[Copeland and Maier 1984] which is related to SmallTalk and uses the Opal language for data definition and manipulation. Abstract data types can be defined, object identity is preserved and objects participate in one or more collections to provide a shared subobject facility. Behavioural aspects are handled by messaging.

The strengths of the object-oriented approach lie in the ability to import advanced programming techniques into areas of data modelling in which database technology has been traditionally weak. However, in the management of persistent data, object-oriented systems have a number of significant weaknesses. These include many of the standard functions which are an essential part of any database system. Thus security, concurrency, transaction control, archiving and some aspects of integrity are achieved by primitive methods, if at all. Optimisation of data storage and indexing are at an early stage perhaps analagous to that of the first relational systems.

Of greatest significance, perhaps, is that owing to their procedural nature, many object-oriented systems do not provide the non-procedural interactive languages that end-users require for data manipulation. Procedural interfaces requiring some knowledge of high-level programming languages may be acceptable in engineering applications where the clientale usually has a relatively sophisticated programming background. However, in areas such as text and office automation, it is considered that procedural interfaces are not appropriate to the environment. Clearly, ad hoc query languages could be designed for applications by writing an interface program in a host language. However, the more durable non-procedural languages have been based on mathematical methods, such as relational calculus and algebra, applied to a conceptual model of the data. There is thus, owing to a lack of emphasis on conceptual modelling techniques, a layer of control missing from current object-oriented systems to provide the necessary user environment. There are also difficulties with closure: if the result of a query is presented as a table, that is not a viable structure for further work.

6 Discussion

The last six columns of figure 1 show the extent to which our critical requirements for textbases are met by the techniques of free text retrieval, ISO-standard relational database, extended relational database with facilities to flatten textual data, semantic models oriented towards static and dynamic aspects such as E-R and Taxis respectively, and object-oriented