Information technology tools for sustainable development*

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Abstract

Information Technologies models the reality in such a way that information on it can be efficiently found and transported to the decision makers in a useful, readable form. There is still a need of standardisation of nomenclatures, interchange formats and languages in order to accelerate the communicability of information so it can be useful for any decision maker or for the public. But this standardisation or modelling process increase the errors in interpreting the reality, which can lean to unsustainable decisions. However, the growing velocity of communication exchanges and the power of recent information technologies will probably reduce the standardisation needs in time and allow a communication of less biased information, that is more accurate for a better decision making process.

Keywords: Sustainable development, information technology, communication, standards, metadata, translators, indicators, information paradox.

1. Introduction

Environment and development issues are always complex problems requiring information from many sources (see Bradbury, 1996, EEA, 1994, UNEP, 1992). The following dimensions are as many points of view to take into account:

-disciplines (economical, environmental, sociological, institutional),
-period, time and cycles (generations, irreversibility, recovery time),
-space and scale (global dimensions, finished worlds, charge capacity),
-translation tools, models and languages for assessing the relations and for bringing together the basic information in a coherent framework;
-communication between actors (interest conflicts, different levels of power, of background or personality, of political orientation).

Sometimes the necessary information need to be collected, but frequently much relevant information has already been gathered by various specialist agencies such as statistical institutes, universities, environment departments or national mapping authorities. Information technology can help to:

-find the existing data and sources, or collect new data;
-bring data together in a coherent framework, following well funded models, communication standards or languages and reliable analysis tools;
-integrate and display resulted information so that decision- makers, or the public, can understand it.

* Presented at IATAFI '96, 8-10 October 1996, Brussels Congress Centre.

The range of dimensions and disciplines represented in any comprehensive analysis of a sustainable development problem is greater than any individual, no matter what their competencies, can be expected to grasp. Yet decision-makers need to be able to comprehend the material sufficiently well for them to be able to make a rational, informed and transparent decision about the issue.

Information technology tools and communication infrastructures, and especially the World Wide Computer Network (Internet) can help the individuals, and mainly the decision makers to improve their capacity to 'think globally', or to interact with different representative groups in order to find, step by step, the best possible solutions for a more sustainable development. The only problem today is that the communication capacity of the entire human information technology system is too low in comparison with the fluxes of information needed for sustainable development.

We will concentrate here on 'translation' tools that would have a positive effect on the communication for a more sustainable world.

2. The information paradox.

Each language is a modelisation of the reality that reflects the culture behind it.

The modelisation of the reality through information accelerates the possibility to manage it. More the real world is modelled, quicker the management of information is and so is the response and further impact to reality.

But also, further is the answer from the reality, and bigger is the risk of error.

This information paradox can not be solved, but we will see later that information technology could help to reduce its size.

Figure 1 illustrates the process of making synthetic information by successive modelling of the reality. Agenda 21 (UNEP, 1992) and the United Nations Commission on Sustainable Development (1995) agreed that a set of new indicators would be necessary for sustainable decisions. Basic data are more close to the reality, but are not workable for the decision makers. Derived data, indicators and indices give a more readable image of the reality and can be compared, aggregated, combined, discussed, presented in charts and maps for a better implication of the different actors involved in the decision making process. Indices and indicators are more visible, even if they are far from the reality.

It is the information paradox.

2. The information retrieval pyramid

Considering that a lot of data and information are already available, Agenda 21 (chap. 40.24) states that ''the organs and organisations of the United Nations system, as well as

other governmental and non-governmental organisations, should document and share information about the sources of available information in their respective organisations'' (UNEP, 1992).

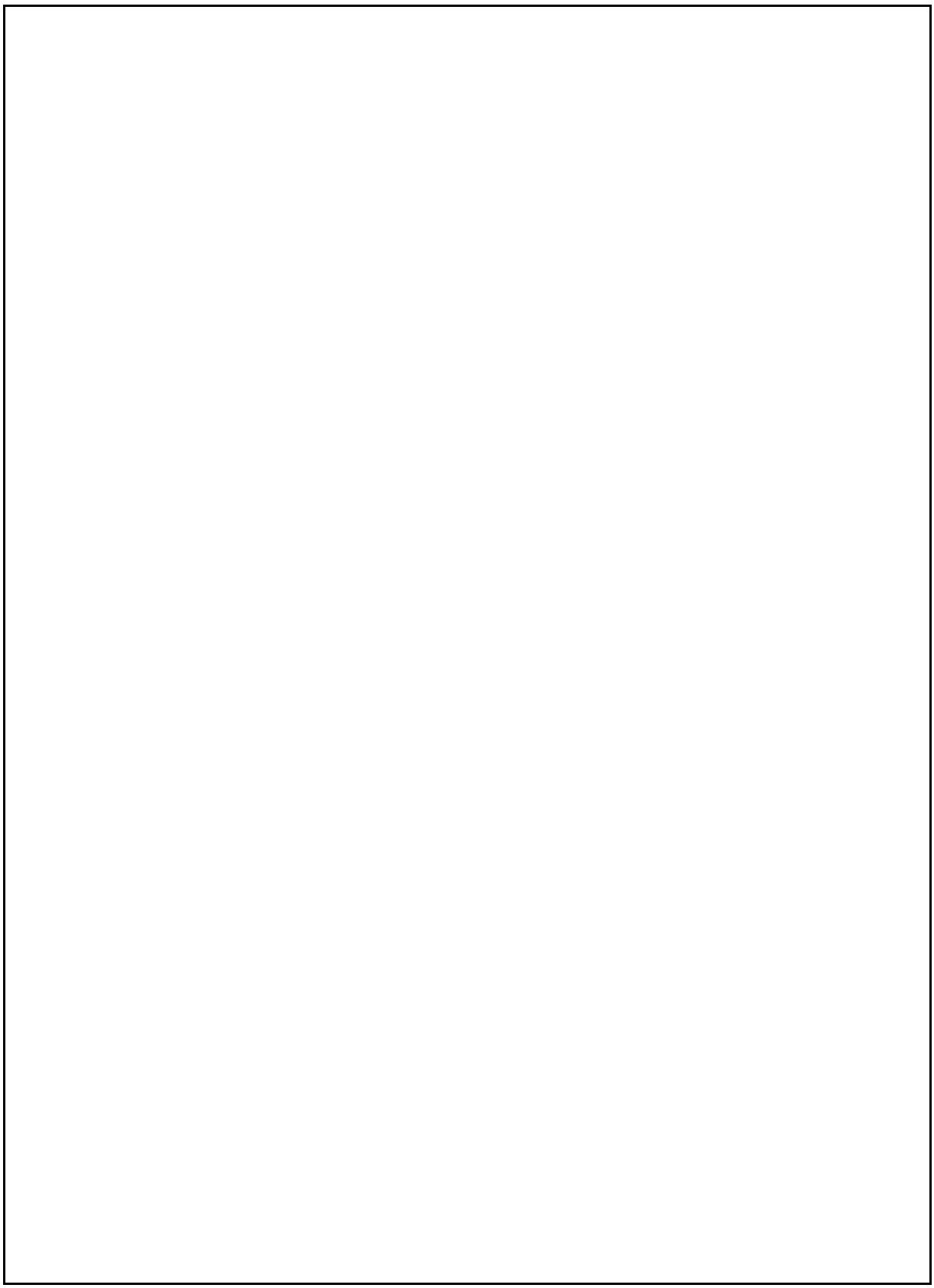
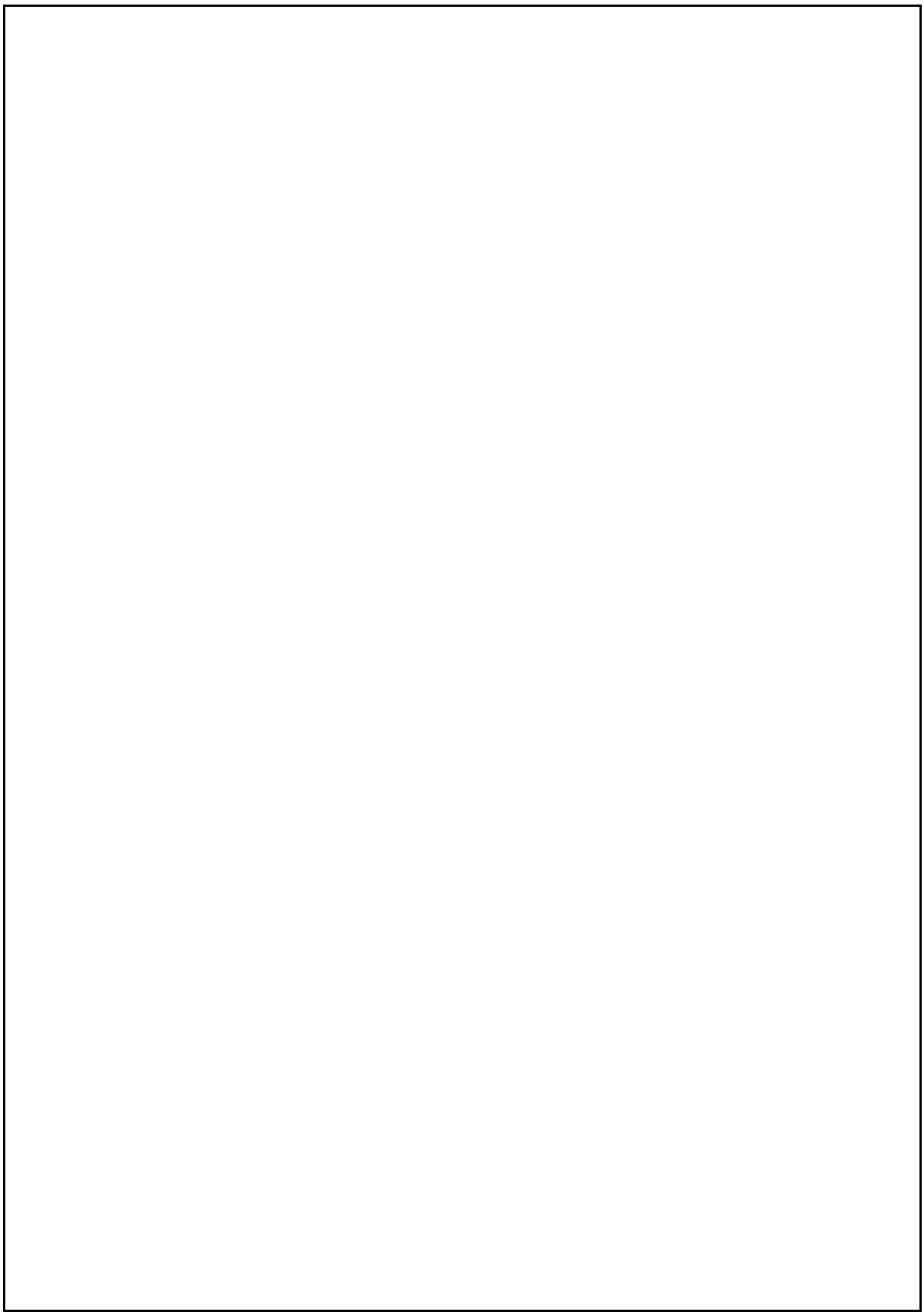


Figure 1: The information pyramid and the paradox of information



(B.Kestemont, 1996)

Figure 2: The paradox of data retrieval pyramid

Data about data are called metadata. The role of metadatabases is to accelerate the research of information for specific use. A good example is the bibliographical metadatabases used by the libraries. A title, a summary and keywords help to index the data sources. It works well within a single library, because the keywords used are adapted to the needs of the specific users community. But for the description of other types of data or information sources, such as organisations, experts, databases, samples, satellite images, projects etc., the system of the libraries is not sufficient, and a more complex set of descriptive elements are needed (quality and size information, languages used, formats, addresses). Otherwise, the relevant data sources are not found by the users. In a world wide environment, where potential data providers and users are not of the same culture and do not speak the same language, this problem is even more accurate.

Here we face a problem of standardisation of the metadata: if each library, each catalogue, each address list uses other conventions, no communicability is possible, no information can be found by external people, which is not the goal of Agenda 21 statements. The necessary standardisation of data format is stated by all international agencies, but also within countries, e.g. between regions or administrations.

Metadata standardisation is easy if only a small set of descriptive elements are used: author, title or name, address, keywords, summary. It is difficult if more details on the source are given (for example: which language to use for full text description?). The cost of listing a lot of data sources is also much lower if a single title or name is used, but a catalogue of data sources is more useful if more description are given.

We face the paradox of data retrieval pyramid, illustrated in figure 2: on the lowest level, data are well described (the extreme is that the data themselves are stored), but difficult to harmonise or to collect within a single system, on the highest level, it is easier to make comprehensive lists, but the metadata are too far from the data they are suppose to describe.

This paradox of describing and retrieving data and information is also not solvable: more modelling of the reality gives more visibility and communicability but are more biased and does not represent well the quality of a data source. But information technology, and in addition the generalisation of metadata standards, can also help to reduce the size of the paradox, as we shall see later.

4. Information communication today and tomorrow

Figure 3 shows the structure of information interchanges today on the Internet, with a view to the future. Standardisation seems to be one of the crucial points to solve today. If English is already the main key language of the Internet, the system is evolving to the use of metadata standards in the header of each document, in order to allow the search engines to find the relevant information from the users point of view (see Kestemont et al, 1996).

Figure 3: Communication through the World Wide Computer Network.

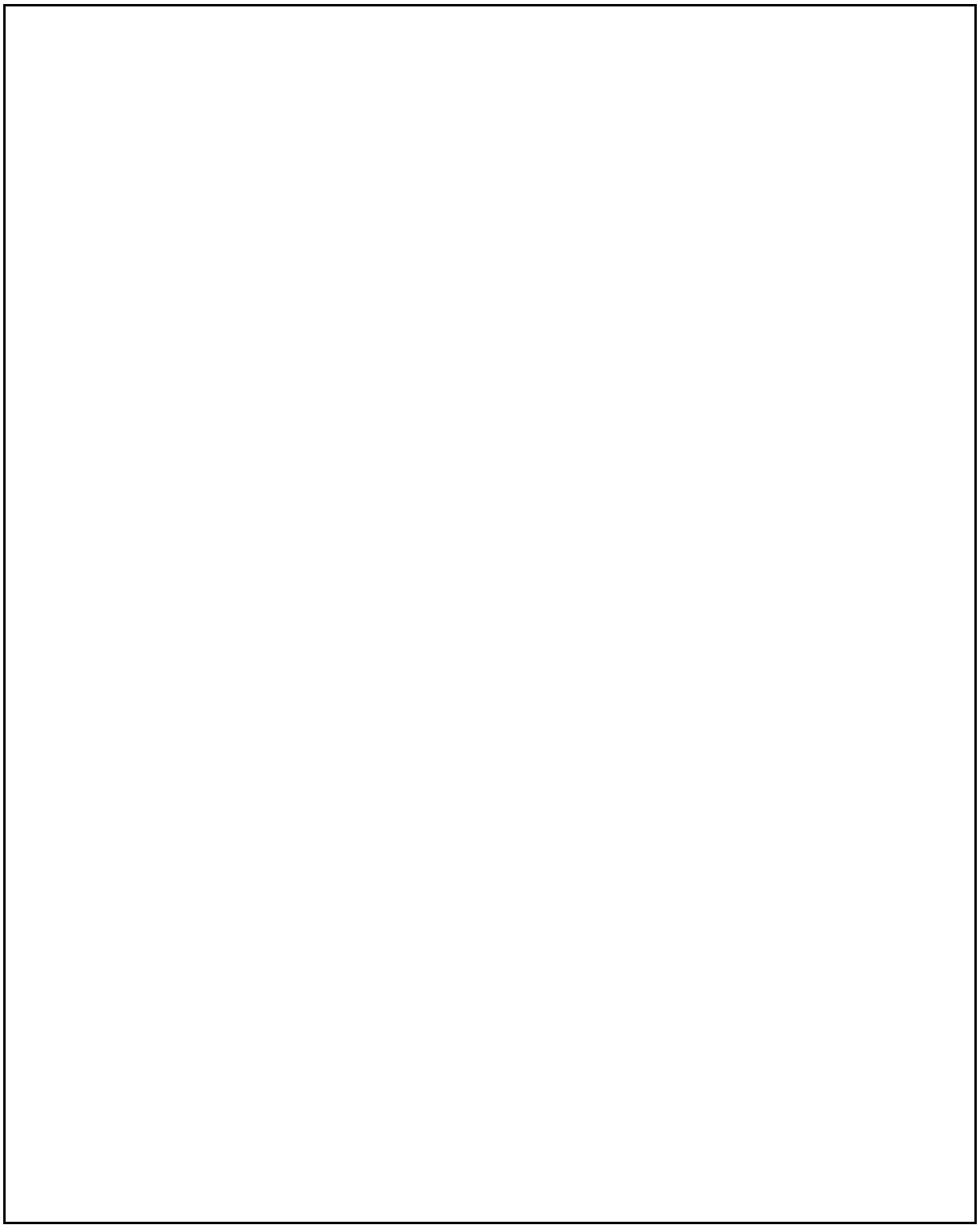


Figure 4: Growing performances of search engines

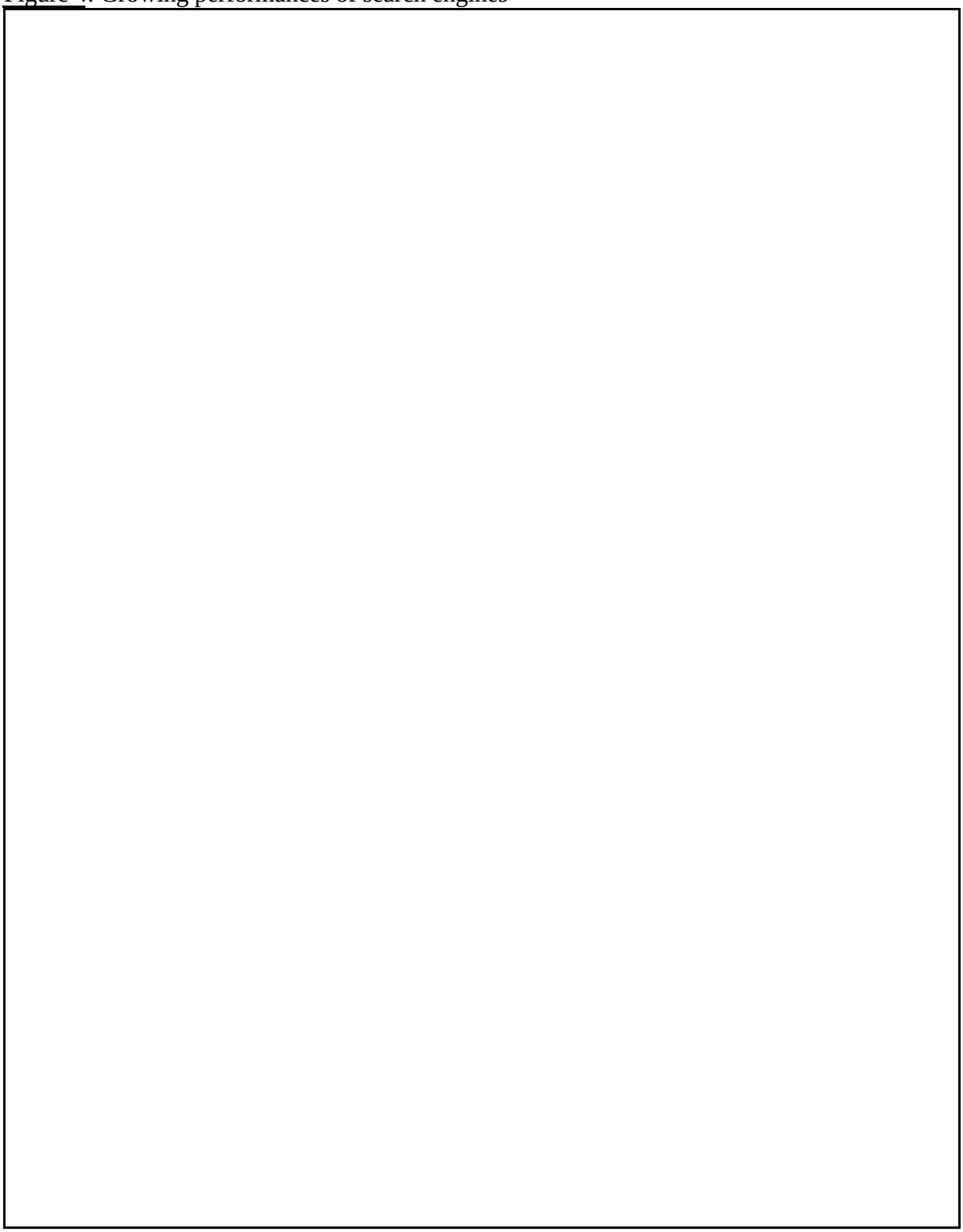


Figure 4 illustrates that in the future, information technology (IT) will be able to deal with more precise, less standardised, less biased information interchange: ideally, IT would be able to reduce the level of modelisation of the reality, and help reducing the errors and misunderstandings..

To allow communication for sustainable development, it is necessary today to improve:

-information storage and processing infrastructure,
-communication channels and terminals (80% of the world's population have no access to the telephone);
-interactive communication efficiency and velocity.
-standardisation (of data, of metadata, of interchange protocols and formats, ...);

The two first points will depend on:
-reduction of the costs of IT;
-policy of equal distribution between the rich and the poor.

The evolution of the IT market shows a drastic reduction of the costs implied (if compared with their performances): telephone terminals and televisions are now accessible for average villages in Africa, radio receivers are accessible to individuals; but computer or Internet terminals are already too expensive for even the poorest people even in the richest countries. The cost for telephone lines are however too high for mainly African users, and already cut them from the digital information sources.

We will treat here the two last priorities, which are more directly linked to technological progresses.

Communication capacity (capacity of the technology to transport information, expressed e.g. in Kbytes/sec for the world) and standardisation needs are linked issues as shown in figure 5: with low potentials of communication fluxes, a high degree of standardisation is needed. On the contrary, when the IT efficiency increases (e.g. for automatic translation or for databases searching capacity), the standards (indexes, key languages, ...) become less necessary. Standards in information technology, useful today, will gradually disappear and not be replaced by anything (R. Bradbury, 1993). But today, hardware progresses and interchange languages (standards) progresses are both still important. For the short and medium term, standardisation is crucial in this way. The implicit use of key languages for communication, such as English for this paper, is necessary today because of the costs of edition of papers in different languages, and the cost of translations in several languages. English (or French) used as standards allow to make a translation to or from only one key language. The costs are supported by the non English speaking authors or readers (who have to learn English or pay for translations), but this standardisation of an interchange language is, for scientific and commercial international purposes, the most efficient way to improve communication efficiency (figure 6). However, this system is not completely satisfactory, because the quality of translation is not optimal: to pass from language A to B (figure 6), two translations are necessary, against one in the case of bilateral translations (no standard). In bi- or trilingual countries, the pupils learn at school both languages: no one language is selected as standard,

unless it is demographically or historically predominant. When a large number of languages are existing within the same communication forum, the choice of a standard language becomes necessary.

Figure 5: Communication capacity and standardisation needs

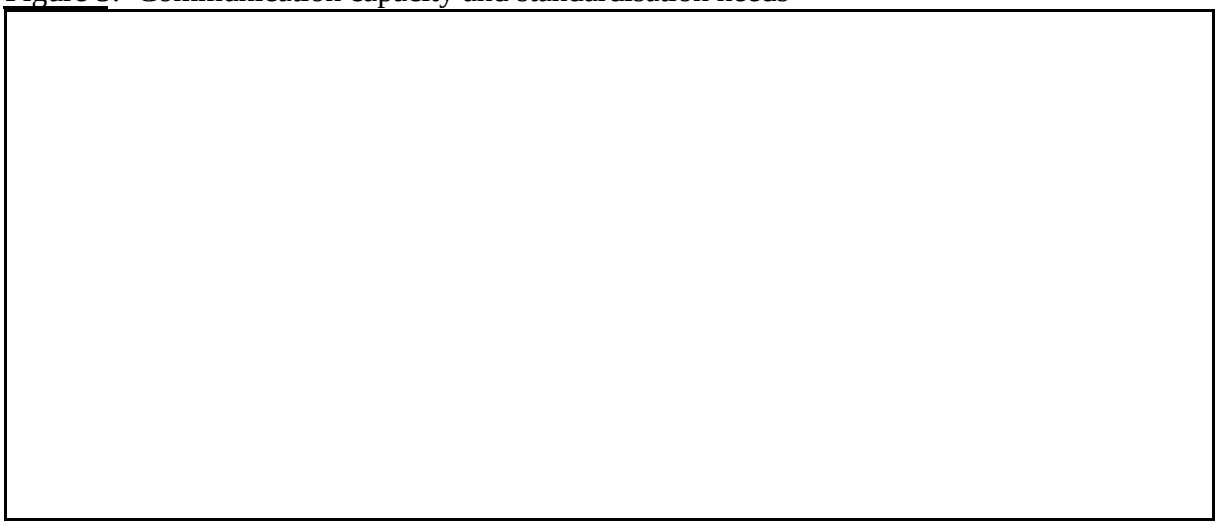


Figure 6: Intercommunication between languages A, B, C, D, E, F.

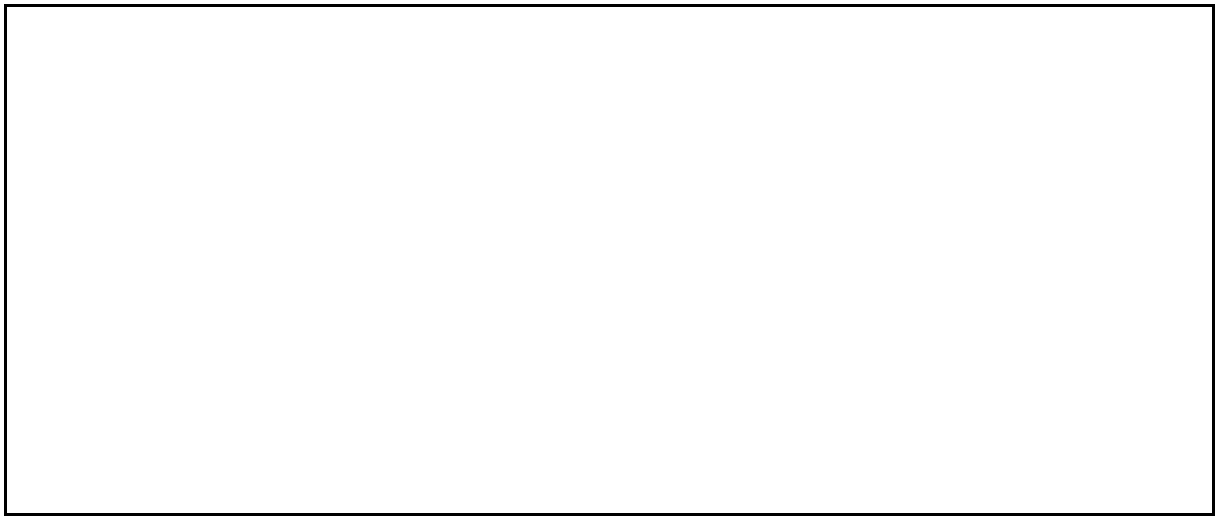
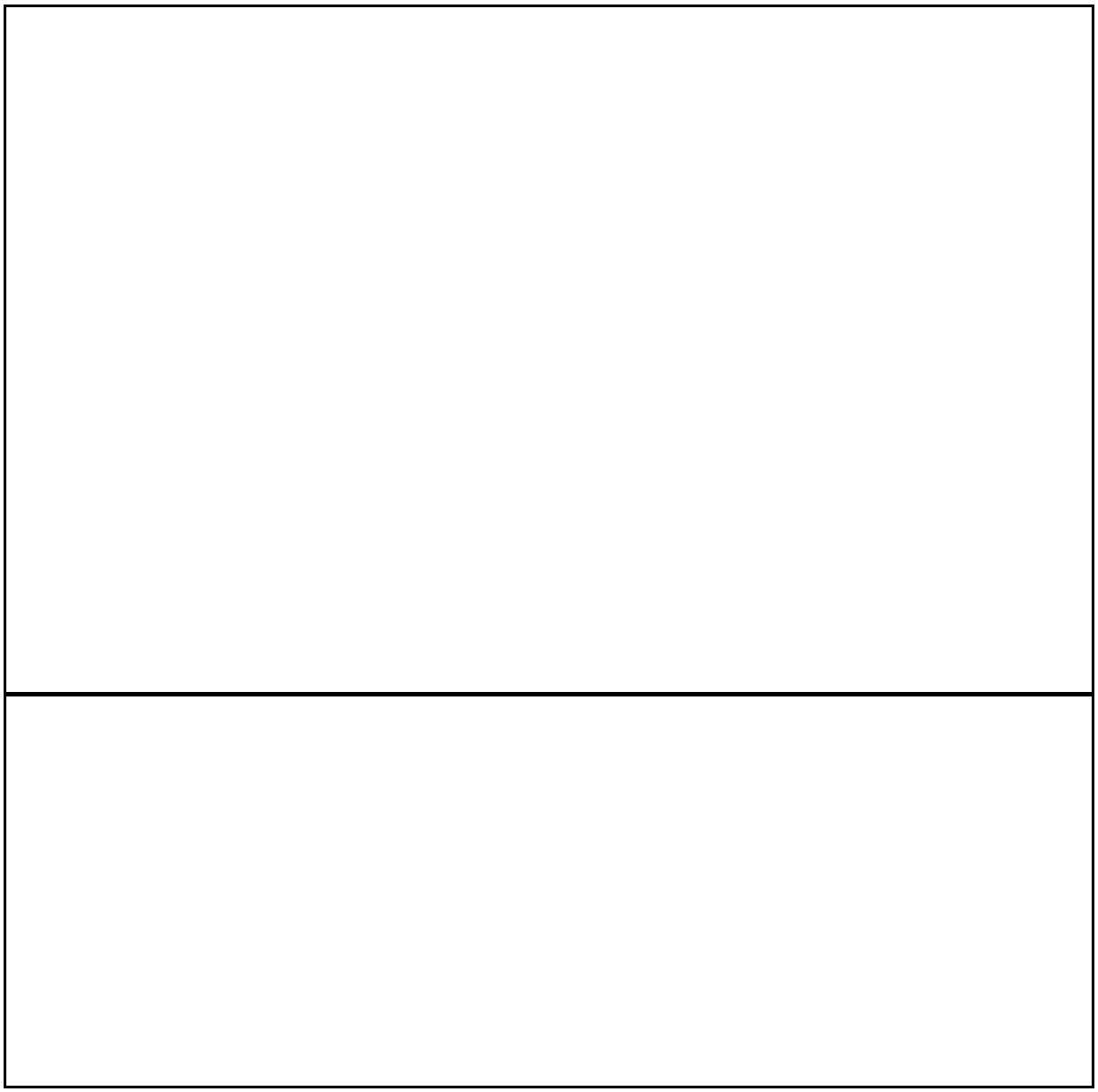


Table 1: Intercommunication between n languages



If we consider that misunderstandings are against sustainable development (creating errors of decisions, or even conflicts), the errors in translations (or transmission of information) are important for the overall efficiency of the communication system. The quality of the communication is function of the quality of the translations if different languages (cultures) are communicating. T able 1 shows that the quality decreases sharply with the number of languages in a forum using a standard language. But the use of a standard needs less translators, and it is thus the cheapest solution.

This example can be extrapolated if we consider 'language' being any format of communication of the reality (human languages as well as machine or software languages and formats). The translators can, in this case, be human or authomatic: translation programs, or functionalities to transfer a digital file from one format to another for example.

On the Internet, the html language, using the ASCII character sets, is a standard allowing communication between many different platforms. Translators are ready in construction to extend the character sets or data exchange (e.g. images) that Internet can transport. Other examples show that the use of authomatic 'translation' tools can, because of the rapidity of the computers and the use of a set of well considered standards, transport readable information from one 'culture' or speciality to another.

For images or movies, which are more international than any articulated language, the tools are already satisfactory. On the contrary, the automatic translations of the human language are only satisfactory for glossaries, but not yet for complete sentences (the automatic translation tools on the market need already a human assistance). However, the most advanced tools, originally developped for automatic translation within the European Communities or bilingual countries like Canada, are already able to use linguistic analysis in order to find documents close to a natural language query or document (query by example). We are not far from the automatic translation of metadata, and in the near future (depending on the prices of the translators on the market), the metadata standards will disappear. Information Technology research, and in particular the quick advances of the linguistic science, allow us to foresee the satisfactory automatic translation of human language within a few decades, if not a few years for the main international key languages such as English-French.

The promises of various socio-technical progresses of information technology (from the networking to the translation tools) is a chance for global sustainable development, if the society really wants equity and finds a way to solve the possible interest conflicts mentioned above.

The ideal situation for sustainable development would be if anybody could speak to anybody using such a language that he/she can be sure to be understood, and take decisions knowing exactly which would be the effects of this decision on the present and future environment or societies.

5. Conclusion

Improving information technology is a way to improve the decision making process to be more reliable and less risky in its results, because it would accelerate the way of making reliable information from ground measurements, and allow more transparency in the modelling processes. Higher the communication capacity, higher the potential of humanity's sustainable development. Information technology gives powerful tools - and no solution - for sustainable development.

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Aknowledgments

This paper was prepared within the framework of a project financed by the Belgian Federal Office for Scientific, Technical and Cultural Affairs.