DATA REDUNDANCY. Independent data files included a lot of duplicated data; the same data (such as a customer's name and address) were recorded and stored in several files. This data redundancy caused problems when data had to be updated. Separate filemaintenance programs had to be developed and coordinated to ensure that each file was properly updated. Of course, this coordination proved difficult in practice, so a lot of inconsistency occurred among data stored in separate files. LACK OF DATA INTEGRATION . Having data in independent files made it difficult to pro-vide end users with information for ad hoc requests that required accessing data stored in several different files. Special computer programs had to be written to retrieve data from each independent file. This retrieval was so difficult, time-consuming, and costly for some organizations that it was impossible to provide end users or management with such information. End users had to extract the required information manually from the various reports produced by each separate application and then prepare cus-tomized reports for management. DATA DEPENDENCE . In file processing systems, major components of a system—the organization of files, their physical locations on storage hardware, and the application software used to access those files—depended on one another in significant ways. For example, application programs typically contained references to the specific format of the data stored in the files they used. Thus, changes in the format and structure of data and records in a file required that changes be made to all of the programs that used that file. This program maintenance effort was a major burden of file processing sys-tems. It proved difficult to do properly, and it resulted in a lot of inconsistency in the data files. LACK OF DATA INTEGRITY OR STANDARDIZATION. In file processing systems, it was easy for data elements such as stock numbers and customer addresses to be defined differently by different end users and applications. This divergence caused serious inconsistency problems in the development of programs to access such data. In ad- dition, the integrity (i.e., the accuracy and completeness) of the data was suspect be-cause there was no control over their use and maintenance by authorized end users.Thus, a lack of standards caused major problems in application program develop- ment and maintenance, as well as in the security and integrity of the data files needed by the organization.

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