[0089] In Figure 16A, the start of a sequence of tote moves of portion 1600A has reference number 1610. Successive time periods are labeled 1611 (tote A is loaded on vertical slot 1641 using 1.0 second, per the Key 1 above), 1612 (tote A is moved 7 slots upward to slot 1648) and 1613 (tote C is loaded to slot 1641 and tote A is unloaded to the top horizontal conveyor 1651). The arriving totes are on arriving horizontal conveyor (AHC) 1671 of apparatus 1601 and will travel up the steps 1641, 1642, 1643, 1644, 1645, 1646, 1647 and 1648 of upward vertical conveyor 1640 of subsystem 1602, then across top horizontal conveyor 1651, then travel down the steps 1661, 1662, 1663, 1664, 1665, 1666, 1667 and 1668 of downward vertical conveyor 1660, and completed totes will be output to on departing horizontal conveyor (DHC) 1672. The accumulated time is set forth in the action boxes at the top of each time period. Continue to refer to 1610 of Figure 16 A for reference numbers of the respective slot positions.

[0090] In Figure 16B, the continuing sequence of tote moves of portion 1600B has time periods are labeled 1614 (tote c is moved 7 slots upward to slot 1648; tote A is transferred across top horizontal conveyor 1651), 1615(tote A is moved 3 slots downward to slot 1664 and starts handling 1685 (i.e., being loaded by human picker 90), tote B is loaded on vertical slot 1641 and tote C is unloaded to the top horizontal conveyor 1651), 1616 (tote B is moved 4 slots upward to slot 1645; tote C is transferred across top horizontal conveyor 1651), 1617 (tote E is loaded on vertical slot 1641) and 1618 (tote A completes handling 1685 (i.e., it is done being loaded by human picker 90)).

[0091] In Figure 16C, the continuing sequence of tote moves of portion 1600C has time periods labeled 1619, 1620, 1621, 1622, and 1623, with the actions and accumulated times listed at the top of each time period.

[0092] In Figure 16D, the continuing sequence of tote moves of portion 1600D has time periods labeled 1624, 1625, 1626, 1627, and 1628, with the actions and accumulated times listed at the top of each time period.

[0093] In Figure 16E, the continuing sequence of tote moves of portion 1600E has time periods labeled 1629, 1630, 1631, 1632, and 1633, with the actions and accumulated times listed at the top of each time period.

[0094] In Figure 16F, the continuing sequence of tote moves of portion 1600F has time periods labeled 1634, 1635, 1636, 1637, and 1638, with the actions and accumulated times listed at the top of each time period.

[0095] In Figure 16G, the continuing sequence of tote moves of portion 1600G has time periods labeled 1639, 1640, 1641, 1642, and 1643, with the actions and accumulated times listed

What is claimed is:

1. An apparatus (700, 903, 904, 905) comprising:

an automatically guided vehicle (AGV) (701, 801, 901, 902, 909, 970, 980, 1602) that carries a human picker (90) within a safety cage (711, 811, 911) coupled to the AGV (701, 801, 901, 902, 909, 970, 980); and

a holder attached to the AGV (701, 801, 901, 902, 909, 970, 980), wherein the holder holds a plurality of totes (125), wherein the holder includes a first vertical tote-conveyor system (731, 1640) operatively coupled to the AGV (701, 801, 901, 902, 909, 970, 980) and configured to convey vertically each tote of the plurality of totes (125) to a plurality of vertical locations (1641-1648), wherein each of the plurality of locations (1641-1648) of the first vertical tote-conveyor system is at a different height relative to the AGV (701, 801, 901, 902, 909, 970, 980), wherein the AGV (701, 801, 901, 902, 909, 970, 980) moves to a successive plurality of inventory stock bins (240, 705) and the first vertical tote-conveyor system (731, 1640) moves preselected ones (923) of the plurality of totes (125) vertically so the human picker (90) successively retrieves each of a plurality of stock items from the stock bins (240, 705) and places the respective items in the preselected ones (923) of the plurality of totes (125) based on a customer shipment order.

2. An apparatus for order fulfillment from stored items in a plurality of bins (240, 705) located along at least a first side of a first aisle (113), the apparatus comprising:

a first guided vehicle (701, 801, 901, 902, 909, 970, 980) configured to move horizontally along the first aisle (113);

a first horizontal tote-conveyor system (704, 804, 950, 940) positioned along a first horizontal tote path that runs parallel to the first side of the first aisle (113), wherein the horizontal tote-conveyor system moves a first sequence of totes (125) to the first guided vehicle (701, 801, 901, 902, 909, 970, 980);

a first vertical tote-conveyor system (731, 1640) operatively coupled to the first guided vehicle (701, 801, 901, 902, 909, 970, 980) and configured to convey vertically each tote of the first sequence of totes (125) to a plurality of vertical locations (1641-1648), wherein each of the plurality of locations (1641-1648) of the first vertical tote-conveyor system is at a different height relative to the first guided vehicle (701, 801, 901, 902, 909, 970, 980);

a second vertical tote-conveyor system (732, 1660) operatively coupled to the first guided vehicle (701) and configured to convey vertically each tote of the first sequence of totes

(125) to a plurality of vertical locations (1661-1668), wherein each of the plurality of locations (1661-1668) of the second vertical tote-conveyor system (732, 1660) is at a different height relative to the first guided vehicle (701, 801, 901, 902, 909, 970, 980);

a horizontal tote-transfer mechanism (720, 1651) operatively coupled to the first guided vehicle (701) and configured to move each tote of the first sequence of totes (125) between the first vertical tote-conveyor system (731, 1640) and the second vertical tote-conveyor system (732, 1660), wherein the first sequence of totes (125) includes a first tote (A) and a second tote (B), wherein the first vertical tote-conveyor system (731, 1640) is further configured to move the second tote (B) from a first vertical location (1641) of the plurality of vertical locations (1641-1648) to a second vertical location (1645) of the plurality of vertical locations (1641-1648) while the first tote (A) remains vertically stationary at a third vertical location (1664) on the second vertical tote-conveyor system (732, 1660); and

a first picker platform (911) operatively coupled to the first guided vehicle (701, 801, 901, 902, 909, 970, 980) and configured to move to one of a plurality of vertical positions to facilitate the movement of picked items from the plurality of bins (240, 705) to stow in the first sequence of totes, wherein the first horizontal tote-conveyor system (704, 804, 950, 940) moves the first sequence of totes (125) away from the first guided vehicle (701, 801, 901, 902, 909, 970, 980) to an end of the first aisle (113).

3. The apparatus of claim 2, wherein the first guided vehicle (701, 801, 901, 902, 909, 970, 980) is configured to carry a human operator picker (90), and wherein the human picker (90) sequentially picks items from the plurality of plurality of bins (240, 705) and stows the picked items in the first sequence of totes (125), the apparatus comprising:

a horizontal vehicle-motion system (713, 917, 918) operatively coupled to the first guided vehicle (701, 801, 901, 902, 909, 970, 980) and configured to move the first guided vehicle (701, 801, 901, 902, 909, 970, 980) to a first selected horizontal location along the first aisle (113), wherein the first vertical tote-conveyor system moves a first selected tote (125) of the plurality of totes (125) vertically to a first selected one of a plurality of different tote heights, such that the first selected tote (125) is next to a first selected bin (240, 705); and

a vertical picker-motion system (712, 910) operatively coupled to the first guided vehicle (701, 801, 901, 902, 909, 970, 980) and configured to move the human picker (90) vertically to a first selected one of a plurality of different picker heights such that the human picker (90) is next to the first selected tote (125, 923) and the first selected bin (240, 705) to pick a first selected item from the first selected bin (240, 705) and place the first selected item

into the first selected tote (125, 923).

4. The apparatus of claim 2, further comprising:

a robotic picker (1101) operatively coupled to the first guided vehicle (701, 801, 901, 909, 970, 980) and configured to sequentially pick items from the plurality of bins (240, 705);

a horizontal vehicle-motion system (713, 917, 918) operatively coupled to the first guided vehicle (701, 801, 901, 909, 970, 980) and configured to move the first guided vehicle (701, 801, 901, 909, 970, 980) horizontally to a first selected horizontal location along the first aisle (113), wherein the first vertical conveyor system moves a first selected tote (125) of the plurality of totes (125) vertically to a first selected one of a plurality of different tote heights, such that the first selected tote (125) is next to a first selected bin (240, 705); and

a vertical picker-motion system (712, 910) operatively coupled to the first guided vehicle (701, 801, 901, 909, 970, 980) and configured to move the robotic picker (1101) to a first selected one of a plurality of different picker heights such that the first selected to the robotic picker (1101) is next to the first selected tote (125) and the first selected bin (240, 705) so that the robotic picker (1101) picks a first selected item from the first selected bin (240, 705) and places the first selected item into the first selected tote (125).

5. The apparatus of claim 2, wherein the first horizontal tote-conveyor system (704, 804, 950, 940) includes a plurality of parallel horizontal tote paths (704A, 704D, 804A, 804D, 940, 950), wherein the first sequence of totes (125) moves towards the first guided vehicle (701, 801, 901, 902, 909, 970, 980) on a first one of the plurality of parallel horizontal tote paths (704A, 804A, 940, 950) and the first sequence of totes (125) move away from the first guided vehicle (701, 801, 901, 902, 909, 970, 980) on a second one of the plurality of parallel horizontal tote paths (704D, 804D, 950', 940') in opposite horizontal directions.

6. The apparatus of claim 2, wherein the first horizontal tote-conveyor system (704, 804, 950, 940) includes a plurality of parallel horizontal tote paths (704A, 704D, 940, 950, 950', 940'), wherein the first sequence of totes (125) move towards the first guided vehicle (901, 902, 909, 970, 980) on a first one (950) of the plurality of parallel horizontal tote paths (940, 950, 950', 940') and the first sequence of totes (125) move away from the first guided vehicle (901, 902, 909, 970, 980) on a second one (940') of the plurality of parallel horizontal tote paths (940, 950, 950', 940') in opposite horizontal directions from and to a first end of the first aisle (113), wherein the first horizontal tote-conveyor system (704, 804, 950, 940) is

configured to convey horizontally a second sequence of totes (125) to the first guided vehicle (901, 902, 909, 970, 980) from a second end of the first aisle (113).

7. The apparatus of claim 2,

wherein the first sequence of totes (125) move towards the first guided vehicle (970, 980) on the first horizontal tote path (950) from a first end of the first aisle (113), and the first sequence of totes (125) move away from the first guided vehicle (970, 980) on the first horizontal tote path (950') towards a second end of the first aisle (113),

wherein the first horizontal tote-conveyor system (950, 940) is configured to convey horizontally a second sequence of totes (125) to the first guided vehicle (901, 902, 909, 970, 980) on a second horizontal path (940) from the second end of the first aisle (113), and the second sequence of totes (125) move away from the first guided vehicle (970, 980) on the second horizontal tote path (940) towards the first end of the first aisle (113).

8. The apparatus of claim 2, wherein the first horizontal tote-conveyor system (704, 804) has a single horizontal tote path (704A, 804A) on which the first sequence of totes (125) is horizontally conveyed to the first guided vehicle (701, 801) and on which the first sequence of totes (125) are horizontally conveyed from the first guided vehicle (701, 801) to the end of the first aisle (113) in a single horizontal direction.

9. The apparatus of claim 2, wherein the first vertical tote-conveyor system (704, 804, 950, 940) includes a mechanism that moves totes (125) along a first upward vertical tote path, and wherein the second vertical tote-conveyor system (732, 1660) includes a mechanism that moves totes (125) along a first downward vertical tote path.

10. The apparatus of claim 2, wherein the first horizontal tote-conveyor system (950) has a single horizontal tote path on which the first sequence of totes (125) is horizontally conveyed to the first guided vehicle (970, 980) and on which the first sequence of totes (125) are horizontally conveyed from the first guided vehicle (970, 980) to the end of the aisle (113) in a single horizontal direction, wherein the first vertical tote-conveyor system (920) vertically conveys each tote to each of the plurality of vertical locations along a first upward vertical tote path, and wherein the second vertical tote-conveyor system vertically conveys each tote to each of the plurality of vertical locations along a first downward vertical tote path.

11. The apparatus of claim 2, further comprising:

a lower support (917) operatively coupled to the first guided vehicle (901, 902, 909, 970, 980) to support the first guided vehicle (901, 902, 909, 970, 980) from below only on a first vehicle ground path located only on a single side of the first horizontal tote path (950);

an upper support (915) operatively coupled to the first guided vehicle (901, 902, 909, 970, 980) to support the first guided vehicle (901, 902, 909, 970, 980) from above on at least a first upper track, wherein the first upper track is parallel to the first vehicle ground path; and

a motion device (917, 918) operatively coupled to the first guided vehicle (901, 902, 909, 970, 980) to move the first guided vehicle (901, 902, 909, 970, 980) successively to a plurality of different horizontal locations along the first aisle (113).

12. The apparatus of claim 2, wherein the first horizontal tote-conveyor system (950, 940) includes a first horizontal tote conveyor (950') that moves the first sequence of totes (125) along the first aisle (113) away from the first guided vehicle (901, 902, 909, 970, 980) to a first end of the first aisle along the first horizontal tote path and a second horizontal tote conveyor (940') that is parallel to and moves totes (125) in an opposite direction to the first horizontal tote conveyor (950') that moves a second sequence of totes (125) away from the first guided vehicle (901, 902, 909, 970, 980) to a second end of the first aisle (113) on a second horizontal tote path (940'), and wherein the apparatus further includes:

a lower support (917) operatively coupled to the first guided vehicle (901, 902, 909, 970, 980) to support the first guided vehicle (901, 902, 909, 970, 980) from below only between the first horizontal tote conveyor (950) and the second horizontal tote conveyor (940) along a first vehicle ground path;

an upper support (915) operatively coupled to the first guided vehicle (901, 902, 909, 970, 980) to support the first guided vehicle (901, 902, 909, 970, 980) from above on at least a first upper track, wherein the first upper track is parallel to the first vehicle ground path; and

a motion device (917, 918) operatively coupled to the first guided vehicle (901, 902, 909, 970, 980) to move the first guided vehicle (901, 902, 909, 970, 980) successively to a plurality of different horizontal locations along the first vehicle ground path.

13. The apparatus of claim 2, wherein the first horizontal tote-conveyor system (950, 940) includes a first horizontal tote conveyor (950') that moves the first sequence of totes (125) along the first aisle (113) away from the first guided vehicle (901, 902, 909, 970, 980) to a first end of the first aisle along the first horizontal tote path and a second horizontal tote conveyor

(940') that is parallel to and moves totes (125) in an opposite direction to the first horizontal tote conveyor (950') that moves a second sequence of totes away from the first guided vehicle (901, 902, 909, 970, 980) to a second end of the first aisle (113) on a second horizontal tote path that is parallel to first horizontal tote path.

14. The apparatus of claim 2, wherein a plurality of bins (240, 705) is located along at least a first side of a second aisle (113), wherein the first guided vehicle (701, 801, 901, 902, 909, 970, 980) is configured to move to the second aisle (113), and wherein the apparatus further includes:

a second horizontal tote-conveyor system (704, 804, 950, 940) positioned along a second horizontal tote path that runs parallel to the first side of the second aisle (113), wherein the horizontal tote-conveyor system (704, 804, 950, 940) moves a third sequence of totes (125) to the first guided vehicle (701, 801, 901, 902, 909, 970, 980) in the second aisle (113), wherein the first vertical tote-conveyor system (731, 732, 831, 832, 920, 920') is configured to convey vertically each tote of the third sequence of totes (125) to a plurality of vertical locations, wherein each of the plurality of locations of the first vertical tote-conveyor system (731, 732, 831, 832, 920, 920') is at a different height relative to the first guided vehicle (701, 801, 901, 902, 909, 970, 980) such that items selected from the plurality of bins (240, 705) on the second aisle (113) are placed in the third sequence of totes (125).

15. The apparatus of claim 2, further comprising:

a collection-and-shipping system (242) configured to collect the first sequence of totes (125) and take the picked items from the first sequence of totes (125) and place the picked items into shipping containers for shipment to customers.