I.F. THESAURUS OF BUILDING SCIENCE AND TECHNOLOGY

(Thésaurus I.F. - Sciences et Technologie du Bâtiment)

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ABSTRACT

The I.F. Team have been struggling with the problems of information storage and retrieval in building, to the point that the basic tools had to be developed. These tools had to be explicit in their structure and construction, to compensate for the diversity of the building industry audience. The first of these tools is a hierarchical thesaurus, distinguished by its structure (a semi-lattice with nine levels) and its construction (based on a set of logical propositions). Candidate terms are treated in pairs, using a set of questions to ascertain systematically what are the relationships between them. Data processing helped with the construction of the thesaurus, particularly in terms of methodology. There is a scope for further work, particularly in preparing the bilingual (English-French) version of the thesaurus, now in draft.
(L'équipe I.F. a lutté avec les problèmes de l'enregistrement et de la recherche de l'information dans le domaine de la construction; fort de cette expérience, les membres de l'équipe se sont rendu compte qu'il fallait développer les outils de base. Ces outils devraient avoir une structure et une construction claires, afin de compenser la diversité de l'audience; les membres de l'industrie du bâtiment. Le premier de ces outils est un thésaurus hiérarchique, sa structure (un semi-réseau à 9 niveaux) et sa construction (basée sur une série de propositions logiques) représentent des innovations. Des termes candidats sont traités par paires, en se servant d'une série de questions afin d'identifier systématiquement la nature des liens entre les termes. L'informatique a aidé avec la construction du thésaurus, surtout en ce qui concerne la méthodologie. Il y a de grandes possibilités de continuer le travail, surtout pour la préparation d'un thésaurus bilingue (anglais-français) actuellement à l'étude).

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I.F. THESAURUS

INTRODUCTION

This paper describes work that has been carried out by the "I.F. Team" at the Faculté de l'Aménagement, Université de Montréal. For reasons that are described below, we decided to develop a Thesaurus in the domain of building science and technology; for reasons that are also explained below, this lead to a number of special problems, the solutions to which - we believe - are of general significance for Thesaurus construction.

THE CONTEXT

Members of our team had been struggling with problems of information storage and retrieval in building for a while; the frustrations of trying to use the existing classification systems (devised to deal with bricks and mortar and quite unsuited for environmental phenomena or building processes) need not be described here. In addition, we were publishing a quarterly magazine (called Industrialization Forum (Ref.1) - whence our name "I.F. Team") which had a built-in coordinate indexing system - complete, but for a controlled vocabulary.

The nearest thesaurus was E.J.C. (Ref.2), but attempts to use it showed that (i) it did not cover our domain adequately, and (ii) it seemed that its structure was not appropriate - particularly in its liberal use of the related term (RT) cross references. A preliminary enquiry showed that one other English language thesaurus existed in the domain of building, - a loosely structured working document prepared by the Building Research Station in the U.K. (Ref.3); two were about to be prepared - one concerning building products in Canada (Ref.4) and a facetted thesaurus being considered in the U.K. (Ref.5). A French thesaurus, dealing with construction technology, had also been drafted (Ref.6).

THE PROBLEM

We were concerned with a domain of activity (building - science and technology) and not a "discipline"; an immediate consequence of this was that the people in the domain of activity have varied backgrounds, functions, vocabularies... to the point that communications were already difficult because of varied usages of terms. As a result, we were going to have to use every conceivable device - in the construction and presentation of our Thesaurus - to help standardize the use of terms.

THE I.F. THESAURUS

A thesaurus is a controlled and dynamic vocabulary, which covers a particular domain of knowledge and activities adequately. A thesaurus can be characterized by:

(i) its domain:

- particular domain,
- neighboring domains,
- degree of depth of coverage of these domains,
- extent of coverage of these domains;

(ii) its structure:

- internal structure,
- compatibility with other thesauri;

(iii) its different functional parts, (figs. 1 and 2);

(iv) its physical form;

(v) its method of use;

(vi) its process of evolution.

The I.F. Thesaurus can be characterized against each of these criteria. However, this paper emphasizes aspects of: (i) its structure, and: (ii) its process of evolution.

The Structure.

Because of the nature of the building industry "public" (varied, with no natural standardization of terms), we felt the need to adopt a "scientific" approach to structuring and constructing the thesaurus. By "scientific" we meant that there should be clear rules against which any and all decisions could be made; these same rules could be referred to in any subsequent arguement about the outcome of these decisions. The more rigorous the scientific approach, the better we would be compensating for the "undisciplined" (pluri-disciplined?) nature of our public.

The structure we adopted is rigorously hierarchical. Each descriptor has a defined level in the hierarchy (except for some general terms (Ref.7))and each descriptor has relationships to descriptors one level "up", one level "down" or on the same level in the hierarchy. The structure as a whole (a semi-lattice, with SCIENCES and ENVIRONMENT at the top level - level 1) is built up by systematic accretion of these individual relationships.

The relationships (which are registered by cross-references) were selected to avoid some of the uncertainties that prevail in many existing thesauri (Ref.8). These are: Broader Term (BT) and its reciprocal Narrower Term (NT) - restricted to the meaning: "type of"; Whole Term (WT) and its reciprocal Part Term (PT) - restricted to the meaning: "part of"; Related Term (RT) - restricted to the meaning: "associated with". The BT/NT and WT/PT relationships exist - and only

EXPERIMENTAL PSYCHOLOGY ***
...USE PSYCHOLOGY
EXPERIMENTS *0*
EXPERTISE ***
...USE SKILL
EXPLOSIONS *6*
EXPLOSIVES *6*
EXPONENTS *5*
EXPOSED CEILINGS *7*
EXPOSED CONCRETE FINISHE *7*
EXPOSURE *0*
EXPRESSION *0*
EXTERIOR LIGHTING *6*
EXTERIOR SPACES *5*
EXTERNAL ENVELOPES *6*
EXTERNAL FORCES ***
...USE LOADS(FORCES)
FIRE EXTINGUISHERS *8*
FIRE EXTINGUISHING EQUIP ***
...USE FIRE FIGHTING EQUIPMENT
EXTRACT VENTILATION *7*
EXTRACTION(CHEMISTRY) *6*
EXTRACTS(DOCUMENTATION) *6*
EXTRAPOLATION *5*
EXTRUDING *6*
EXTRUSIONS ***
...USE SECTIONS(MATERIALS)
EYE WINDOWS *7*
FABRICATION ***
...USE MANUFACTURING PROCESSES
FABRICATORS ***
...USE MANUFACTURERS
FABRICS *6*
FACADES *6*
LIGHTWEIGHT FACADES *7*
COORDINATING FACES *7*
FUNCTIONAL FACES *7*
FACETED CLASSIFICATION I *7*
TELECOMMUNICATIONS FACIL *5*
ADMINISTRATION FACILITIE *5*
PUBLIC SERVICE FACILITIE *5*
FACILITIES *4*
AGRICULTURAL FACILITIES *5*
CATERING FACILITIES *5*
CIVIL DEFENSE FACILITIES *5*
COMMERCIAL FACILITIES *5*
COMMUNITY FACILITIES *5*
CULTURAL FACILITIES *5*
DWELLING FACILITIES ***
...USE RESIDENTIAL FACILITIES
EDUCATIONAL FACILITIES *5*
ENTERTAINMENT FACILITIES ***
...USE RECREATIONAL FACILITIES
EXHIBITION FACILITIES *6*
HEALTH FACILITIES *5*
INDUSTRIAL FACILITIES *5*
MAINTENANCE FACILITIES ***
...USE STORAGE FACILITIES
MILITARY AIR FACILITIES ***
...USE MILITARY FACILITIES
MILITARY FACILITIES *5*
MOBILE FACILITIES *5*
MOTOR RACING FACILITIES *6*
MULTI-PURPOSE FACILITIES *5*
NAVAL FACILITIES ***
...USE MILITARY FACILITIES
OLYMPIC FACILITIES *6*
RECREATIONAL FACILITIES *5*
RELIGIOUS FACILITIES *5*
RESEARCH FACILITIES ***
...USE SCIENCE FACILITIES
RESIDENTIAL FACILITIES *5*
SCIENCE FACILITIES *5*
SPORTS FACILITIES *5*
STORAGE FACILITIES *5*
TEMPORARY FACILITIES *5*
TERMINAL FACILITIES *5*
TOILET FACILITIES ***
...USE TOILET SPACES
WELFARE FACILITIES ***
...USE HEALTH FACILITIES
BANKS(FACILITIES) *6*

FACING BRICKS *7*
FACINGS ***
...USE CLADDINGS
UTILIZATION FACTOR *6*
ZONAL FACTOR METHOD *6*
FACTORIES ***
...USE INDUSTRIAL FACILITIES
FACTORS *0*
DANGER FACTORS ***
...USE HAZARDS
WEIGHTING FACTORS *0*
FADING ***
...USE DECREASE
FAIENCE *7*
FAILURES *0*
FAIR GROUNDS ***
...USE LUNA PARKS
FAIRS *6*
FALL-OUT SHELTERS ***
...USE ATOMIC SHELTERS
FALL(AUTUMN) ***
...USE AUTUMN
WATER FALLS *6*
FALSE DROPS *7*
FAMILIES *4*
FANLIGHTS *7*
FANS *8*
FAR EAST *7*
FARM HOUSES *6*
FARMS *6*
FASHION *4*
MODE(FASHION) ***
...USE FASHION
MECHANICAL FASTENERS *6*
BOLTS(FASTENERS) *7*
SPACERS(FASTENERS) *7*
FASTENING ***
...USE JOINING(PROCESS)
FAT CONCRETE *7*
FATIGUE LIFE ***
...USE FATIGUE RESISTANCE
FATIGUE LIMIT *7*
FATIGUE RESISTANCE *6*
FATIGUE STRENGTH AT N CY ***
...USE FATIGUE RESISTANCE
FATIGUE(MATERIALS) ***
...USE FATIGUE RESISTANCE
FAUCETS *8*
FEASIBILITY *0*
FEASIBILITY STUDIES *5*
GLACIAL FEATURES ***
...USE HYDROGRAPHIC FEATURES
HYDROGRAPHIC FEATURES *5*
TOPOGRAPHIC FEATURES *4*
FEDERAL SCOPE ***
...USE NATIONAL SCOPE
FEEDBACK *5*
NEGATIVE FEEDBACK *6*
POSITIVE FEEDBACK *6*
THRESHOLD OF FEELING(SOU *7*
FEELINGS ***
...SEE SCOPE NOTE
FELTS *6*
FENCES *7*
FENESTRATION *6*
FERMENTATION *6*
FERROUS METALS ***
...USE METALS
FERTILIZERS *7*
GLASS FIBER *6*
FIBER GLASS ***
...USE GLASS FIBER
FIBERS *6*
FIBROUS AGGREGATES *7*
FIELD TESTS *0*
FIELD THEORY(MATHS) *4*
ABELIAN FIELDS *5*
ELECTRIC FIELDS *6*
ELECTROMAGNETIC FIELDS *5*
ELECTROSTATIC FIELDS ***
...USE ELECTRIC FIELDS
MAGNETIC FIELDS *5*

Figure 1: Typical page of Alpha-Permuted Index.

* ENTHALPY *6*
BT thermodynamic properties
RT entropy
GRT energy

* ENTRANCES *7*
UF doorways
BT access spaces
RT fire escapes
porches

* ENTROPY *6*
BT thermodynamic properties
RT enthalpy
GRT energy

* ENVIRONMENT *1*
SN the complex aggregate of physical and geo-, bio- and socio-physical conditions that influence the life of organisms, individuals and communities.
...
use of a more specific term is recommended.
NT physical environment
socio-cultural environment
RT sciences
GRT interaction
relationships

* ENVIRONMENTAL ACOUSTICS *5*
UF architectural acoustics
BT acoustics
NT open air acoustics
room acoustics
PT acoustical defects
acoustical qualities
RT acoustic properties
acoustical control
acoustical environment
auditory perception

* ENVIRONMENTAL CONTROL *4*
UF space conditioning
NT acoustical control
air circulation control
air conditioning
hygrothermal control
luminous control
noise control
pollution control
WT building science
RT acoustical engineering
ambient environment
architectural design
environmental properties
illuminating engineering
thermal engineering

* ENVIRONMENTAL DESIGN *3*
NT architectural design
landscape design
urban design
RT building science
built environment
design

* ENVIRONMENTAL PERFORMANCE *5*
SN performance related to built environment and particularly to ambient environment.
NT acoustical performance
biological performance
hygrothermal performance
luminous performance
WT architectural design
environmental properties
industrial design
urban design
RT building performance
environmental requirements
GRT performance

* ENVIRONMENTAL PROPERTIES *4*
NT acoustic properties
biological properties
fire safety
hygrometric properties
optical properties
thermodynamic properties
PT environmental performance
RT environmental control
GRT properties

* ENVIRONMENTAL REQUIREMENTS *5*
SN in relation to ambient environment.
RT aesthetic requirements
architectural programming
design criteria
environmental performance
psychrometry
safety requirements
spatial requirements
GRT comfort
requirements

* ENVIRONMENTAL SCIENCE *3*
SN see also environment.
BT applied sciences
RT building science
built environment
ecology
psychology
sociology

* EPEIROGENY *5*
UF earth movements
orogeny
orography
WT geomorphology
seismology
RT earthquakes
hydrographic features
landforms
volcanology

* EPOXY *7*
BT thermosets

* equations(calculation) ***
USE FORMULAS(CALCULATION)

* EQUATORIAL REGIONS *6*
BT climatic regions
RT humid climates
tropical regions

* EQUILIBRIUM CONDITIONS *0*
GRT boundary conditions
conditions

* EQUILIBRIUM METHOD *6*
NT flexibility method
WT structural analysis
RT dynamic structural analysis
elastic analysis
plastic analysis
static structural analysis

* EQUIPMENT OPERATORS *5*
WT personnel

* EQUIPMENT(TOOLS) *4*
UF instruments
machinery
machines
tools
BT artifacts
resources
NT automated equipment(tools)
calculating equipment
construction equipment
draughting instruments
hand tools
machine tools
measuring instruments
observing instruments
power tools
production equipment
testing equipment
WT technology
RT ergonomics
manufactured products
processing
work(activity)

* EQUITY CAPITAL *6*
UF venture capital
BT capital(finance)

* EQUIVALENCE *0*

* erecting ***
USE ERECTION

* ERECTION *5*
UF erecting
tilting up
WT building technology
RT assembly processes
building processes
construction(techniques)

* ERGODIC THEORY *4*
WT mathematical analysis
RT probability theory

* ERGONOMICS *4*
UF man-machine interface
BT engineering
RT equipment(tools)

(E6) Figure 2: Typical page of Alpha-Hierarchical Index.

exist - between descriptors on one level in the hierarchy and appropriate descriptors one level "up" or one level "down" the hierarchy; The RT/RT relationships exist - and only exist - between descriptors on the same level of the hierarchy (Ref.9).

This set of relationships is shown graphically in fig.3 and typographically (as used in our alpha-hierarchical index) in fig.4. These "hierarchical groups" as has been stated - are joined by systematic accretion to form the whole structure or "conceptual space".

Before dwelling on the importance of this rigorous structure, we wish to describe the procedures that were used to generate the individual hierarchical groups. The key for this construction work is a set of so-called "logical propositions".

Obviously there are preliminary stages in which candidates are collected, their usage evaluated and their meanings agreed; once this has been done a preliminary sortation is made (which used certain computerized techniques)making clusters of candidates that apparently were likely to be related. At this moment, terms in these clusters were taken - two by two - and "processed" with the logical propositions (fig.5).

Let us consider, for example, some of the descriptors in the hierarchical group TOWNS (figs. 3 and 4).

(i) Let I be NEW TOWNS and J be TOWNS

P 1: NEW TOWNS can be a type of TOWNS - true
P 3: NEW TOWNS is always a type of TOWNS - true

therefore: NEW TOWNS is a NT of TOWNS

(ii) Let I be BUILT-UP AREAS and J be TOWNS

P 1: BUILT-UP AREAS can be a type of TOWNS - false
P 2: TOWNS can be a type of BUILT-UP AREAS - true
P 4: TOWNS is always a type of BUILT-UP AREAS - true

therefore: BUILT-UP AREAS is a BT of TOWNS

(iii) Let I be STREETS and J be TOWNS

P 1: STREETS can be a type of TOWNS - false
P 2: TOWNS can be a type of STREETS - false
P 5: STREETS can be an element, a sub-set, a sub-system or an aspect of TOWNS - true
P 7: if STREETS exist then TOWNS exist - true
P 8: if TOWNS exist then STREETS exist - true

therefore STREETS is a PT of TOWNS (PT_s meaning immediately part of it).

Figure 3: GRAPHIC DISPLAY OF THE HIERARCHY

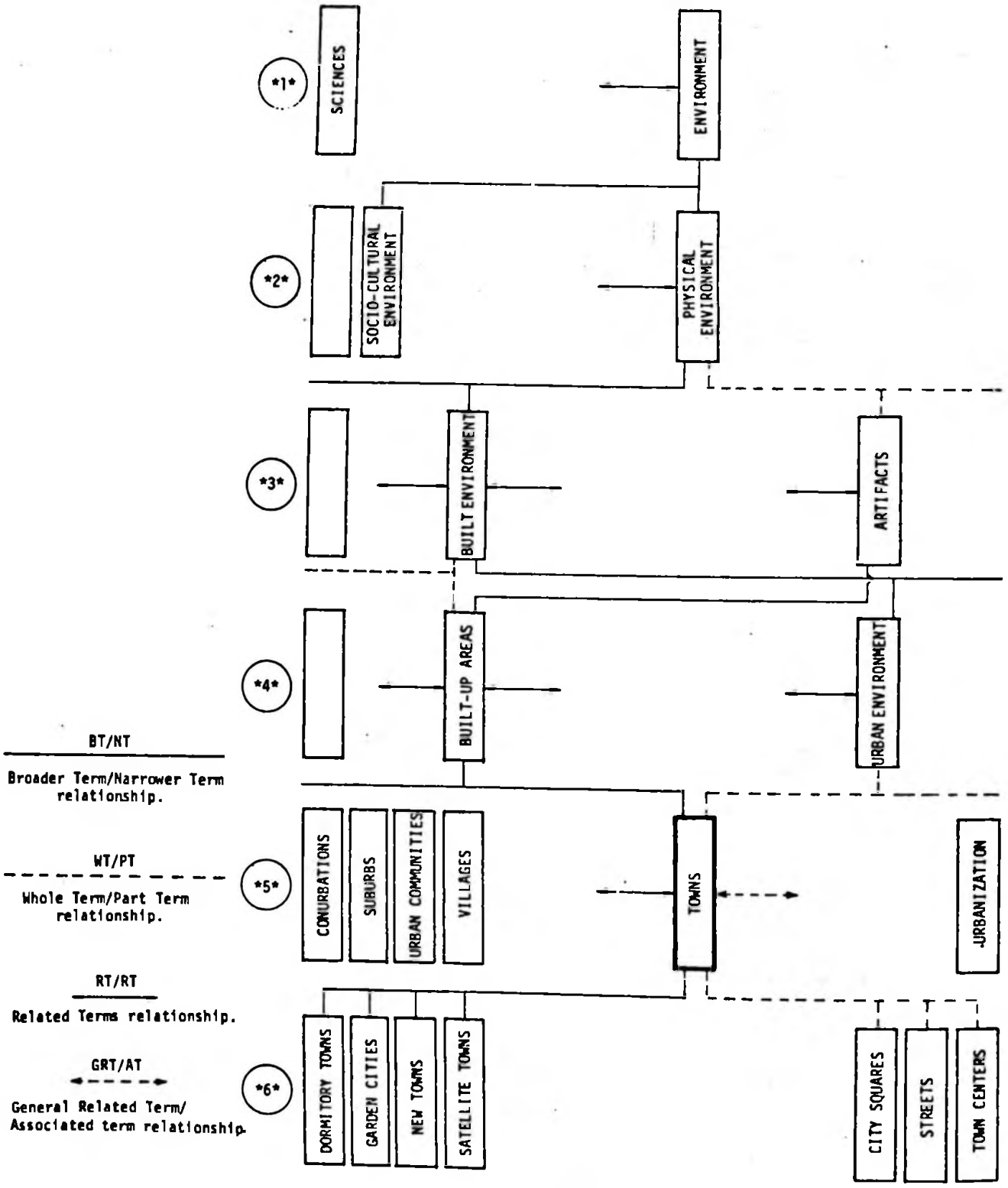
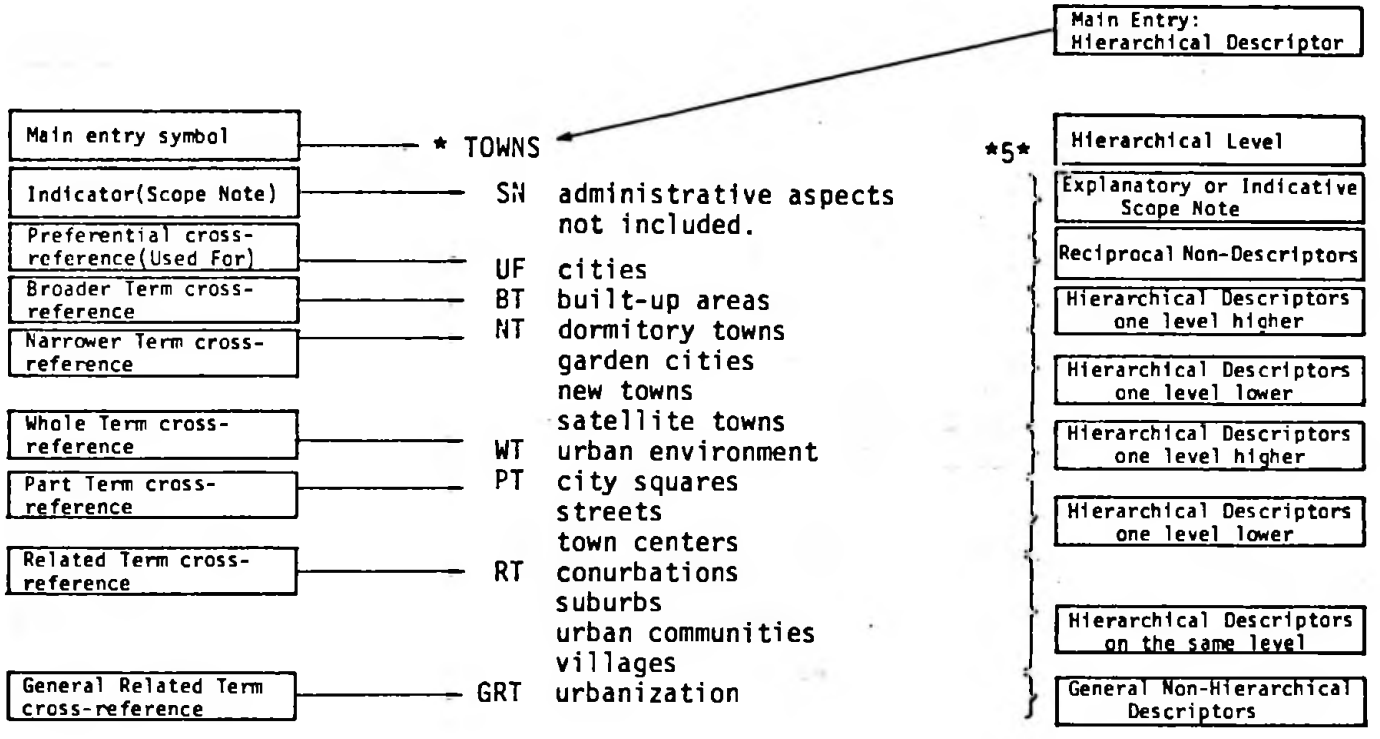


Figure 4: EXAMPLES OF MAIN ENTRIES IN THE ALPHA-HIERARCHICAL LIST

Hierarchical Descriptor

(This example is based on an existing group in the thesaurus, which has been completed, for the purposes of this section.)



Reciprocal Non-Descriptor

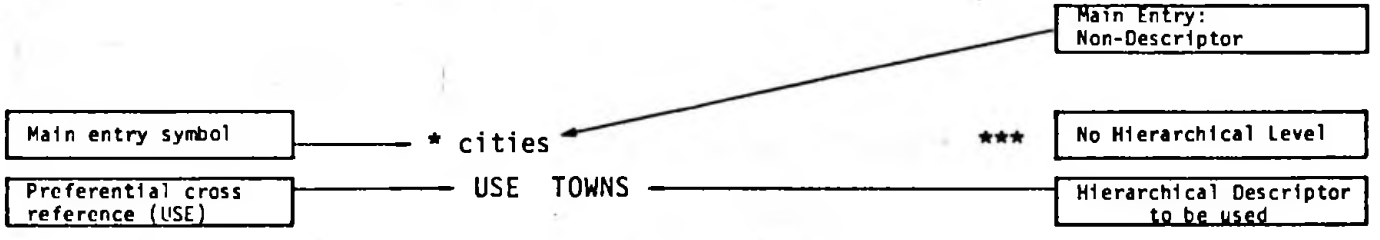
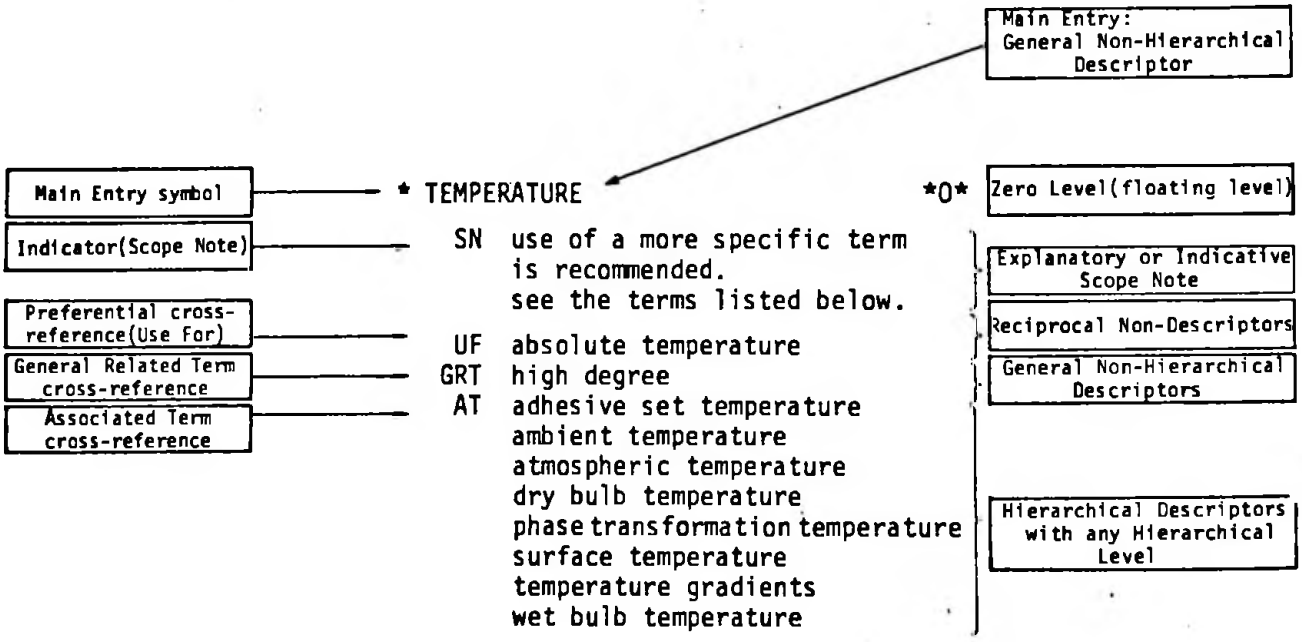


Figure 7: General Non-Hierarchical Descriptor



Guide Non-Descriptor

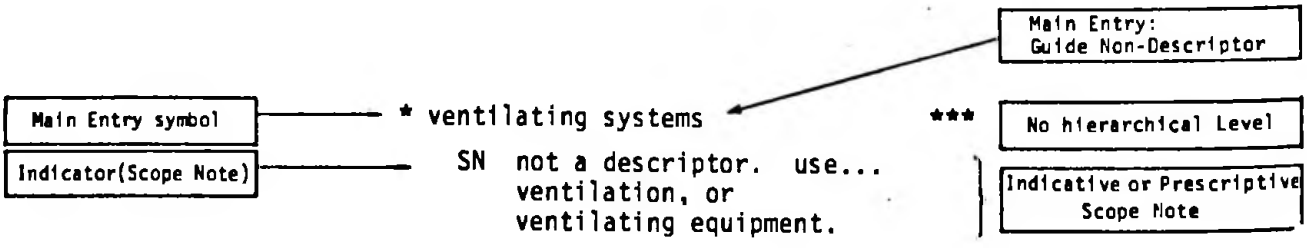


Figure 5: L O G I C A L P R O P O S I T I O N S

P1 (I) can be a type of (J).

P3 (I) is always of type of (J).

P2 (J) can be a type of (I).

P4 (J) is always of type of (I).

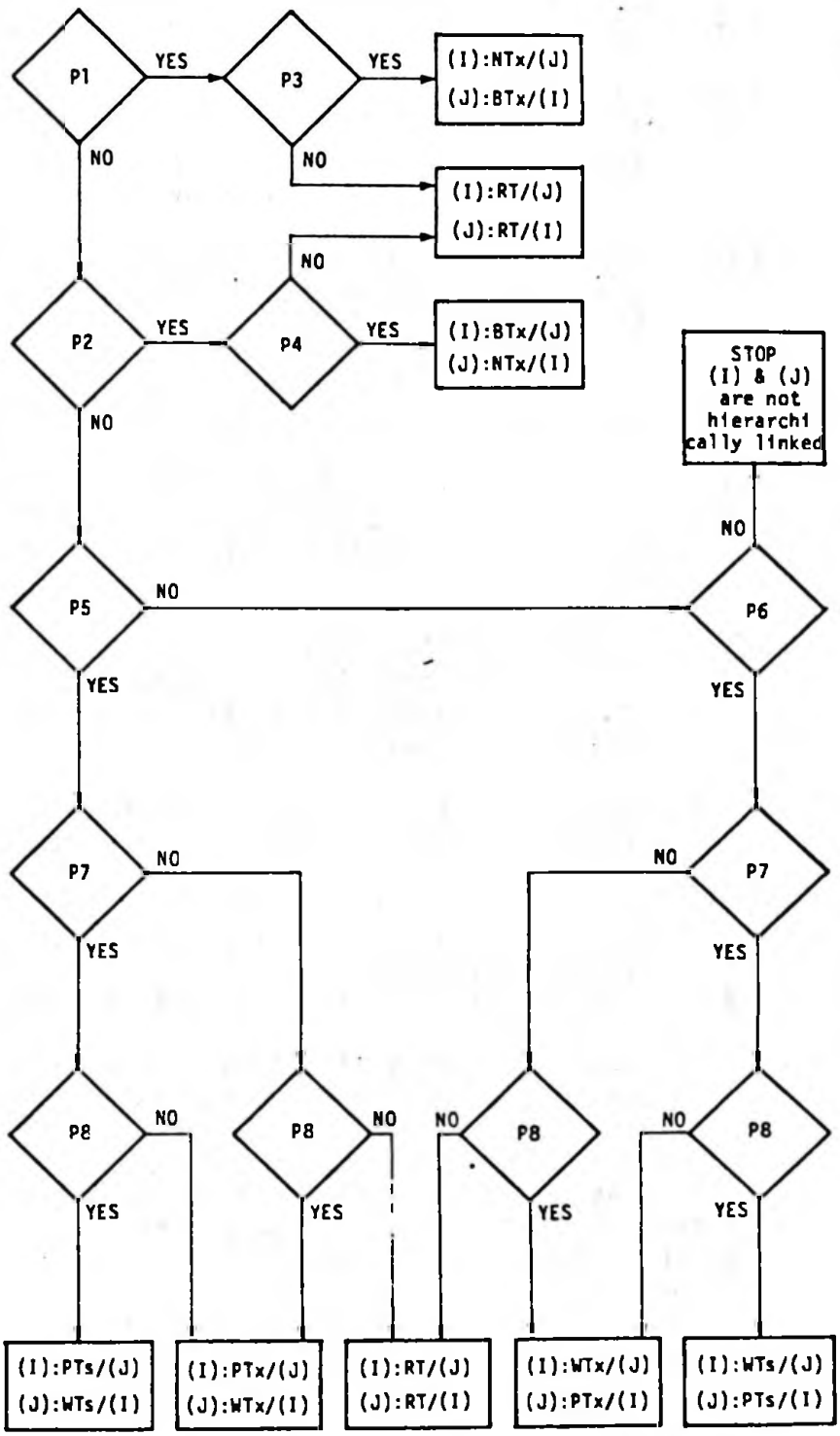
P5 (I) is an element, a sub-set a sub-system or an aspect of (J).

P6 (J) is an element, a sub-set, a sub-system or an aspect of (I).

P7 if (I) exist, then (J) exist.

P8 if (J) exist, then (I) exist.

(s : specific)
(x : less specific)



(iv) Let I be CITY SQUARES and J be TOWNS

P 1: CITY SOUARES can be a type of TOWNS - false
P 2: TOWNS can be a type of CITY SOUARES - false
P 5: CITY SQUARES can be an element, a sub-set, a sub-system or an aspect of TOWNS - true
P 7: if CITY SQUARES exist, then TOWNS exist - true (since TOWNS UF CITIES)
P 8: if TOWNS exist, then CITY SQUARES exist - false

therefore CITY SQUARES is a PT_x of TOWNS (though it is just possible there may be another intermediate term yet to be found)

(v) Let I be URBAN ENVIRONMENT and J be TOWNS
a similar procedure leads from P 1 to P 2 to P 5 to P 6 to P 7 to P 8; therefore URBAN ENVIRONMENT is a WT of TOWNS

(vi) Supposing, by chance, one had stated:
Let I be NEW TOWNS and J be SATELLITE TOWNS

P 1: NEW TOWNS can be a type of SATELLITE TOWNS - false
P 2: SATELLITE TOWNS can be a type of NEW TOWNS - false
P 5: NEW TOWNS can be an element (etc) of SATELLITE TOWNS - false
P 6: SATELLITE TOWNS can be an element (etc) of NEW TOWNS - false

therefore STOP! NEW TOWNS and SATELLITE TOWNS are not hierarchically related. In the event, they are both NT of TOWNS, and could be RT's of each other (though in practice it may not be worthwhile showing the RT relationship)

(vii) Supposing, by chance, one had stated:
Let I be DORMITORY TOWNS and J be GARDEN CITIES

P 1: DORMITORY TOWNS can be a type of GARDEN CITIES - false
P 2: GARDEN CITIES can be a type of DORMITORY TOWNS - after some hesitation: - true
P 4: GARDEN CITIES is always a type of DORMITORY TOWNS - false

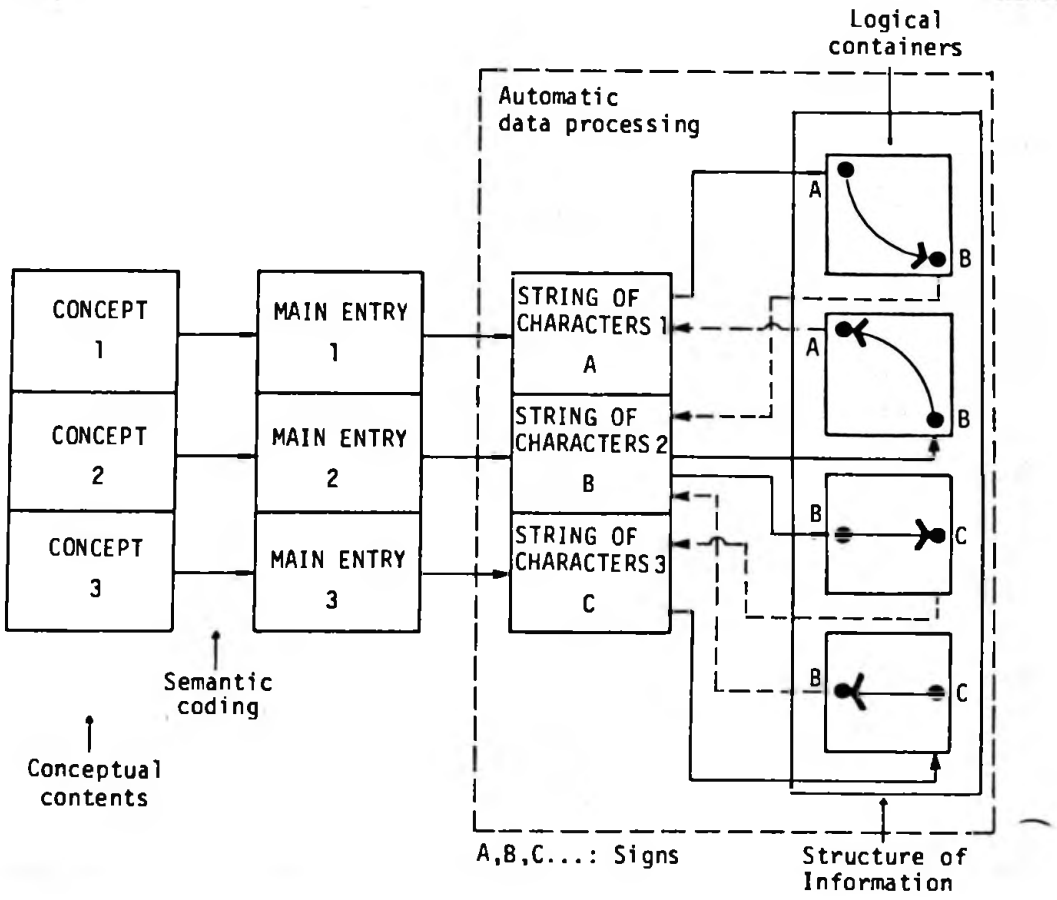
therefore GARDEN CITIES is a RT of DORMITORY TOWNS
(In this case they are both NTs of TOWNS, relationships which emerge sooner or later).

This is actually not as laborious as it seems, because one becomes adept at the logical propositions and only has to linger over them in controversial cases.

Data processing played an important part in the structure of the thesaurus, particularly in terms of methodology (fig. 6). The relationships between concepts which make up the hierarchy of the thesaurus are reflected at the level of the logical containers within the automatic data processing; the logical containers must be able to be processed

Figure 6: The role of data processing.

Suppose concept 1 is at level (n - 1), concept 2 is at level (n + 2), concept 3 is also at level (n + 2);
(i) Suppose that the logical propositions show that A is a BT of B - the data processing will (a) check that B is on one level below A and (b) then enter the cross reference and its reciprocal (B is an NT of A; A is a BT of B).
(ii) Suppose that the logical propositions show that C is an RT of B - the data processing will (a) check that C is on the same level as B and (b) then enter the cross reference and its reciprocal (B is an RT of C; C is an RT of B).



(2) See introduction 6. Thesaurus Development.

without knowing about the conceptual content to which they correspond.

Computer science does not have access to the semantic content of the data that is being processed; it deals only with the processing of symbols and numbers. Because of this characteristic, computer science provides - at all stages - the best possible logical check of the chosen structure and its rules. Identifying and dealing with special cases and "exceptions" have a detrimental influence on the clarity, concision and efficacy of the computer programs; any rule that has no logical relationship to the set of rules will be spotted quickly. In this way, computer processing of data is an effective way of appreciating the elegance and consistency of the structure as a whole.

What does this structure mean for the user of the Thesaurus? We have used the term "conceptual space" to describe the structure as a whole; each descriptor (which is a "label" for a concept) has an unique position within the conceptual space. Experience shows us that this is a great asset in guiding towards the best descriptor with which to describe a concept - whether in indexing comments, indexing queries or whether for other purposes for which concepts and their relationships are useful. The "conceptual space" is too complicated to represent graphically in its entirety (see, however, fig. 3 for an extract relating to our example TOWNS); the regular user of the Thesaurus - by constantly referring to the hierarchical groups - quickly forms a mental image of the main features of the "conceptual space".

The Process of Evolution.

A thesaurus - we stated - is a controlled and dynamic vocabulary... In our case, we developed the Thesaurus up to a certain point prior to using it for indexing; during that time, we drew upon the work of the Construction Industry Thesaurus team (Ref.5) whenever appropriate, to increase the chances of compatibility. Then the draft thesaurus was used for indexing. During this time, some candidate terms were being generated; they were "fitted in" to the structure, using the same logical propositions. Sometimes obvious "gaps" were thus filled in; sometimes term errors were corrected and sometimes (though not often) whole sections of the Thesaurus had to be "slipped" down or up one level (this had major repercussions on RT/RT relationships; in practice we found that any such major upheaval actually often lead to the elimination of some questionable RT/RT relationships).

The English edition of the I.F. Thesaurus was published as soon as we felt confident that the rate of changes was being reduced; this was in May 1972. Since then we have published one set of addenda and corrigenda.

A more significant aspect of the process of evolution is particular to the bilingual status of Canada. We have translated the Thesaurus into French (a "rough" translation, which reflects the structure of the English Thesaurus but contains some term forms we are not

satisfied with). This involved preparing sets of computer programs, enabling monolingual or bilingual alpha-hierarchical and non-hierarchical listings to be produced - with English or with French entry. Possibly thanks to the discipline in the structure, we did not encounter too much difficulty with the descriptors, though many of the non-descriptors did not need to be translated.

More significantly, however, is the fact that we are now collaborating with the Groupe Latin (a sub-group of Commission W.52 of the International Council for Building Research, Studies and Documentation) in preparing a basic latin-language thesaurus for building. Thanks to the collaboration of the researchers in the Groupe Latin, the coverage of the French Thesaurus is being improved; this in turn will be fed back into the English edition.

Obviously, the massive addition of new terms poses major problems - both in the hierarchical structuring of these terms and in data processing. An ideal we would like to attain would be to have the Thesaurus on-line on a CRT, so that one could "walk-through" the conceptual space, making improvements on the way.

CONCLUSIONS

This paper has scarcely mentioned the problems of indexing and the related problems of indexing rules. It is our experience, however, that for all aspects of working with, or on, a thesaurus the "scientific" approach is advisable. The rigorous structure enables the user to identify the position of the concept within the conceptual space; the logical propositions enable the hierarchical groups to be fully understood, and the significance of the relationships between terms to be grasped. Once this has been accomplished, indexing rules and search strategies can be built up appropriately.

Footnotes.

(1) Industrialization Forum - Building: Systems, Construction, Analysis, Research; published in English and in French jointly at Massachusetts Institute of Technology, Washington University and Université de Montréal; see: Wert, Leonard, "Information Retrieval and Industrialization Forum". Industrialization Forum, Vol.1, No.1 (October 1969), pp.11-17.

(2) Engineers Joint Council. Thesaurus of Engineering and Scientific Terms. New York, Engineers Joint Council, 1967, 690pp.

(3) Building Research Thesaurus; compiled in the Library of the Building Research Establishment, revised edition, Garston, Building Research Establishment, Department of the Environment, 1972 , 1 vol.

(4) Canada. Department of Industry, Trade and Commerce. Materials Branch. Thesaurus of Canadian Construction Terminology, preliminary edition. Ottawa, Department of Industry, Trade and Commerce, 1971, 1 vol.

(5) Roberts, Michael, Chris. Eve, PeterLinn and Ellen MacHale: Construction Industry Thesaurus; second preliminary draft. North Western Polytechnic School of Librarianship and the Polytechnic of the South Bank, 1971, 1 vol.

(6) Thésaurus du Bâtiment et des Travaux Publics. Paris, Institut Technique du Bâtiment et des Travaux Publics, 1970, 149pp. This document is now being merged into a basic latin-language building thesaurus in preparation by the Groupe Latin of the International Council for Building Research, Studies and Documentation.

(7) General Terms exist ex-hierarchy (e.g. TEMPERATURE, see fig.7) they have associative relationships with other General Terms (designated General Related Term - GRT) or with hierarchical terms (designated Associated Term - AT). Since the General Terms are ex-hierarchy, there can be no question of hierarchical levels in their cross-references.

(8) For example, E.J.C. puts part terms in the RT groups; whereas the Thesaurus of Canadian Construction Terminology puts them in the NT relationships. For an attempt to sort out RT's, see the introduction to: Barhydt, Gordon C. Charles T. Schmidt and Kee T. Chang. Information Retrieval Thesaurus of Education Terms. Cleveland, Press of Case Western Reserve University, 1968, 133pp.

(9) This restriction means that the associative relationship is only shown between descriptors that are "comparable" - in the sense that they represent concepts of analogous generality or specificity.