 30. The manufacturing system of claim ~~31~~ 1 or 29, wherein the two-dimensional gridded track structure at one of the plurality of levels of the multi-level structure is attached to a corresponding one of the storage levels in the ASRS structure at which the robotic storage/retrieval vehicles ~~are configured to~~ transition between the ASRS structure and the multi-level structure.

~~33~~ 31. The manufacturing system of claim 1 or 16, wherein the manufacturing cells ~~comprise~~ include fully automated manufacturing cells and ~~one or more~~ human-attended manufacturing cells configured with respect to ~~a~~ the two-dimensional gridded track structure comprising the sets of intersecting rails on which the robotic storage/retrieval vehicles are navigable in the two dimensions, wherein the fully automated manufacturing cells are positioned at distributed locations throughout a main internal area of the two-dimensional gridded track structure, and ~~wherein~~ the ~~one or more~~ human-attended manufacturing cells are positioned at an outer perimeter area of the two-dimensional gridded track structure.

~~34~~ 32. The manufacturing system of claim 1 or 7 or 8, ~~further comprising a computerized control system in operable communication with the fleet of robotic storage/retrieval vehicles,~~ wherein the computerized control system comprises:

a network interface coupled to a communication network;

at least one processor coupled to the network interface; and

a non-transitory, computer-readable storage medium communicatively coupled to the at least one processor, wherein the non-transitory, computer-readable storage medium is configured to store computer program instructions, which when executed by the at least one processor, cause the at least one processor to activate ~~one or more of~~ the robotic storage/retrieval vehicles to ~~perform one or more of~~:

(a) ~~navigating~~ navigate within the ASRS structure and~~/or~~ through the manufacturing cells;

(b) ~~retrieving one or more of~~ retrieve the workpieces contained in ~~one or~~

~~more~~ the storage units ~~from~~ stored at the storage locations of the ASRS structure;

(c) ~~delivering~~ deliver the ~~one or more of the~~ workpieces contained in the ~~one or more~~ storage units to the at least one kitting workstation for kitting into ~~one or more~~ the kit storage units;

(d) pick~~ing~~ up the ~~one or more~~ kit storage units from the at least one kitting workstation;

(e) return~~ing~~ and stor~~e~~ing the ~~one or more~~ kit storage units to the storage locations of the ASRS structure;

(f) retriev~~e~~ing at least one of the ~~one or more~~ kit storage units and ~~one or more of~~ the workpieces contained in ~~another one or more of~~ the storage units, ~~one or more~~ the tool pieces contained in ~~another one or more~~ the storage units, and ~~one or more~~ the workpiece supports from the ~~same~~ ASRS structure;

(g) deliver~~ing~~ the ~~at least one of one or more~~ kit storage units and the ~~one or more of the~~ workpieces contained in the ~~another one or more of the~~ storage units, the ~~one or more~~ tool pieces contained in the ~~another one or more~~ storage units, and the ~~one or more~~ workpiece supports to the manufacturing cells for manufacture of ~~the~~ goods; and

(h) induct~~ing~~ the goods into the ASRS structure on a final workpiece support.

~~35~~ 33. A manufacturing system, the manufacturing system comprising:

a storage arrangement, the storage arrangement comprising:

an automated storage and retrieval system (ASRS) structure comprising a three-dimensional array of storage locations distributed throughout a two-dimensional footprint of the ASRS structure at a plurality of storage levels within the ASRS structure, wherein the ASRS structure further comprises at least one track-equipped level comprising a two-dimensional gridded track layout;

a supply of workpieces, tool pieces, and workpiece supports stored within the storage locations of the ASRS structure for use in manufacturing goods ~~from the workpieces~~; and

a fleet of robotic storage/retrieval vehicles navigable within the ASRS structure in at least two dimensions on the two-dimensional gridded track layout, each of said robotic storage/retrieval vehicles configured to carry storage units of compatible size and shape for storage in the storage locations of the ASRS structure, the storage units configured to hold at least the workpieces and tool pieces;

a plurality of manufacturing cells positioned outside the ASRS structure, wherein each of the manufacturing cells comprises ~~one or more~~ a plurality of modular components, the manufacturing cells configured in a continuous arrangement outside the ASRS structure, wherein the storage units are configured to be transferred to and from the storage locations of the ASRS structure and between the manufacturing cells, free of identification or scanning of the storage units, based on the continuous arrangement of the manufacturing cells; ~~and~~

a track structure connected to the ASRS structure and laying out ~~one or more~~ travel paths traversable by the robotic storage/retrieval vehicles from the ASRS structure, wherein at least a subset of the manufacturing cells is positioned along the track structure; and

a computerized control system in operable communication with each of the storage/retrieval vehicles, the computerized control system configured to orchestrate movement of the storage/retrieval vehicles on a two-dimensional gridded track structure interconnecting each of the manufacturing cells and the ASRS structure, the computerized control system further configured to trigger said storage/retrieval vehicles to deliver the storage units just-in-time, grouped based on corresponding work orders, and in specific sequences to the manufacturing cells, instead of linearly with conveyors, thereby facilitating just-in-time manufacturing of subassemblies at any stage of a manufacturing process, and thereby allowing any number of manufacturing processes to be completed multiple times in any order.

~~36~~ 34. The manufacturing system of claim ~~35~~ 33, wherein the track structure is a gridded track structure comprising sets of intersecting rails on which the robotic storage/retrieval vehicles are navigable in the at least two dimensions.

~~37~~ 35. The manufacturing system of claim ~~36~~ 34, wherein each of the ~~one or more~~ modular components comprises a footprint whose width, in at least one of the ~~at least~~ two dimensions, is ~~generally~~ equal to a whole number multiple of a distance measured between two adjacent parallel rails of the gridded track structure.

~~38~~ 36. The manufacturing system of claim ~~36~~ 34, wherein ~~each of the one or more modular components comprises a footprint whose~~ the width of the footprint, in each of the ~~at least~~ two dimensions, does not exceed a distance measured between the two adjacent parallel rails of the gridded track structure.

~~39~~ 37. The manufacturing system of claim ~~35~~ 33, wherein the ~~storage arrangement further comprises a supply of tool pieces for use in manufacturing the goods, wherein the~~ tool pieces are stored within the ~~same~~ ASRS structure in the storage units ~~as the workpieces~~, and wherein the tool pieces are retrievable from the ~~same~~ ASRS structure and deliverable to the manufacturing cells by the ~~same~~ fleet of robotic storage/retrieval vehicles.

~~40. The manufacturing system of claim 35, wherein the one or more modular components comprise robotic worker modules.~~

~~41~~ 38. The manufacturing system of claim ~~35~~ 33, wherein each of the ~~one or more~~ modular components comprises holding station modules configured to hold supplies required by ~~the~~ each of the manufacturing cells.

~~42~~ 39. The manufacturing system of claim ~~41~~ 33 or 38, wherein ~~the storage arrangement further comprises a supply of storage units of compatible size and shape for storage in the storage locations of the ASRS structure, wherein~~ the storage units are configured to be carried by the robotic storage/retrieval vehicles for the transfer of the storage units to and from the storage locations and to and from the manufacturing cells, and wherein the holding station modules are configured to receive the storage units.

~~43~~ 40. The manufacturing system of claim ~~35~~ 33, wherein ~~the storage arrangement further comprises a supply of storage units of compatible size and shape for storage in the storage locations of the ASRS structure, wherein the storage units are configured to be carried by the robotic storage/retrieval vehicles for transfer of the storage units to and from the storage locations and to and from the manufacturing cells, and wherein the~~ storage units comprise ~~at least one of~~:

workpiece storage units, each of the workpiece storage units configured to hold ~~one or more of~~ the workpieces; and

tool piece storage units, each of the tool piece storage units configured to store ~~one or more of~~ the tool pieces.

~~44~~ 41. The manufacturing system of claim ~~35~~ 33, wherein the track structure is an extension of the two-dimensional gridded track layout of the ~~at least one~~ track-equipped level of the ASRS structure.

~~45~~ 42. A method for executing a workflow in a manufacturing system, the method comprising:

(a) in an automated storage and retrieval system (ASRS) structure of the manufacturing system, storing workpieces, tool pieces and workpiece supports in respective storage locations of the ASRS structure, wherein the workpieces are stored in workpiece storage units at the storage locations, and the tool pieces are stored in tool piece storage units at the storage locations;

(b) using a fleet of robotic storage/retrieval vehicles navigable within the ASRS structure, extracting ~~one or more of~~ the workpiece storage units and ~~a~~ selected workpiece supports from the ASRS structure according to requirements of ~~a~~ manufacturing processes to be performed at ~~a~~ manufacturing cells positioned outside the ASRS structure and in a neighboring relation to the ASRS structure, and separately delivering the ~~one or more of the~~ workpiece storage units and the selected workpiece supports to the manufacturing cells, free of identification or scanning of the storage units, based on the continuous arrangement of the manufacturing cells outside the ASRS structure;

(c) at each of the manufacturing cells, positioning the selected workpiece supports in ~~a~~ working positions accessible by ~~one or more~~ workers of the manufacturing cells; and

(d) at each of the manufacturing cells, with the selected workpiece supports maintained in the working position:

(i) transferring ~~one or more of~~ the workpieces from the ~~one or more of the~~

workpiece storage units onto the selected workpiece supports; and

(ii) performing ~~a~~ process steps of the manufacturing processes on the ~~one or more of the~~ workpieces held on the selected workpiece supports;

(e) orchestrating, by a computerized control system, movement of the storage/retrieval vehicles on a two-dimensional gridded track structure interconnecting each of the manufacturing cells and the ASRS structure, and triggering the storage/retrieval vehicles to deliver the storage units just-in-time, grouped based on corresponding work orders, and in specific sequences to the manufacturing cells, instead of linearly with conveyors, thereby facilitating just-in-time manufacturing of subassemblies at any stage of a manufacturing process and allowing any number of manufacturing processes to be completed multiple times in any order.

~~46~~ 43. The method of claim ~~45~~ 42, wherein the step ~~(b)~~ of using the fleet of robotic storage/retrieval vehicles navigable within the ASRS structure, includes a step of ~~comprises~~ using ~~a same type of~~ the robotic storage/retrieval vehicles to ~~solely~~ perform ~~the~~ extraction and ~~the~~ delivery of both ~~of~~ the ~~one or more of the~~ workpiece storage units and the selected workpiece supports from the ASRS structure to the manufacturing cells.

~~47~~ 44. The method of claim ~~45~~ 42, ~~further comprising~~ wherein:

~~in step (a)~~ the step of storing the workpieces, the tool pieces and the workpiece supports in the respective storage locations of the ASRS structure further includes, storing tool piece storage units in the ASRS structure, wherein the tool piece storage units are configured to hold the tool pieces for use in the manufacturing process; and

prior to ~~step (d)(ii)~~ performing the process steps of the manufacturing processes on the workpieces held on the selected workpiece supports, using one of the robotic storage/retrieval vehicles to extract a subset of the tool piece storage units from the ASRS structure and deliver the subset of the tool piece storage units to the manufacturing cells.

~~48~~ 45. The method of claim ~~47~~ 42 or 44, wherein the step of performing the process steps of the manufacturing processes on the workpieces held on the selected workpiece supports further includes, ~~step (d)(ii) comprises,~~ prior to performing the

process steps of the manufacturing processes, attaching a select one of the tool pieces from the subset of the tool piece storage units to ~~a~~ robotic workers of the manufacturing cells according to the requirements of the manufacturing processes to be performed on the ~~one or more of the~~ workpieces by the robotic workers.

~~49~~ 46. The method of claim ~~45~~ 42, wherein the step of extracting the workpiece storage unit further includes ~~one or more of the workpiece storage units comprise two workpiece storage units, and wherein step (b) comprises~~ delivering ~~the~~ at least two workpiece storage units to two respective holding areas of ~~the~~ a manufacturing cell, and ~~wherein step (d)(i) comprises~~ transferring two workpieces respectively from the two workpiece storage units parked at ~~the~~ two respective holding areas, onto ~~the~~ a selected workpiece support.

~~50~~ 47.The method of claim ~~45~~ 42, further comprising:

~~after step (d)(i),~~ removing from the manufacturing cells, ~~an~~ unneeded or empty ~~one of the~~ workpiece storage units from which ~~a~~ selected ~~one or more of the~~ workpieces ~~is~~ are already removed ~~in step (d)(i)~~ and from which no further workpieces are required for the manufacturing processes at the manufacturing cells; and

using one of the robotic storage/retrieval vehicles to deliver ~~delivering~~ to the manufacturing cells ~~an~~ additional workpiece storage units containing ~~one or more~~ additional workpieces ~~needed at the manufacturing cell~~.

~~51~~ 48. The method of claim ~~50~~ 46 or 47, wherein the ~~one or more~~ additional workpieces are for use in a different manufacturing process to be performed at the ~~same~~ manufacturing cell, and wherein ~~after step (d)(ii),~~ the method further comprises:

removing from the manufacturing cell the selected workpiece support and the ~~one or more of the~~ workpieces mounted thereon ~~that were processed in step (d)(ii)~~;

using one of the robotic storage/retrieval vehicles ~~delivering~~ to deliver another workpiece support to the manufacturing cell for use in the different manufacturing process;

supporting the another workpiece support in ~~the~~ a working position;

transferring the ~~one or more~~ additional workpieces from ~~the~~ an additional

workpiece storage unit delivered to the manufacturing cell, onto the another workpiece support; and

performing ~~one or more~~ process steps of the different manufacturing process on the ~~one or more~~ additional workpieces.

~~52~~ 49. The method of claim ~~51~~ 48, further comprising removing the unneeded or empty ~~one of the~~ workpiece storage units using a ~~different one of the~~ robotic storage/retrieval vehicle~~s~~ ~~from that which~~ different from the robotic storage/retrieval vehicle that ~~delivers~~ delivered the additional workpiece storage unit to the manufacturing cell.

~~53. The method of claim 52, wherein the different one of the robotic storage/retrieval vehicles is configured to remove the unneeded or empty one of the workpiece storage units after having dropped off a different one of the workpiece storage units at a different manufacturing cell to supply contents of the different one of the workpiece storage units to the different manufacturing cell.~~

~~54~~ 50. The method of claim ~~45~~ 42, further comprising after completion of a finished good by processing of the ~~one or more of the~~ workpieces at ~~one or more~~ the manufacturing cells, inducting the finished good into the ASRS structure on one of the robotic storage/retrieval vehicles.

~~55~~ 51. The method of claim ~~54~~ 42, further comprising inducting the finished good into the ASRS structure on a final workpiece support on which ~~one or more~~ final process steps were carried out to complete the finished good.

~~56. The method of claim 55, wherein the final workpiece support is the same selected workpiece support onto which the one or more of the workpieces were transferred in step (d)(i).~~

~~57~~ 52. The method of claim ~~45~~ 42, further comprising~~, prior to step (a),~~ filling each of the workpiece storage units with a kit of different workpieces according to the requirements of the manufacturing process~~es~~.

~~58~~ 53. The method of claim ~~57~~ 42 or 52, wherein the filling of ~~the~~ each of the workpiece storage units is performed at a kitting workstation ~~that is~~ connected to the ASRS structure, and wherein at the kitting workstation:

the fleet of robotic storage/retrieval vehicles is configured to deliver inventory

storage units retrieved from respective storage locations in the ASRS structure, wherein the inventory storage units are configured to contain inventory workpieces;

the different workpieces of the kit are picked from the inventory workpieces stored in the inventory storage units, and compiled into the workpiece storage units; and

~~the~~ each of the workpiece storage units is carried away from the kitting workstation by ~~one of~~ the robotic storage/retrieval vehicles and deposited into a respective one of the storage locations in the ASRS structure for subsequent retrieval from the ASRS structure ~~in step (a)~~.