

Task 4

Use Cases:

I. Operator Controls: machine movement

- Use Case: control interface that allows the user to change the forward/backward movement of the machine and the yaw of the machine.

II. Operator Controls: linkage movement

- Use Case: control interface that allows the user to change the pitch, yaw, roll, and/or lateral position of the linkages within the limits of each linkage.

III. Hydraulic Cylinders

- Use Case: moves laterally forward/backward in accordance controller input; connects to linkages to afford movement.

IV. Boom

- Use Case: lifts objects off the ground so that the vehicle can move them.

V. Arm

- Use Case: extension for linkages. Connects to a boom and a linkage and can pitch from the boom and pitch the linkage.

VI. Bucket

- Use Case: Scoops material and dumps material and holds it with an inner volume. Attaches to an arm.

VII. Scoop

- Use Case: Scoops material with an inner volume and a blade or teeth. Attaches to two boom arms.

VIII. Blade

- Use Case: used to smooth and contour land.

Questions:

I. Operator Controls: machine movement

1. How should the controls be designed for most efficient use (e.g. levers, wheels, stick etc.)?
2. How sensitive should the controls be?
3. What should be done if the user has linkages and the front and back of the vehicle?

II. Operator Controls: linkage movement

1. How should the controls be designed for most efficient use (e.g. levers, wheels, stick etc.)?
2. How long will the operator be operating the vehicle?
3. What should be done if the user has linkages and the front and back of the vehicle?

III. Hydraulic Cylinders

1. When should the machine move rather than hydraulics?
2. Where are the hydraulics located?
3. What will the hydraulic cylinders do if the operator tries to extend them beyond their limit?

IV. Boom

1. How is the boom configured?
2. What is the lifting strength of the booms?
3. What sort of linkages are compatible with the booms?

V. Arm

1. What sort of operations should the operator be able to perform with the arm?
2. How much weight should the arm be able to lift?
3. When should the arm be serviced?

VI. Bucket

1. How much volume should the bucket hold?
2. What should the breakout force of the bucket be?
3. How will the bucket break through hard material?

VII. Scoop

1. How much volume should the Scoop hold?
2. What should the breakout force of the scoop be?
3. How will the scoop break through hard material?

VIII. Blade

1. How does the blade contour land?
2. What sort of ground should the blade be used on?
3. How will material be kept from piling up too much in front of the blade?

Requirements:

I. Operator Controls: machine movement

- a. The controls should emulate common vehicles where possible. (1)
- b. The controls should not hinder the operation of the vehicle. (1)
- c. The controls should not be so sensitive that the driver will require great precision and timing. (2)
- d. The movement controls should assume forward orientation. (3)

II. Operator Controls: linkage movement

- a. The controls should correspond to the movement axes of the linkage. (1)
- b. The controls should be easy to access and differentiate from movement controls. (1)
- c. The controls should be designed to be comfortable over long hours of operation. (2)
- d. The linkage controls should be available to the operator regardless of facing. (3)

III. Hydraulic Cylinders

- a. Hydraulics should, in most cases, not be used when the machine movement provides the orientation. (1)
- b. When precision is needed, hydraulics may provide a degree of movement already afforded by the machine movement. (1)
- c. Hydraulics should be installed between any linkages that require a degree of movement not afforded by the orientation of the machine and other linkages. (2)
- d. Hydraulic Cylinders should not be able to go beyond or below their min/max lengths. (3)

IV. Boom

- a. The boom must be stable along the length of the linkage. (1)
- b. The booms should be able to hold the weight of its linkage and most loads that can with within the volume of the linkage. (2)
- c. The booms should be able to connect to the most common linkages. (3)
- d. Options should exist for other sorts of linkages. (3)

V. Arm

- a. The operator should be able to use the arm to reach loads up to 18^{ft} away. (1)
- b. The arm should be able to lift the weight of its linkage and most loads that fit the volume of the linkage. (2)
- c. The arm should be serviced periodically to reduce wear. (3)
- d. The arm should be checked regularly for structural fractures. (3)

VI. Bucket

- a. The bucket should have enough volume to not exceed the lifting strength of the arm and boom when full. (1)
- b. The breakout force should exceed the lifter force of the boom and arm. (2)
- c. The bucket should have some means to pierce through hard rock and concrete. (3)
- d. The bucket should have enough force to break through hard material. (3)

VII. Scoop

- a. The scoop should have enough volume to not exceed the lifting strength of the boom arms when full. (1)
- b. The breakout force should exceed the lifter force of the boom arms. (2)
- c. The scoop should have some means to pierce through hard rock and concrete. (3)
- d. The scoop should have enough force to break through hard material. (3)

VIII. Blade

- a. The blade should have additional degrees of movement to afford more control. (1)

- b. The blade should be able to cut through dense plant material as well as soft earth. (1)
- c. The ground should have only light debris and small rocks. (2)
- d. The blade should have a means to move excess material aside. (3)

Specifications:

I. Operator Controls: machine movement

- A. A steering wheel will control yaw and pedals and shift stick will control lateral movement. [a]
- B. The control locations will afford ample room for the operator to access linkage controls and movement controls easily. [b]
- C. The controls will have a slight delay so that the driver can react quickly if the position or movement must be changed. [c]
- D. The controls should be large to afford a greater degree of control to the user. [c]
- E. The movement controls will be located on the floor and on the dash of the forward end of the cab. [d]

II. Operator Controls: linkage movement

- A. The linkage control will be a lever, since these generally have a definitive neutral position and axes to govern direction. [a]
- B. See 1.A.a. Furthermore, the lever will be long enough that the operator can reach them easily. [b]
- C. The controls will not require straining posture from the operator. [c]
- D. The controls will be designed to support ergonomical posture for the operator. [c]
- E. The linkage controls for the linkage the operator is facing will reside on the appropriate side of the vehicle. [d]

III. Hydraulic Cylinders

- A. Hydraulics will only be attached to linkages if another degree of movement is needed and the machine movement cannot accomplish the orientation. [a]
- B. Hydraulics will be attached to the arm boom and the blade to provide yaw movement. [b]
- C. Hydraulics will give pitch movement to the boom, arm, bucket, shovel, and blade, and may be installed elsewhere as necessary. [c]
- D. The cylinders will clamp at their limit. [d]
- E. If the control continues to command the cylinder to go above or below its limit for more than 5 seconds, an alarm will sound as long as the control is held. [d]

IV. Boom

- A. The boom will connect to the linkage with two boom arms on either side when attached to a scoop or blade. [a]
- B. The boom will connect to the linkage with one boom arm when attached to an arm or a bucket. [a]
- C. The booms will be able to lift at least 3.5 tons. Single booms will have to be larger to afford more lifting power. [b]
- D. The booms will be minimally compatible with arms, scoops, buckets, and blades. [c]

- E. Booms will be compatible with adapters to allow more uncommon linkages. [d]

V. Arm

- A. The arm will level with the boom to extend its, and the booms, full length. [a]
- B. The arm will be able to lift at least 2 tons. [b]
- C. The arm should be lubricated every 12 months. [c]
- D. Hoses should be changed every 3 years. [c]
- E. The arm should be examined before each use. [d]

VI. Bucket

- A. The bucket should hold 6 cu. ft. of material. [a]
- B. The bucket should hold 7cu. ft. of heaped material. [a]
- C. The breakout force will be at least 4 tons. [b]
- D. The bucket will have teeth to break hard materials. [c]
- E. VI.2.b.C [d]

VII. Scoop

- A. The scoop should hold 10 cu. ft. of material. [a]
- B. The scoop should hold 12cu. ft. of heaped material. [a]
- C. The breakout force will be at least 4.5 tons. [b]
- D. The scoop will have teeth to break hard materials. [c]
- E. VII.2.b.C [d]

VIII. Blade

- A. The blade will have hydraulic mechanisms that allow for pitch, roll and yaw. [a]
- B. The blade will have a sharp edge. [b]
- C. The blade cannot scoop large rocks. [c]
- D. The blade cannot move densely packed clays or large debris piles (like large building debris). [c]
- E. The blade will have a concave bevel so the material rolls over itself and is pushed sideways. [d]