a predecessor of critical activity **h**, and along this path task **d** must be completed by Day 11 or **h** will be late to start. Task **d**, therefore, has only *two* days of slack, not three.

Slack for other tasks are determined in the same way. Task **f** precedes **i**, and the latter has an LS of Day 15. Given an LF of 15, **f** must start no later than Day 11. Its ES of Day 8 means that **f** has three days of slack. Task **c** is a predecessor of **f**, and because the latter's LS is Day 11, **c** must be completed by then. With an LF of 11 and an EF of 8, **c** has three days of slack. The only remaining task to be considered is **b**. This task is linked to **f** and, like **c**, must be complete by **f**'s LS, Day 11. With an EF of Day 4, **b** has seven days of slack.

Throughout this discussion of calculating slack we have made two assumptions that are standard in these analyses. First, when calculating slack for a set of activities on a noncritical path, the calculation for any given activity assumes that no other activity on the path will use any of the slack. Once a project is underway, if a predecessor activity uses some of its slack, its EF is adjusted accordingly and the ESs of successor activities must also be corrected. We have also assumed that the critical time for the project is also the project's due date, but it is not uncommon for a project to have "project slack" (or "network slack"). Our 21-day project might be started 23 days before its promised delivery date, in which case activities on the "critical path" would have two days of slack and noncritical activities would have an additional two days of slack.

Milestones may be added to the display quite easily: Add the desired milestone event as a node with zero duration. Its ES will equal its EF, and its LS and LF will be equal. Milestones should, of course, be immediate successors of the activities that result in the milestone events. Finally, if a starting date has been selected for the project, it is common to show ES, EF, LS, and LF as actual dates.

Before continuing, a pause is in order to consider the managerial implications of the critical path and slack. The PM's primary attention must be paid to activities on the critical path. If anything delays one of these activities, the project will be late. At the start of the project, the PM correctly notes that activity **a** is on the critical path and **b** is not. This raises an interesting question. Can any resources reserved for use on **b** be borrowed for a few days to work on **a** and thereby shorten its duration? The nature of **b**'s resources and **a**'s technology will dictate whether or not this is possible. If **a**, for example, could be shortened a day by using **b**'s resources for four days, the critical path would be shortened by a day. This would cause no problem for **b**, which had seven days of slack. If the delivery date for the project remains the same, the entire project would then have a day of slack. The presence of project slack tends to lower the PM's pulse rate and blood pressure.

Doing It the Easy Way—Microsoft Project (MSP)

As promised, once the reader understands how to build a network by hand, we can introduce tools provided through project management software. The first task is transferring information from the project plan into the software, MSP in this case. This is not difficult. MSP presents a tab entry table much like the project plan template shown in Table 5-3. It has spaces where the tasks can be identified, plus spaces for activity durations and predecessors. The software automatically numbers each activity that is entered. MSP offers a great number of options for viewing the data once it is entered into the project plan or entry view. If a specific start date or finish date is already determined for an activity, MSP allows you to enter it as well.

Once the project plan data are entered, MSP will automatically draw an AON PERT/CPM network as shown in Figure 5-11. Note that the figure lacks start and finish nodes—because they were not entered on the activity list. Note also that the tasks in the network appear with ID numbers in order, flowing from left to right and from the