Background

- In a human–machine system, the control panel is the major bridge between the operator and machine. When operating a heavy machinery, the operator needs to produce a specific system response to perform a machine motion.
- When the control/display relationship is not compatible, the selection errors would occur.
- Research found that a single bank of controls with all the controls moving in only one direction would be a very poor design, which does not follow the directional compatibility.
- Accidents and injuries have been reported due to the selection errors of the control when operating heavy machinery.

Literature Review

Directional compatibility

The control and machine components directions of movement are the same.

There are 3 principles to determine whether a control/motion relationship has a good directional compatibility:

1. Control-Display (CD) compatibility
   When the control motion was in the same direction and parallel to the controlled target.

2. Visual Field (VF) compatibility
   When the controlled element (lever or rotary knob) and the motion of the relevant limb segment were in the same direction in the visual field.

3. Muscle Synergy (MS) compatibility
   Make use of the muscle synergy (muscle movement) associated with the required direction as seen in the visual field.

Methodology for designing the control layouts

5 rules are applied when designing the control layouts:
1. Single bank of controls / original designs
2. Designs with partial directional compatibility
3. Designs with higher directional compatibility
4. Designs with rotary knob
5. Possible alternative set

Aims

1. Review of population stereotypes principles that are related to the control/display relationship.
2. Examine whether people can nominate the purpose of the controls with different directional compatibility levels.
3. Investigate how people rank between the single bank of control designs and new designs with directional compatibility.

Experiment

Objective:
- Investigate the control/display relationships in 4 machineries
- Investigate how the directional compatible designs are ranked

Participants:
38 in total - 21 male & 17 female; All are right-handed
Randomly assigned to different testing order of four machineries, as well as the control layouts.

Apparatus:
- Toy models of the machinery
- Photographs describe the motions
- Control layout diagrams in A4 sheets
- Data record sheet