One apparatus and method for pattern creation. One aspect provides for measuring a dimension of an object and using the dimension to pick and place the object. A first input device conveys an object into contact with a feed forward unit. The contact causes displacement of the feed forward unit and conditions the object. A distance sensor measures a distance to a surface of the object. One aspect provides for maintaining a pattern of objects in a desired position and orientation. A first surface, second surface, and third surface are mutually orthogonal and meet at a point to form a lowest corner. One aspect provides for transferring a pattern from a universal surface with finger wall slats to an ultimate package. The apparatus comprises a crowder plate with crowder plate slats. A portion of the crowder plate slats are sized to pass between a portion of mating finger wall slats.
We claim:

1. An apparatus for use in picking and placing a non-rigid object, said apparatus comprising:
   a first input device;
   a feed forward unit; and
   at least one line of communication;
   wherein the first input device conveys a non-rigid object into contact with the feed forward unit, which contact causes a displacement of the feed forward unit,
   wherein the displacement measures a measured dimension of the object, and
   wherein the measured dimension is transmitted via the at least one line of communication.

2. The apparatus of claim 1, further comprising:
   a distance sensor, wherein the distance sensor measures the measured dimension of the object by measuring the displacement of the feed forward unit.

3. The apparatus of claim 2, wherein the distance sensor measures a measured distance between the feed forward unit and the input device while the object is in contact with the feed forward unit, and wherein the measured dimension is substantially equal to the measured distance.

4. The apparatus of claim 1 further comprising:
   a robot, wherein the robot is positioned to pick and place the object using the measured dimension, and wherein the measured dimension is transmitted to the robot via the at least one line of communication.

5. The apparatus of claim 4, wherein the robot is positioned a specified distance above an object-contacting surface of an input device to pick the object from the object-contacting surface, and wherein the specified distance is at least as large as the measured dimension.

6. The apparatus of claim 1, further comprising:
   a presence sensor; wherein the presence sensor detects a presence of the object.
7. The apparatus of claim 6, wherein the presence sensor detects a position of the object.

8. The apparatus of claim 6, wherein a distance sensor measures the measured dimension of the object by measuring a measured distance between the feed forward unit and the input device while the presence sensor detects the presence of the object between the feed forward unit and the input device.

9. The apparatus of claim 1, wherein a distance sensor measures a measured distance between the feed forward unit and the input device while the object is in contact with the feed forward unit; and wherein the measured dimension is substantially equal to a maximum measured distance between the feed forward unit and the input device that occurs while the object is in contact with the feed forward unit.

10. The apparatus of claim 1, further comprising:
   a vision system, wherein the vision system detects information selected from the group consisting of a more accurate position of the object, a more accurate orientation of the object, and both a more accurate position and orientation of the object.

11. The apparatus of claim 10, wherein the information, selected from the group consisting of the more accurate position of the object, the more accurate orientation of the object, and both the more accurate position of the object and the more accurate orientation of the object, is used to pick the object.

12. The apparatus of claim 11, wherein the group consisting of the more accurate position of the object, the more accurate orientation of the object, and both the more accurate position of the object and the more accurate orientation of the object is transmitted via the at least one line of communication.

13. The apparatus of claim 4, wherein the robot picks the object from the first input device and places the object on a universal surface, which universal surface is on a universal surface conveyor.
14. The apparatus of claim 1, wherein the first input device and the universal surface conveyors are moving, wherein the first input device and the universal surface conveyors are conveyor belts, and wherein the universal surface is a tray.

15. The apparatus of claim 4, wherein the robot comprises a vacuum nozzle to pick and place the object.

16. The apparatus of claim 1, wherein the object is a pillow bag.

17. The apparatus of claim 1, wherein the measured dimension is selected from the group consisting of a thickness, a height, a length, a width, and a diameter of the object.

18. The apparatus of claim 1, wherein the feed forward unit comprises a secondary input device.

19. The apparatus of claim 18, wherein the secondary input device comprises a driven overhead conveyor belt, wherein the secondary input device has a translational velocity that is substantially equal to a translational velocity of the first input device, and wherein an object in contact with both the first input device and the secondary input device will be conveyed by both input devices at approximately the same speed so that the first and secondary input device result in substantially no net torque on the object.
20. A method for measuring a dimension of a non-rigid object and using the dimension in picking and placing the object, said method comprising the steps:
   measuring a dimension of a moving non-rigid object to provide a measured dimension;
5   using the measured dimension to pick the object; and
   using the measured dimension to place the object in an array of objects;
10  wherein the measuring step comprises:
   using a first input device to convey the object into contact with a feed forward unit, wherein the contact causes a change in position of the feed forward unit to accommodate the measured dimension of the object; and
   using a distance sensor to detect the change in position of the feed forward unit.

21. The method of claim 20, wherein the measured dimension is substantially equal to a measured distance between the feed forward unit and the first input device.

22. The method of claim 20, further comprising:
   using the distance sensor to detect a maximum change in position of the feed forward unit as the object passes under the feed forward unit; and
   selecting the maximum change in position of the feed forward unit to be the measured dimension of the object.

23. The method of claim 20, wherein the measured dimension is substantially equal to a measured distance between the first input device and the feed forward unit when the object is between the first input device and the feed forward unit.

24. The method of claim 20, further comprising:
   using a presence sensor to detect a position of the object.

25. The method of claim 20, further comprising:
   using a presence sensor to detect a presence of the object between the feed forward unit and the first input device.
26. The method of claim 20, wherein the method further comprises transmitting the measured dimension of the object.

27. The method of claim 20, wherein the method further comprises transmitting information from which the measured dimension of the object can be determined.

28. The method of claim 20, wherein the method further comprises capturing information about the array.

29. The method of claim 20, wherein the method further comprises transmitting information about the array.

30. The method of claim 20, wherein the method further comprises:
   using a vision system to detect information selected from the group consisting of a more accurate position of the object, a more accurate orientation of the object, and both a more accurate position of the object and a more accurate orientation of the object.

31. The method of claim 30, wherein the method further comprises:
   forming a first queue with the measured dimension and a position of the object;
   forming a second queue with information selected from the group consisting of the more accurate position of the object, and both the more accurate position of the object and the more accurate orientation of the object;
   combining information from the first queue and the second queue to form a more accurate queue comprising the measured dimension of the object and information selected from the group consisting of the more accurate position of the object, the more accurate orientation of the object, and both the more accurate position of the object and the more accurate orientation of the object.

32. The method of claim 31, wherein the combining information step only occurs if the position in the first queue and the more accurate position in the second queue match to a specified degree.

33. The method of claim 32, wherein the specified degree is about 10 cm in a direction of conveyance of the object.
34. The method of claim 20, wherein the method further comprises:

   generating a queue comprising information regarding the measured dimension and a position of each object;

   generating a second queue comprising more accurate information selected from the group consisting of information regarding a more accurate position of each object, and both information regarding a more accurate position of each object and information regarding a more accurate orientation of each object;

   comparing the information regarding the position of each object in the first and second queues, and, if the position of an object in the first queue matches the more accurate position of an object in the second queue to a specified degree, combining the information regarding the measured dimension of the object in the first queue with the more accurate information in the second queue to form a more accurate queue comprising the information regarding the measured dimension of the object and information selected from the group consisting of the information regarding the more accurate position of the object, the information regarding the more accurate orientation of the object, and both the information regarding the more accurate position of the object and the information regarding the more accurate orientation of the object.

35. The method of claim 20, wherein the object is a pillow bag.

36. The method of claim 20, wherein the measured dimension is selected from the group consisting of a thickness, a height, a length, a width, and a diameter of the object.

37. The method of claim 20, further comprising using the measured dimension to pick the object from an input device.

38. The method of claim 20, wherein the object is placed on a universal surface.

39. The method of claim 38, wherein the universal surface is moving on a universal surface conveyor.
40. An apparatus for use in picking and placing a non-rigid object, said apparatus comprising:
   a first input device;
   a feed forward unit;
   a distance sensor; and
   at least one line of communication;
   wherein the first input device conveys a non-rigid object into contact with the feed forward unit, which contact conditions the object to form a conditioned object; wherein the distance sensor is positioned over a gap in the feed forward unit to measure a distance to a surface of the conditioned object; wherein the distance to the surface of the object measures a measured dimension of the conditioned object; and wherein the measured dimension is transmitted via the at least one line of communication.

41. The apparatus of claim 40 further comprising:
   a robot, wherein the robot is positioned to pick and place the object using the measured dimension, and wherein the measured dimension is transmitted to the robot via the at least one line of communication.

42. The apparatus of claim 41, wherein the robot is positioned a specified distance above an object-contacting surface of an input device to pick the object from the object-contacting surface, and wherein the specified distance is at least as large as the measured dimension.

43. The apparatus of claim 40, further comprising:
   a presence sensor; wherein the presence sensor detects a presence of the object.

44. The apparatus of claim 43, wherein the presence sensor detects a position of the object.

45. The apparatus of claim 40, further comprising:
   a vision system, wherein the vision system detects information selected from the group consisting of a more accurate position of the object, a more accurate orientation of the object, and both a more accurate position and orientation of the object.
46. The apparatus of claim 45, wherein the information, selected from the group consisting of the more accurate position of the object, the more accurate orientation of the object, and both the more accurate position of the object and the more accurate orientation of the object, is used to pick the object.

47. The apparatus of claim 46, wherein the group consisting of the more accurate position of the object, the more accurate orientation of the object, and both the more accurate position of the object and the more accurate orientation of the object is transmitted via the at least one line of communication.

48. The apparatus of claim 41, wherein the robot picks the object from the first input device and places the object on a universal surface, which universal surface is on a universal surface conveyor.

49. The apparatus of claim 40, wherein the first input device and the universal surface conveyors are moving, wherein the first input device and the universal surface conveyors are conveyor belts, and wherein the universal surface is a tray.

50. The apparatus of claim 41, wherein the robot comprises a vacuum nozzle to pick and place the object.

51. The apparatus of claim 40, wherein the object is a pillow bag.

52. The apparatus of claim 40, wherein the measured dimension is selected from the group consisting of a thickness, a height, a length, a width, and a diameter of the object.

53. The apparatus of claim 40, wherein the feed forward unit comprises a secondary input device.

54. The apparatus of claim 53, wherein the secondary input device comprises a driven overhead conveyor belt, wherein the secondary input device has a translational velocity that is substantially equal to a translational velocity of the first input device, and wherein an object in contact with both the first input device and the secondary input device will be
conveyed by both input devices at approximately the same speed so that the first and secondary input device result in substantially no net torque on the object.

55. The apparatus of claim 40, wherein a bulge forms on the surface of the object at the gap in the feed forward unit and the distance sensor directly measures the distance to the bulge.
56. An apparatus for maintaining a pattern of non-rigid objects in a desired position and orientation, said apparatus comprising:
   a first surface;
   a second surface;
   a third surface;
   a lowest corner; and
   a bottom,
   wherein the first surface, second surface, and third surface are mutually orthogonal and meet at a point to form the lowest corner,
   wherein the second and third surfaces are supported by, attached to and extend at least somewhat vertically from the apparatus,
   wherein the first surface is oriented at a compound angle to a plane running through the bottom and thereby provides the lowest corner.

57. The apparatus of claim 56, wherein the compound angle comprises two angles and each of the two angles is greater than 0° and less than about 90°.

58. The apparatus of claim 56, wherein the second and third surfaces are supported by, attached to and extend vertically from two edges of the first surface.

59. The apparatus of claim 56, wherein the first surface is supported by a post that is attached to both the first surface and the bottom.

60. The apparatus of claim 56, wherein the first surface is coated with a frictional coating.

61. The apparatus of claim 60, wherein the frictional coating provides a static coefficient of friction between the first surface and the objects that prevents the objects from sliding against the first surface under a force experienced during transportation of the objects.

62. The apparatus of claim 60, wherein the frictional coating provides a static coefficient of friction that is high enough to keep the objects from sliding when the first surface is at a compound angle of at least about 15° from horizontal.
63. The apparatus of claim 56, wherein the universal surface is decoupled from a universal surface conveyor.
64. A method for loading non-rigid objects on a compound-angled universal surface to form a pattern, said method comprising the steps of:
   picking non-rigid objects; and
   placing the objects in a first pattern on a compound-angled universal surface so that the objects are supported by three mutually orthogonal surfaces of the universal surface.

65. The method of claim 64, wherein at least one of the objects is supported, at least partially, by at least one supporting object, wherein the at least one supporting object is directly supported by at least two of the three mutually orthogonal surfaces.

66. The method of claim 64, wherein the step of picking objects is accomplished using a robot.

67. The method of claim 64, wherein the method further comprises:
   transporting the first pattern on the universal surface; and afterwards, transporting a second pattern that, compared to the first pattern, takes up a differently sized area on the universal surface;
   wherein the configuration of the three mutually orthogonal surfaces are not adjusted while transporting the first pattern, are not adjusted between transporting the first pattern and the second pattern, and are not adjusted while transporting the second pattern, wherein transporting the first pattern and the second pattern occurs without causing the objects to be substantially displaced relative to the universal surface and without causing the objects to undergo a substantial change in orientation relative to the universal surface.

68. The method of claim 67, wherein the step of transporting the first pattern and the second pattern includes transporting the first pattern and the second pattern to a transfer station.

69. The method of claim 68, further comprising the step of:
   transferring a pattern from the universal surface to a device that places the pattern in an ultimate package.

70. The method of claim 68, further comprising the step of:
   transferring a pattern from the universal surface to an ultimate package.
71. A method for loading a pattern of non-rigid objects on a universal surface that is
decoupled from a universal surface conveyor, said method comprising the steps:
supplying the universal surface on a first universal surface conveyor of a pattern
creation line, wherein the universal surface is decoupled from the first universal surface
conveyor;
conveying the universal surface to a first decision point where the universal surface
can be directed to at least a second universal surface conveyor;
conveying the universal surface to at least one pattern creation cell to form a finished
pattern; and
conveying the universal surface with the finished pattern to at least one pattern
transfer station for transferring the finished pattern to an ultimate package;
wherein the pattern creation line comprises the first decision point, the at least one
pattern creation cell, the at least one pattern transfer station, the first universal surface
conveyor, and the at least a second universal surface conveyor.

72. The method of claim 71, wherein at least one universal surface conveyor comprises at
least one turn to direct the universal surface at a decision point where the universal surface
can be conveyed from the at least one universal surface conveyor to another universal surface
conveyor.

73. The method of claim 72, wherein the at least one universal surface conveyor
comprises a roller conveyor.

74. The method of claim 72, wherein the at least one universal surface conveyor
comprises a conveyor belt.

75. The method of claim 72, wherein the at least one universal surface conveyor
comprises a magnet.

76. The method of claim 72, wherein the universal surface comprises a magnet.

77. The method of claim 72, wherein at least one magnetic field is used to direct the
universal surface.
78. The method of claim 72, wherein the turn is rotatable.
79. A method for using multiple lanes to load a pattern of non-rigid objects on a universal surface that is decoupled from a universal surface conveyor, said method comprising the steps:

- loading a pattern of objects onto the universal surface;
- conveying a universal surface on a work-in-progress lane comprising a first universal surface conveyor, wherein the universal surface is decoupled from the first universal surface conveyor;
- conveying the universal surface to an express lane comprising a second universal surface conveyor after the universal surface has been loaded with a finished pattern, wherein the universal surface is decoupled from the second universal surface conveyor, and wherein, as compared to the work-in-progress lane, the express lane provides a more direct route to a destination of the universal surface.

80. The method of claim 79, wherein the method further comprises the step of conveying the universal surface on a reuse lane comprising a third universal surface conveyor, wherein the universal surface is decoupled from the third universal surface conveyor, and wherein the reuse lane conveys the universal surface towards a turn where the universal surface can be directed to a lane selected from the group consisting of a work-in-progress lane, an express lane, and a pattern creation cell lane.

81. The method of claim 79, wherein the method further comprises the step of conveying the universal surface to a decision point, wherein at said decision point the universal surface can be directed to a fourth universal surface conveyor on a first pattern creation cell lane toward a first pattern creation cell and wherein at said decision point the universal surface can continue past the first pattern creation cell to a second pattern creation cell.

82. The method of claim 79, wherein the method further comprises the steps of conveying the universal surface to a pattern creation cell for loading the universal surface with a pattern.

83. The method of claim 79, wherein the method further comprises conveying the universal surface along a work-in-progress lane if the universal surface is carrying an unfinished pattern.
84. The method of claim 79, wherein the method further comprises, after conveying the universal surface to the express lane, conveying the universal surface to at least one pattern transfer station for transferring the finished pattern to an ultimate package.

85. The method of claim 79, wherein the express lane is generally parallel to the work-in-progress lane so that if the universal surface is carrying a finished pattern after leaving a pattern creation cell, the universal surface can be directed from the work-in-progress lane to the express lane before the universal surface passes a pattern creation cell that is subsequent to the finishing pattern creation cell.

86. The method of claim 79, wherein the express lane provides a more direct route to a pattern transfer station.

87. The method of claim 79, wherein the express lane comprises less turns than the work-in-progress lane.

88. The method of claim 79, wherein a plurality of turns connects the work-in-progress lane to the express lane.

89. The method of claim 79, wherein the express lane conveys more quickly than the work-in-progress lane.

90. The method of claim 79, wherein the express lane conveys at the same speed as the work-in-progress lane.

91. The method of claim 79, wherein the method further comprises the steps of identifying and directing a universal surface conveyor at a decision point.
92. An apparatus for transferring a pattern from a universal surface to an ultimate package, said apparatus comprising:
   an end effector for a pattern transfer robot;
   wherein the universal surface comprises a finger wall, said finger wall comprising finger wall slats spaced apart a distance to form openings between the finger wall slats,
   wherein the end effector comprises a crowder plate, said crowder plate comprising crowder plate slats spaced apart a distance to form openings between the crowder plate slats, and
   wherein a portion of the crowder plate slats are sized to pass between a portion of mating finger wall slats.

93. The apparatus of claim 92, wherein the end effector further comprises:
   an articulated arm that is connected to an adapter plate.

94. The apparatus of claim 92, wherein the end effector further comprises:
   a vacuum tube connected to a plenum, said plenum comprising a bottom surface with holes, said holes providing fluid communication between an interior of the plenum and an exterior of the plenum.

95. The apparatus of claim 92, wherein the end effector further comprises:
   at least two crowder plates.

96. The apparatus of claim 92, wherein the end effector further comprises:
   four crowder plates, wherein each crowder plate is connected to the plenum with hinges.

97. The apparatus of claim 92, wherein the end effector further comprises:
   at least one actuator, wherein each actuator is connected to a crowder plate.

98. The apparatus of claim 97, wherein actuating the actuator that is connected to a crowder plate causes the crowder plate to rotate about a hinge that connects the crowder plate to a plenum.

99. The apparatus of claim 92, wherein the end effector further comprises:
four actuators, wherein each actuator is connected to a crowder plate, and wherein actuating the actuator that is connected to a crowder plate causes the crowder plate to rotate about a hinge that connects the crowder plate to a plenum.
100. A method for transferring a pattern of non-rigid objects from a universal surface to an ultimate package, said method comprising the steps:

- providing a pattern on a universal surface;
- conveying the pattern to a transfer station;
- picking the pattern with an end effector at the transfer station; and
- placing the pattern into an ultimate package, said ultimate package comprising at least one layer of non-rigid objects to form at least one universal element.

101. The method of claim 100, wherein placing the pattern into an ultimate package occurs at the transfer station.

102. The method of claim 100, wherein the pattern is placed into an in-feed of a device for placing the pattern in said ultimate package.

103. The method of claim 100, wherein the placing step comprises flipping the universal surface over to transfer the objects from the universal surface to the ultimate package.

104. The method of claim 100, wherein the picking step comprises using vacuum created by an end effector.

105. The method of claim 100,

wherein the universal surface comprises a finger wall that comprises finger wall slats spaced apart a distance to form openings between the finger wall slats,

wherein the end effector comprises a crowder plate that comprises crowder plate slats spaced apart a distance to form openings between the crowder plate slats,

wherein a portion of the crowder plate slats are sized to pass between a portion of mating finger wall slats, and

wherein the picking step further comprises passage of the portion of the crowder plate slats through the portion of the finger wall slats when the end effector picks the objects for placement in the ultimate package.

106. The method of claim 100, wherein the pattern is placed into an in-feed of a device that will place the pattern into an ultimate package.
107. The method of claim 100, wherein the device that will place the pattern into an ultimate package is a sacking machine and the ultimate package is a sack.

108. The method of claim 100, wherein the device that will place the pattern into an ultimate package is a case packing machine and the ultimate package is selected from the group consisting of a case, a carton, and a box.

109. The method of claim 100, wherein the method further comprises the step of:
constraining the pattern with at least one crowder plate to facilitate transfer of the pattern.

110. The method of claim 100, wherein the method further comprises the step of:
laterally constraining the pattern with at least one crowder plate to facilitate transfer of the pattern into an ultimate package.

111. The method of claim 100, wherein the picking step comprises the steps of:
actuating crowder plates to cause the crowder plates to separate as the end effector approaches a pattern; and
actuating the crowder walls to cause the crowder plates to constrain the pattern,
applying a force to the pattern to hold the pattern against the end effector.

112. The method of claim 100, wherein the placing step comprises the step of:
reducing the force applied to the pattern so that the pattern is free to fall from the end effector under gravitational force.

113. The method of claim 112, wherein the method further comprises the step of:
actuating crowder plates to cause the crowder plates to separate after the end effector is in position to place the pattern.