corresponds to intermediate values (results) of pertinence evaluations, where $f_1 > f_2 > \ldots > f_{m-1} > f_m$. Clearly, in this situation the coefficient of correspondence of the i-th document in the search collection to a user's query, determined by the user (i.e., coefficient k_i; see Section 10.6, "Construction of Complex Search Characteristics"), takes a value that coincides with one of the values in the fuzzy scale defined earlier. At the same time, the values of coefficient v_i (coefficient of correspondence of the i-th document in the search collection to a user's query, calculated from the search results) will be based, as before, on the binary scale, namely, $v_i = 1$ if the i-th document has been found during the search, and $v_i = 0$ otherwise. In the subsequent discussion, for clarity we will use symbol w_i instead of k_i, assuming that $w_i = f_p$, that is, is equal to one of the values of the fuzzy scale. If w_i and v_i are determined for each document of the search collection containing N_0 documents, then the following vectors can be formed from these values:

$$W = (w_1, w_2, \ldots, w_{N_0}) \quad \text{and} \quad V = (v_1, v_2, \ldots, v_{N_0}).$$

Then the content criterion of the functional efficiency evaluation will be defined as follows: the "closer" vectors W and V are, the higher the functional efficiencies of a document search.

The defined content criterion does not allow us to get sufficient clarity on the position of how to evaluate functional efficiency in the given situation (though, it gives some ideas for possible approaches). Yet, as was mentioned earlier, human beings use this position to evaluate functional efficiency. Hence, this leads to the conclusion that today we don't have any basis for successfully realizing any content-based method for evaluating functional effectiveness (in the discussed situation).

The situation is also not clear with a formal method of evaluating functional efficiency. We are unaware of any solutions regarding a realization of such a method. It is not even clear in this case on what principles formal rules must be based. We can only propose to base these rules on complex search characteristics, as is done in the case where a binary scale of pertinence is used in the context of the formal method. However, it is not likely that the use of CSCs discussed in this chapter will be expedient in this situation, and we will need other complex search characteristics. We propose to use several new CSCs which, we believe, may be useful, provided that one of the content criteria determining position from which functional efficiency evaluation is conducted will be the criterion defined in this section. These CSCs are introduced as functions that allow one to evaluate the closeness of vectors W and V. Previously (see Section 10.6, "Construction of Complex Search Characteristics"), for analogous purpose functions $\cos\phi_{XY}$, $\rho(X, Y)$ and $\rho_1(X, Y)$ were used. Recall that in that section we dealt with a special case of vector W, vector K. The use of function $\cos\phi_{XY}$ in this case, that is, its application to vectors K and V, led us to the complex search characteristic $I_2 = \sqrt{R \cdot P}$. At the same time, we showed that

in the case of vectors E and U, the function $\cos\phi_{XY}$ should not be used for constructing complex search characteristics because the evaluation of the search results, based on the CSC constructed in such a way, could sometimes give absurd results. This illustrates why it is necessary to be very precise in using functions that would allow one to evaluate the closeness of vectors.

Analyzing the applicability of functions $\cos\phi_{XY}$, $\rho(X, Y)$, and $\rho_1(X, Y)$ for constructing complex search characteristics for the case of vectors W and V, we did not find any example that would compromise the use for this purpose of functions $\rho(X, Y)$ and $\rho_1(X, Y)$, but we found, in our opinion, such examples for the function $\cos\phi_{XY}$. We present one such example here.

Assume that in some search collection containing N_0 documents, two searches were performed using two different search requests and in the result of these searches the following vectors were formed:

$$V^1 = V^2 = (1;\ 1;\ 1;\ 1;\ 0;\ 0;\ \ldots\ 0).$$

Also assume that the search collection was analyzed for pertinence of the documents to each search request resulting in the following vectors of correspondence:

$$W^1 = (0.1;\ 0.1;\ 0.1;\ 0.1;\ 0;\ 0;\ \ldots;\ 0)$$

and

$$W^2 = (0.1;\ 1;\ 1;\ 1;\ 0;\ 0;\ 0;\ \ldots;\ 0).$$

Then,

$$\cos\phi_{W^1V^1} = \frac{\sum_{i=1}^{N_0} w_i^1 v_i^1}{\sqrt{\sum_{i=1}^{N_0} (w_i^1)^2} \cdot \sqrt{\sum_{i=1}^{N_0} (v_i^1)^2}}$$

$$= \frac{4 \cdot 0.1}{\sqrt{4 \cdot 0.01} \cdot \sqrt{4}} = \frac{4 \cdot 0.1}{2 \cdot 0.1 \cdot 2} = 1;$$

$$\cos\phi_{W^2V^2} = \frac{3.1}{\sqrt{3.01} \cdot \sqrt{4}} \approx 0.89.$$

It follows that if the results of the searches (using the assumptions just described) are evaluated on the basis of complex search characteristic

$$I_{13} = \cos\phi_{WV} = \frac{\sum_{i=1}^{N_0} w_i \cdot v_i}{\sqrt{\sum_{i=1}^{N_0} (w_i)^2} \cdot \sqrt{\sum_{i=1}^{N_0} (v_i)^2}},$$