(a)

(b)

(c)

6.9 • Routegrams for three representative types of network. The 'mixed' case has three times as many types of route as the grid. (a) Tributary. (b) Mixed. (c) Grid.

connectivity, but it appears to have a degree of irregularity or complexity that sets it apart from either of the other two. It is the task of this section to demonstrate quantitative measures of this kind of heterogeneity.

The distributions of route types for these three layouts are first plotted on routegrams, to give an impression of their distribution of differentiation (Figure 6.9). Figure 6.9 shows the difference between the networks in terms of diversity of route type. The 'mixed' layout (b) has twelve distinct route types, whereas the grid (c) only has four (where a distinct route type is taken as a unique combination of continuity, connectivity and depth). In this case, all three networks have the same total number of routes (16). In order to compare networks of different sizes, we can divide the number of distinct route types by the total number of routes, to obtain a property that we can call *irregularity*. The irregularity of the tributary layout (a) is 7/16 = 0.44; that of the 'mixed' case (b) is 0.75, and that of the grid (c) is 0.25.

We can also define *regularity* as the complement of irregularity, such that irregularity and regularity sum to one. In the above examples, then, the tributary layout (a) has a regularity of (1 – 0.44) = 0.36. The grid layout (c) is the most regular with a regularity value of 0.75, while layout (b) has the lowest value of regularity, 0.25.

Recursivity and complexity

We can also identify two further properties that help to distinguish different kinds of heterogeneity, by considering the three structures shown in Figure 6.10. Layout (a) shows a 'comb' structure, which is clearly regular, in having a series of identical cantilevers off a collector stem. Layout (c) shows an irregular structure, which is indeed singularly irregular, in that all 11 routes are of a distinct type. But what of layout (b)? Layout (b) is 'irregular' in the sense of having all routes of a distinct type (since each route

(a)   **(b)**   **(c)**
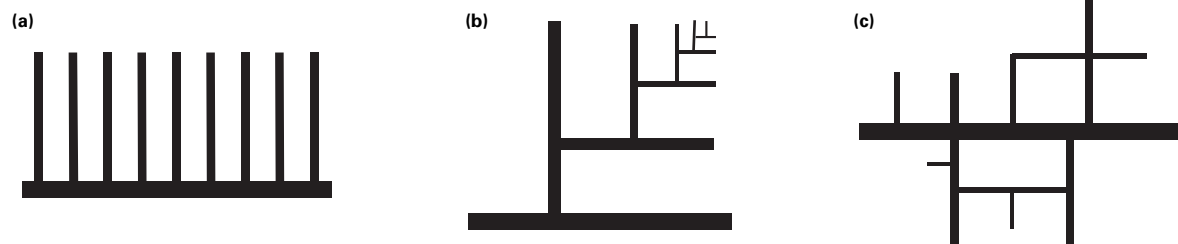
6.10 • Networks embodying three differentiation properties. (a) Regular. (b) Recursive. (c) Complex.