Chapter VII

A Framework for Understanding Information Technology Resources

Information systems developers make use of information technology resources. IT resources might include, for example, tools like editors, compilers, linkers, and debuggers (usually now integrated into development environment software), the languages in which knowledge may be represented (programming or knowledge representation (KR) languages), protocols for inter-program communication (which includes file protocols for various purposes), and building blocks such as ready-made algorithms and libraries of software. Whereas ISD is concerned with specific types of application, IT resources and tools aspire to be valid regardless of type of application.

The communities that have researched and practised in this area include computer science, software engineering, systems engineering, software architecture, programming language design, KR language (KRL) design, and also the data modelling, object-orientation, logic programming, knowledge based systems, and some artificial intelligence communities. There is, of course, considerable interaction and collaboration with IS developers since the latter influence the shape of resources delivered to them. (Often the same person works in both areas.)
Such resources must, of course, be designed and developed, and the methodological issues discussed in Chapter VI are relevant to this. But this chapter is not concerned with methodology for developing them. It is concerned with their quality and appropriateness when employed by IS developers. The central philosophical question addressed in this chapter is: on what basis can or should we understand the need for, and quality of, such resources? The central practical question is: what ranges of resources should we aim for? The very nature of IT resources will be reinterpreted in the light of the everyday experience that is preparing them for IS developers (as recommended by Dooyeweerd in §2.4.2). But what is “everyday” experience in this area? To assess that, it is necessary to review some of the things that have influenced the design of IT resources.

### 7.1 Influences on Design of IT Resources

At least four influences on the design of such resources can be traced, especially of programming and KR languages, the first three of which make it a specialist task.

1. **The way machines work:** Computers work by obeying instructions held in memory in sequence (some now employ several parallel sequences), sometimes jumping to a sequence beginning elsewhere in memory. Most of the instructions store bit patterns in memory cells or retrieve from them for processing. The way computers work is reflected in assembler languages, which provide convenient languages and tokens to express the sequences of instructions. It is also reflected in some of what were called high-level languages in the 1960s. For example in FORTRAN IV programs, though at a higher level of granularity, were still composed of a sequence of individual instructions, with many “GOTO” statements with numeric labels to alter the sequence. Program variables were seen as symbol level versions of memory cells. BASIC and COBOL also reflect this sequential working.

2. **Convenience to programmers:** But that was not very convenient to programmers. The GOTO construct, for example, was notoriously blamed for making programs difficult to understand, debug and modify, and was replaced by other control structures like REPEAT and DO. The long sequence of instructions was replaced by short syntactic units called blocks, which could be nested. Memory cells were replaced by program variables bound together in structures, and the content of these variables was expected to be processed as pieces of data rather than bit patterns, which led to the need to define their data type (integer, character, etc.). Complex mathematical formulae could be written declaratively (this latter was found in FORTRAN: its name is shortened from
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