ties that addresses specific application domains (e.g., applications that are implemented using a specific database system). More important, these reengineering tools are becoming increasingly more sophisticated.

Forward engineering, also called *renovation* or *reclamation* [CHI90], not only recovers design information from existing software, but uses this information to alter or reconstitute the existing system in an effort to improve its overall quality. In most cases, reengineered software reimplements the function of the existing system and also adds new functions and/or improves overall performance.

30.3 REVERSE ENGINEERING

Reverse engineering conjures an image of the "magic slot." We feed an unstructured, undocumented source listing into the slot and out the other end comes full documentation for the computer program. Unfortunately, the magic slot doesn't exist. Reverse engineering can extract design information from source code, but the abstraction level, the completeness of the documentation, the degree to which tools and a human analyst work together, and the directionality of the process are highly variable [CAS88].

The *abstraction level* of a reverse engineering process and the tools used to effect it refers to the sophistication of the design information that can be extracted from source code. Ideally, the abstraction level should be as high as possible. That is, the reverse engineering process should be capable of deriving procedural design representations (a low-level abstraction), program and data structure information (a somewhat higher level of abstraction), data and control flow models (a relatively high level of abstraction), and entity relationship models (a high level of abstraction). As the abstraction level increases, the software engineer is provided with information that will allow easier understanding of the program.

XRef

The notation discussed here is explained in detail in Chapter 12.

KEY POINT

Three reverse engineering issues must be addressed: abstraction level, completeness, and directionality.

The *completeness* of a reverse engineering process refers to the level of detail that is provided at an abstraction level. In most cases, the completeness decreases as the abstraction level increases. For example, given a source code listing, it is relatively easy to develop a complete procedural design representation. Simple data flow representations may also be derived, but it is far more difficult to develop a complete set of data flow diagrams or entity-relationship models.

Completeness improves in direct proportion to the amount of analysis performed by the person doing reverse engineering. *Interactivity* refers to the degree to which the human is "integrated" with automated tools to create an effective reverse engineering process. In most cases, as the abstraction level increases, interactivity must increase or completeness will suffer.

If the *directionality* of the reverse engineering process is one way, all information extracted from the source code is provided to the software engineer who can then use it during any maintenance activity. If directionality is two way, the information is