Link Diagrams

An ounce of pretension is worth a pound of manure.

Dennis Schmitz

Link diagrams, a powerful ergonomics tool, are described in most ergonomics texts e.g. [Kantowitz and Sorkin 1983] or [van Cott and Kinkade (editors) 1972]. On a diagram of a proposed layout, a link or connection is drawn between different elements. The link is labeled or its width changed to show its importance or its frequency of use. The result is a graphic representation of the relationship between the elements and their operation.

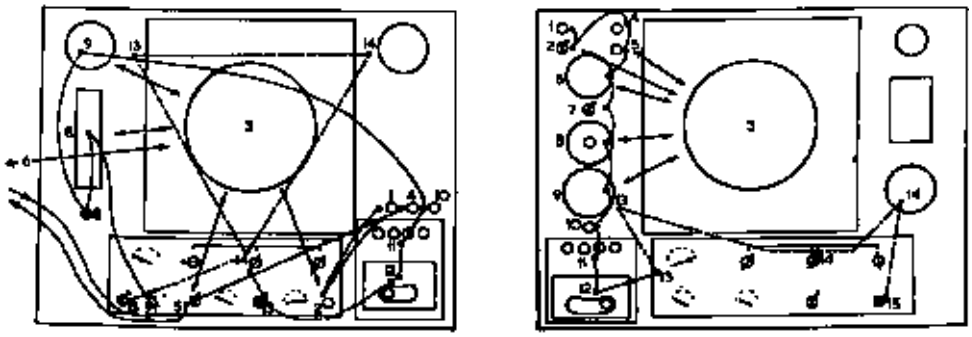

Figure 200: Links on a radar display
Operation sequence links for original and improved layout from Applied Ergonomics Handbook (1974), page 41. The improved layout has an orderly progression through the setup controls.

Link diagrams are used to produce acceptable layouts of function keypads, display screens, workplaces, offices, etc. By analyzing the frequency of links between different components, it is possible to graphically demonstrate the benefits of a revised layout. The link's significance depends on the layout being examined.

Layout of Interest	Links to Draw
keypad	hand movements
display	eye movements
	mouse movements
office	document movement
	person—person communication
assembly line	materiel movement
	tool movement
	people movement

Making these measurements may be difficult, often requiring special equipment. For example, eye movement recording requires a special camera. In many cases, however, the frequency can be calculated from other data. Thus you can calculate the hand movements on a keypad by gathering information on the keystrokes entered.

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The following diagram (adapted from Kantowitz and Sorkin (1983)) shows the percentage of eye movements between pairs of instruments on an aircraft control panel during landing. The data were recorded using an eye marker camera during actual landings. The links show us that the arrangement is not optimal. The most common eye movement is between the "Cross Pointer" and the "Directional Gyro", accounting for 29 percent, yet these instruments are not adjacent. Notice also that the longest movement accounts for ten percent while a shorter one accounts for only four percent. It would improve performance if we could put the most commonly used instrument beside each other and shorten the length for the most frequently performed movements.

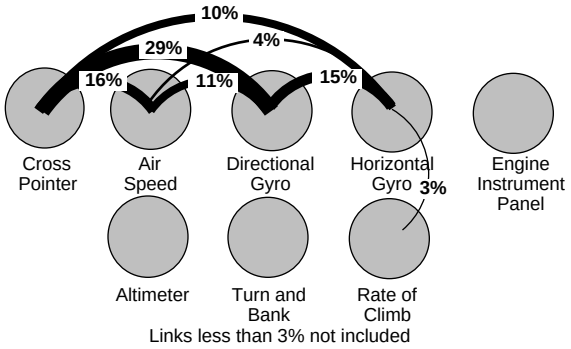

Figure 201: Aircraft instrument links
Frequency of eye movements are shown on this link diagram of an aircraft instrument layout. Notice the highest frequency, 29%, jumps across a less used instrument.

The frequency of use of each instrument should be relatively independent of the layout so that we can rearrange the display and draw in the new link using the original numbers to test the new arrangement without having to retest the display. The link diagram below shows the estimated improvement of interchanging the "Air Speed" and the "Cross Pointer"

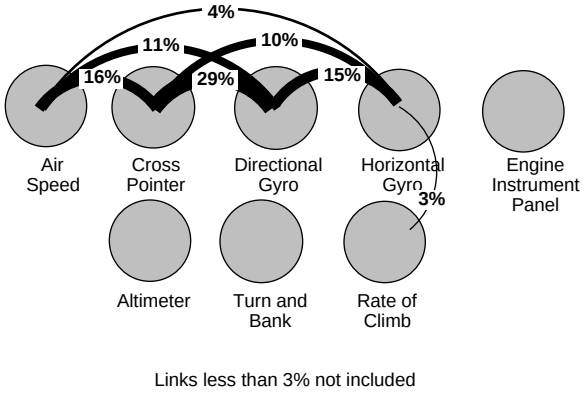

Figure 202: Improved Aircraft instrument links.
Interchanging the Air Speed and Cross Pointer puts the highest frequency movement on adjacent instruments.

This layout is much better from an eye movement standpoint. The most frequent movement (29 percent) is on adjacent instruments, as short as it can be. The longest movement is now only four percent of the total. Eye movements should be easier and faster on the redesigned display than on the original.

Link diagrams can also be used to reduce the distance that people or information must move. This can improve the arrangement of a shopfloor, office, etc. Figure Figure 203: shows the application of this technique to the busiest room in the house. Links are drawn with their width showing the frequency of movements during the preparation and cleanup for a typical meal.

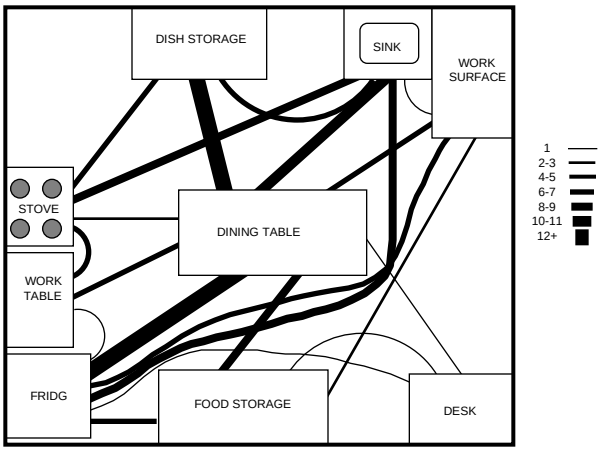

Figure 203: Meal preparation links in a kitchen
In this example links are drawn to show movement in a kitchen while preparing a meal and cleaning up.

The design objective is to reduce the length of the high frequency links. And as the kitchen is often used by more than one person, crossovers should be reduced. The following layout is better than the original as the link lengths are reduced — it could be better.

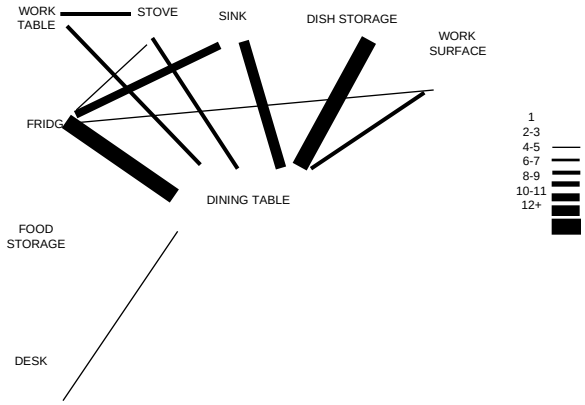

Figure 204: Improved kitchen arrangement.
With this arrangement the distance moved during meal preparation will be reduced.

When using link diagrams:

- try and use the line width to help show link importance.
- minimize the length of important links.
- eliminate crossovers.

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