- Metadata elements tightly coupled with one product or within a suite of products from the same vendor (such as IBM, Microsoft, or Oracle). Limited support is offered by way of common interfaces for metadata exchange, hindering metadata integration across tools. The leading vendors of data warehousing products are trying to address the need for more robust metadata exchange capabilities.

Design and Implementation Challenges

The broad and complex functionality of metadata, coupled with insufficient support for metadata management from software products pose several challenges for implementing metadata solutions. A successful implementation must also address other technical and managerial factors, including:

Interchangeable metadata formats. Metadata can be captured and represented in a variety of formats. For example, textual flat files are easy to implement and read but are less secure and do not readily support the capture of the relationships among metadata components. Relational models are easier to centralize and integrate, relatively secure, and equipped with a standard access method (SQL) and with well-defined data-administration utilities. However, relational implementation can be complex and expensive (in terms of RDBMS purchase costs and administration overhead). Graphical structures (such as entity relationship models) are more interpretable but require user training; they are also not easy to integrate with metadata in other formats. Documents allow business users to easily understand metadata and capture complex detail. On the flip side, integrating documents with other formats is difficult; documents also require significant administrative overhead. Proprietary data structures are customizable for specific organizational needs, but integrating them with standard formats is difficult.

Metadata implementation is likely to involve more than one format. Certain data entities may require abstraction in multiple formats, hence efficient interchangeability among formats is highly desirable. A common approach for achieving compatibility and interchangeability is to choose one format (typically the relational model) as the baseline for the others. Figure 2 outlines the concept of format interchangeability. For example, the Sale Transactions data in the figure is abstracted into three metadata formats—tabular, textual, and visual—each targeting a different user group.

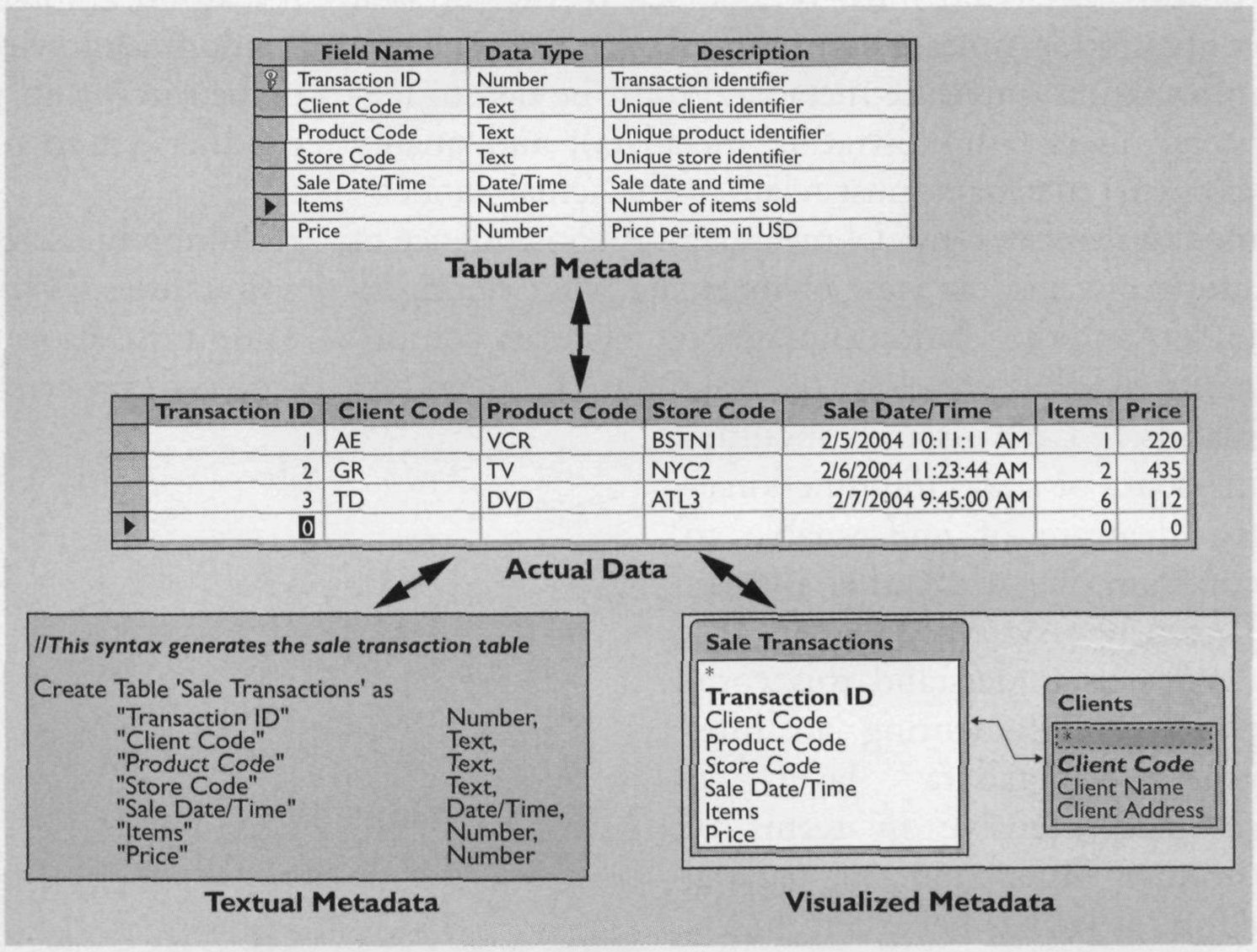

Figure 2. Interchangeability of metadata formats.

Integrating metadata. Without appropriate controls metadata might evolve inconsistently across the enterprise as complex, isolated, nonreusable "pockets" tightly coupled with individual applications [7]. These pockets might lead to conflicting standards for business entities, disable efficient communication among subsystems, and complicate system maintenance [5]. Metadata management is moving from managing decentralized metadata pockets to managing centralized repositories [7]. The metadata repository reflects this trend [3, 5, 10], providing enterprisewide storage of metadata that integrates all components, offers better control, and avoids metadata islands. Unfortunately, a comprehensive commercial solution for full-fledged metadata integration does not exist. A major obstacle for integration, as pointed out earlier, is the lack of standardization among COTS products that manage metadata.

Efforts to overcome metadata exchange and integration problems have been partially successful. The market, however, is still split between two competing metadata exchange standards: the Open Integration Model (OIM) and the Common Warehouse Model (CWM). The Metadata Coalition, led by Microsoft, proposed OIM in 1999. At about the same time, the