Claims

1. A buffer system for a semiconductor device fabrication tool, comprising:

one or more retractable shelves, wherein the one or more retractable shelves are configured to support sealable containers;

one or more sliding assemblies positionable above one or more load ports of the semiconductor device fabrication tool, the one or more sliding assemblies including a plate mounted on a linear rail system, the plate configured to support at least a portion of a bottom side of at least one sealable container of the sealable containers when the at least one sealable container is disposed upon the plate, wherein the one or more sliding assemblies are configured to transport the sealable containers to one or more positions beneath the one or more retractable shelves; and

one or more lifting assemblies, wherein the one or more lifting assemblies are configured to transport the sealable containers between any two of the group including the one or more retractable shelves, the one or more sliding assemblies, and the one or more load ports.

2. The buffer system of claim 1, wherein at least one of the one or more retractable shelves is positionable above at least one of the one or more load ports.

3. The buffer system of claim 1, wherein the one or more retractable shelves comprise:

4. The buffer system of claim 3, wherein the row is oriented horizontally.

5. The buffer system of claim 1, wherein the one or more sliding assemblies transport sealable containers along linear horizontal paths.

6. The buffer system of claim 1, wherein the one or more lifting assemblies support at least a portion of a bottom side of at least one of the sealable containers.

7. The buffer system of claim 1, wherein at least two of the one or more retractable shelves, the one or more sliding assemblies, or the one or more lifting assemblies move concurrently.

8. The buffer system of claim **1**, wherein at least one of the one or more retractable shelves retracts to provide clearance for vertical transport of the sealable containers by the one or more lifting assemblies.

9. The buffer system of claim **1**, wherein motion of the plate is driven by at least one of a leadscrew, a belt drive, a tape drive, a cable drive, or a linear motor.

10. The buffer system of claim **1**, wherein at least one of the one or more retractable shelves or the one or more sliding assemblies includes one or more kinematic pins configured to engage with one or more corresponding slots on the sealable containers to provide flexible alignment of the sealable containers.

11. The buffer system of claim **1**, wherein the one or more lifting assemblies transport the sealable containers along linear vertical paths.

12. The buffer system of claim **1**, wherein the one or more lifting assemblies support at least one of a conveyor rail or a conveyor plate associated with at least one of the sealable containers.

13. The buffer system of claim **1**, wherein motion of at least one of the one or more lifting assemblies is driven by at least one of a cable, a tape, or a counter weight.

14. The buffer system of claim **1**, wherein the one or more lifting assemblies comprise:

one or more forks.

15. The buffer system of claim **1**, wherein at least one of the one or more lifting assemblies or the one or more sliding assemblies include brakes, wherein the brakes engage upon a drive failure.

16. The buffer system of claim **1**, wherein at least one of the one or more retractable shelves, the one or more sliding assemblies, or the one or more lifting assemblies include safety stops to prevent motion beyond a defined limit.

17. The buffer system of claim **1**, wherein at least one of the one or more retractable shelves, the one or more sliding assemblies, or the one or more lifting assemblies are integrateable into the semiconductor device fabrication line tool.

18. The buffer system of claim **1**, wherein at least one of the one or more retractable shelves, the one or more sliding assemblies, or the one or more lifting assemblies are fixedly attachable to the semiconductor device fabrication line tool.

19. The buffer system of claim **18**, wherein at least a portion of the one or more sliding assemblies is mountable to a front side of the semiconductor device fabrication line tool in a cantilevered configuration.

20. The buffer system of claim **1**, wherein at least one of the one or more retractable shelves, the one or more sliding assemblies, or the one or more lifting assemblies are positionable proximate to the semiconductor device fabrication line tool.

21. The buffer system of claim **20**, wherein the one or more sliding assemblies are mountable to the ceiling.

22. The buffer system of claim **20**, wherein the one or more sliding assemblies are mountable to the floor.

23. The buffer system of claim **1**, wherein the semiconductor device fabrication line tool comprises:

at least one of a semiconductor process tool, a metrology tool, or an inspection tool.

24. The buffer system of claim **1**, further comprising:

one or more roller assemblies configured to transport the sealable containers between the one or more retractable shelves of the buffer system and one or more retractable shelves of a second buffer system.

25. The buffer system of claim **1**, wherein the one or more lifting assemblies are further configured to transport the sealable containers to one or more intermediate locations along one or more travel paths associated with the one or more lifting assemblies.

26. A semiconductor device fabrication line tool, comprising:

one or more load ports; and

a buffer sub-system, comprising:

one or more retractable shelves, wherein the one or more retractable shelves are configured to support sealable containers;

one or more sliding assemblies positioned above the one or more load ports, the one or more sliding assemblies including a plate mounted on a linear rail system, the plate configured to support at least a portion of a bottom side of at least one sealable container of the sealable containers when the at least one sealable container is disposed upon the plate, wherein the one or more sliding assemblies are configured to transport the sealable containers to one or more positions beneath the one or more retractable shelves; and

one or more lifting assemblies, wherein the one or more lifting assemblies are configured to transport the sealable containers between any two of the group including the one or more retractable shelves, the one or more sliding assemblies, and the one or more load ports.

27. The semiconductor device fabrication line tool of claim **26**, wherein the semiconductor device fabrication line tool comprises:

at least one of a semiconductor process tool, a metrology tool, or an inspection tool.

28. A semiconductor device fabrication line tool, comprising:

one or more load ports, the one or more load ports configured to receive sealable containers; and

a buffer sub-system operatable in an active mode or a passive mode, comprising:

one or more retractable shelves, wherein at least one retractable shelf of the one or more retractable shelves is positionable above a load port of the one or more load ports, wherein the at least one retractable shelf is configured to engage in the retracted position when in the passive mode to provide clearance for transfer of sealable containers between an overhead delivery device and the load port, wherein the at least one retractable shelf is configured to engage in the extended position when in the active mode for transfer of the sealable containers with the overhead deliver device;

one or more sliding assemblies positioned above the one or more load ports, the one or more sliding assemblies including a plate mounted on a linear rail system, the plate configured to support at least a portion of a bottom side of at least one sealable container of the sealable containers when the at least one sealable container is disposed upon the plate, wherein the one or more sliding assemblies are configured to transport the sealable containers to one or more positions beneath the one or more retractable shelves when in the active mode; and

one or more lifting assemblies, wherein the one or more lifting assemblies are configured to transport the sealable containers between any two of a group including the one or more retractable shelves, the one or more sliding assemblies, and the one or more load ports when in the active mode.

29. The semiconductor device fabrication line tool of claim **28**, wherein the passive mode is a backup to the active mode.

30. The semiconductor device fabrication line tool of claim **28**, wherein the buffer subsystem is configured to dynamically switch between the active mode and the passive mode.

31. The semiconductor device fabrication line tool of claim **28**, wherein at least two retractable shelves of the one or more retractable shelves are vertically aligned and positionable at a location adjacent to the one or more load ports.

32. The semiconductor device fabrication line tool of claim **31**, wherein a topmost retractable shelf of the at least two retractable shelves is configured for transfer of the sealable containers with the overhead delivery device.

33. The semiconductor device fabrication line tool of claim **32**, wherein the buffer sub-system is configured to initiate transfer of the sealable containers between one or more remaining retractable shelves and an additional delivery device.

34. The semiconductor device fabrication line tool of claim **28**, wherein at least two retractable shelves of the one or more retractable shelves are vertically aligned and positionable at a location adjacent to the one or more load ports.

35. The semiconductor device fabrication line tool of claim **34**, wherein a topmost retractable shelf of the at least two retractable shelves is configured for transfer of the sealable containers with an overhead delivery device.

36. The semiconductor device fabrication line tool of claim **35**, wherein the buffer sub-system is configured to initiate transfer of the sealable containers between one or more remaining retractable shelves and an additional delivery device.