Lib sc. 11; 1974: PAPER A.

Interdisciplinary Research and Classification Problems: A Case Study.

(Classification problems. 83).

A Neelameghan, *Documentation Research and Training Centre, Indian Statistical Institute, Bangalore 560 003.*

Interdisciplinary associations lead to the emergence of hybrid disciplines. Interdisciplinary association may be of two types — multi-disciplinary association and interdisciplinary borrowing. Multi-disciplinary association may be juxtaposition studies or convergence of view points. Interdisciplinary borrowing involves borrowing of techniques and tools, or borrowing of data, or use of principles and theories. The emergence of hybrid discipline pose problems in classification. Some of these problems are highlighted by taking the newly emerging discipline of cycle research as a case study. Cycle research is a general theoretical study of cycle phenomenon. It can be deemed to be formed by either of the two modes of formation namely distillation and clustering. In Colon Classification, ed 7, Cycle Research may be accommodated in the schedule of Personality Isolates in the Basic Subject BTM Time Series Analysis.

1 Introduction

11 Emergence of a Hybrid Discipline

Interdisciplinary interaction and flow of ideas promote the development of new ideas and the emergence of new disciplines. In establishing such interdisciplinary communication one approach appears to be to examine the "empirical universe and to pick out certain general phenomena which are found in many different disciplines, and to seek to build up general theoretical models relevant to these phenomena." This is one form of interdisciplinary association and a methodology in general systems research (1). For example, such inquiries on common phenomenon have included "growth", "entropy", "feedback and control", and "homoeostasis", in diverse systems — physical, biological, and sociological. The founding of an institute, the starting of a periodical, and/or the organisation of a interdisciplinary conference to discuss such a common phenomenon may mark the explicit recognition of specialists in diverse fields of a possible interdisciplinary association. This can also be an indication to the information scientist in general, and the classificationist and classifier in particular, of the emerging interdisciplinary association and the possible emergence of a new hybrid discipline.

12 Study of "Cycle" Phenomenon

An interdisciplinary association which has come into prominence is the study of periodic, rhythmic, and cyclic pattern of phenomenon in diverse systems. The International Institute for Interdisciplinary Cycle Research (Leiden), a division of the Foundation for the Study of Cycles (Pittsburgh, Pa, USA), is particularly concerned with the promotion of the study of such phenomenon. The *Journal of Interdisciplinary Cycle Research*, published for the Institute by Swets & Zeitlinger, Amsterdam, aims "to unite in one scientific journal all reports in the field of cycle research which in the past were scattered over many scientific journals covering a great number of different disciplines. By bringing these papers together the Editorial Board hopes to stimulate interdisciplinary cycle research not only because of the similarity of the methods applied in different fields of cycle research, but also because of increasing conviction of many scientists that, apart from the direct mechanisms involved in cyclic phenomena, other still unknown exogenous forces, partly of an extra-terrestrial origin, seem to be responsible for long term endogenous rhythms in the living organisms: plants, animals and man" (5). This description of the scope of the periodical may appear to confine the study of cyclic phenomena to biological systems. However, the periodical does publish contributions on cyclic phenomenon in non-biological systems. For example, volume 4, number 1, 1973, carries the article "Analysis of Cyclic Labour-Management Relations" by A M Strauss and R L Huston. The International Institute has already sponsored three International Interdisciplinary Cycle Research Symposia. The papers contributed to the third symposium held in Noordwijk (The Netherlands) from 22–28 August 1971 have been published in volume 3, number 3–4, 1972 of the periodical mentioned above. The papers are grouped as follows:

I Biological Cycles in Plants and Animals
  1 At the Cellular Level
  2 In Living Organisms
  3 At Population Level
II Entomological Cycles
III Physiological Cycles
IV Medical Cycles
V Veterinary Cycles in Domestic Animals
VI Cycle Statistics
VII Geophysical Cycles
  1 Meteorological Cycles
  2 Geological Cycles
  3 Astronomical Cycles

VIII Fluctuating Phenomena
IX Cycle Synchronies

Out of the forty-nine papers discussed at the Conference, the following may be considered to be studies not confined to biological and geological systems:

1 Possible planetary effects at the time of birth of "successful" professionals: An experimental control.
2 Cycles in economic phenomena.
3 Historical changes in social cycles.
4 Daily, monthly and yearly fluctuations in total number of suicides and suicide attempts in the western part of the Netherlands.
5 Cycles determination.

2 Interdisciplinary Association

Pierre de Bie points out that in problem-focussed research a distinction can be made between multi-disciplinary research and inter-disciplinary research on the basis of the level of integration of the disciplines involved. Some of the features of interdisciplinary association are mentioned in the succeeding sections (3).

21 Multi-Disciplinary Research

211 *Juxtaposition of Studies on a Phenomenon*

A research programme or the investigation of a phenomenon may require the calling in or efforts by specialists in two or more disciplines. They may make a more or less parallel study of the various aspects of the problem from the angle of their respective fields of specialisation and produce separate reports. Even a mere juxtaposition of the reports may throw some light on the problem; at least the combined findings may provide a fuller and less one-sided view of the problem; and further, it may trigger interdisciplinary association. For example, papers and reports generated by international programmes, such as the International Geophysical Year, or the Indian Ocean Studies, or by symposia on a subject such as pollution, brought together in a volume or a series of volumes may provide for such interdisciplinary association in relation to the phenomenon investigated.

212 *Convergence of Viewpoints*

The specialists in diverse disciplines involved in the study of a phenomenon may synchronise their efforts and exchange information on their respective findings or viewpoints at different stages of research. This may lead to or facilitate the preparation of a joint report or summary integrating the findings. A convergence of the findings and recommendations, if any, of the group is sought in the joint report. This may indicate a common idea or other element detectable or emerging from the approaches or studies by the specialists with respect to the problem concerned. In due course this common element may form the core entity of study in a new interdisciplinary field. For example, in the Epilogue to the *Hierarchical Structures*, edited by Whyte, Wilson, and Wilson (10) two features of hierarchical structure are shown to be common to structures in diverse subject-fields. This formulation is based on the papers contributed to the symposium on hierarchical structures by specialists in different disciplines.

In as light variation of the above pattern of association among disciplines, the specialists in different disciplines investigating a phenomenon may compare their working hypotheses and methodology, so that all of them work towards verifying one and the same hypothesis though, perhaps, from different angles and using different methodology. In the resulting joint report a greater amount of convergence and integration of views may be found than in the collection of reports mentioned in the preceding section.

22 Inter-Disciplinary Borrowing

221 *Borrowing of Techniques and Tools*

In the investigation of a problem or in setting up models, one discipline may make use of the techniques, tools, and methodology mainly developed in another discipline or disciplines. The application of measuring techniques, mathematics, logic, statistical techniques in such fields as physics, chemistry, biology, agriculture, medicine, linguistics, psychology, political science, economics, and sociology is well known.

222 *Borrowing of Data*

A similar feature in interdisciplinary association is the use of data collected or generated in one discipline by another. Such interdisciplinary borrowing does help in the conservation of research potential by minimising unnecessary duplication of effort. Thereby it also accelerates the development of the borrowing discipline at least.

223 *Use of Principles and Theories*

A greater amount of integration between discipline may occur when one discipline uses the principles and theories of another discipline or disciplines for its own development and for the formulation of guiding principles and theories of its own.

Piaget (8) points out that in respect of the type of interdisciplinary association mentioned above one may note a hierarchy of increasing complexity among the disciplines in the natural sciences when arranged in the sequence mathematics, physics, chemistry, and biology. It means that a physicist needs to have a knowledge and requires the use of mathematics; that a chemist needs to have a knowledge and requires the use of physics and mathematics; and that a biologist needs to have a knowledge and requires the use of chemistry, physics, and mathematics. Out of such interdisciplinary association new disciplines such as astrophysics, biochemistry, geophysics, genetic epistemology, and psycholinguistics emerge. Piaget calls such association as "hybridisation with fruitful recombination or mutual enrichment" as differentiated from the mere use of data or techniques of one discipline by another.

3 Cycle Research

In the investigation of cyclic phenomenon in diverse fields or systems, interdisciplinary association of different levels of integration appears to exist concurrently. The scope and some relevant features of cycle analysis or cycle research are the following (2, 4).

31 Cycle

A " cycle " may be defined as a sequence of events that brings a phenomenon back to the stage it started with. For example, from larva to pupa to adult stage to larva again. Similarly, from seed to seedling to adult plant to flowering, to seed again.

32 Cycle Analysis

" Cycle analysis " is concerned with the detection, definition, and evaluation of repetitive behaviour patterns in numerical data. It is a particular aspect of time series analysis in statistics. In time series there are three components, namely, trend, cycle, and randomness; in this the term ' cycle ' denotes a single oscillation. An epoch is any fixed point on a curve depicting the oscillatory pattern. In a succession of cycles, the epochs may occur at more or less regular time intervals — that is, with rhythm. Therefore, cycle analysis is also called rhythm analysis. Harmonic analysis, periodogram analysis, and spectrum analysis are helpful in detecting cycles.

33 Comparative Cycle Analysis

It has been observed that rhythms of approximately the same period occur in a variety of phenomena. And noticing the synchronisation of epochs in such rhythms has led to the investigation of possible interrelation among the disciplines and systems involved. Such a study forms part of " comparative cycle analysis ". The existence of rhythmicity has been observed for many years in diverse systems: astrophysical systems, meteorological data, biological systems, geological data, medical phenomena, and sociological data. It has also been noticed that cycles of the same period occur at more or less the same calendar time. It suggested that such a behavioural pattern might not be purely accidental, but that an inter-relationship might exist among the diverse phenomena or the different systems might be responding to a common stimulus or a common control mechanism. Thus, the basis of comparative cycle analysis is the assumption that there may be, at least in certain cases, exogenous cycles relationships and that multidisciplinary investigation going across the boundaries of individual disciplines in which the cycles have been noticed would help to identify the exogenous causes.

4 Modes of Formation of Basic Subjects

The different modes of formation of basic subjects and their accommodation and representation in a scheme for classification have been discussed in a series of papers (6). A review of interdisciplinary association and the problems of classification is under preparation. The modes of formation of relevance here are " distillation " and " clustering ". When an idea denoting a practice-in-action occurring initially as a facet in diverse fields attains the status of an independent discipline — for instance, with its own general principles and theory distilled out of the experience in the diverse fields — then the new discipline is deemed to be formed by the distillation mode. In a somewhat analogus manner, when a particular idea denoting a phenomenon occurring as a facet in diverse subjects becomes the focus or nodal point of study with inputs from diverse disciplines to form a new discipline then the new discipline is deemed to be formed by the clustering mode.

5 Cycle research: Varying Levels of Integration

A perusal of the published documents on cycle research and taking into consideration the objectives and activities of the International Institute for Interdisciplinary Cycle Research and of the *Journal of Interdisciplinary Cycles Research* mentioned above, it would appear that both multidisciplinary association and interdisciplinary research of various levels of integration of the following types exist or are being promoted in relation to studies of cyclic phenomenon:

— Identifying common features of rhythmic phenomenon occurring in diverse subjects;

— Formulation of general theories/principles explaining cyclic phenomenon in diverse systems;

— Interdisciplinary research in cyclic phenomenon *per se*, without reference to any particular system or subject-field; and

— Bringing together in juxtaposition studies on cycle phenomenon in diverse fields; and

— Interdisciplinary borrowing of methods and techniques in the investigation of cyclic phenomenon.

6 Classification of " Cycle " Studies

Thus, one finds documents dealing with the subject in the following ways:

61 The study of cycles or rhythms as such without reference to its occurrence in any particular field such as biology, geology, or economics except for the purpose of providing illustrative examples to explain or support a theory or principle.

Such studies may warrant cycle phenomenon being treated as an independent discipline, the mode of formation of the discipline being that of distillation. However, the Basic Subject, Time Series Analysis forming a division (fission) of Statistical Calculus can conveniently accommodate such subjects. " Cycle " would form the core entity of study (personality isolate) in subjects going with Time Series Analysis. In Colon Classification, ed 7, Time Series Analysis is scheduled as follows:

BT	Statistical Calculus
BT1	Probability
...	... ...

BTE Multivariate Analysis
... ...
BTH Sequential Analysis
BTK Index Number
BTM Time Series Analysis
BTN Actuarial Analysis
etc etc etc

62 Collections of studies on cyclic or rhythmic phenomenon in diverse fields being brought together as in a periodical such as the *Journal of Interdisciplinary Cycle Research* or a volume of papers and proceedings of a symposium or conference with specialists in diverse fields contributing to the study of cycle phenomenon from their respective speciality point of view.

This may warrant cycle research being deemed as a focus of study in a discipline formed by the clustering mode, in treating cycle as the core entity of study (personality isolate) going with the Basic Subject Time Series Analysis (see 61), the features of a cluster have been recognized and provided for.

In an earlier paper (7) the close analogy and difficulties in distinguishing between the distillation mode and clustering mode of formation of subjects have been indicated. This problem is well illustrated in considering the pure theory of cycle phenomenon as a discipline formed by distillation mode, but provided for as if formed by clustering, and a collection of papers on cycle also being accommodated in the same class. If a distinction is sought to be made between the two— that is, pure theory of cycle phenomenon and a collection of papers on cycle phenomenon observed in diverse fields — the latter can be expressed using the common isolate (anteriorising), ' collection ' suffixed to the class " Time Series Analysis, Cycle ".

63 The study of rhythm in a specific field or system. For example,

(*a*) Periodicities in the daily records of global radiations at College Park, Maryland; and

(*b*) Seasonal variations of congential malformations.

Each of the subjects will go with the appropriate Basic Subject— Atmospheric Sciences and Human Biology respectively — and " cycle " or a particular form of it, can be represented as a property isolate in each case. In the arrangement of these subjects in the classified sequence, the studies on cycle phenomenon will naturally be dispersed by the subject fields in which the phenomenon has been reported. The entries in the alphabetical subject index (to the cacalogue or documentation list) will indicate all the subjects in which cycle phenomenon is an isolate.

If, however, there is a dominant continuing interest in a particular group of clientele to study rhythmic or cycle phenomenon irrespective of its field of occurrence and therefore would prefer all the studies being brought together in a small range of entries, it may be done by creating a class "Applied Cycle Phenomenon " as an adjunct to the class " Time Series Analysis, Cycle ". The latter would accommodate studies of the pure theory of cycle phenomenon, whereas the former would accommodate the diverse subjects in which cycle phenomenon is observed.

In an earlier paper the preparation of duplicate set of entries in each case has been discussed (9).

7 Acknowledgement

The problem of classification of " cycle " research was brought to my notice by Ms Judith Rendle, a participant in the course Special Topic in Librarianship, (Fall 1973), School of Library and Information Science, University of Western Ontario, London, Ont, Canada.

8 Bibliographical References

1 Sec 11 BOULDING (K E). General systems theory — the skeleton of science. (*In* Buckley (C W), *Ed.* Modern systems research for the behavioural scientist. 1968. Chapter 1).

2 Sec 3 CROXTON (F E), and COWDEN (D J). Applied general statistics. Ed 2. 1955.

3 Sec 2 DE BIE (P). Problem-focussed research. (*In* Main trends of research in the social and human sciences. Part 1. Social sciences. 1970. Chapter 9).

4 Sec 3 DEWEY (E R). Cycles and periodicities. (*In* Fairbridge (R W), *Ed.* Encyclopedia of atmospheric sciences and astrogeology. 1967. P 295–300).

5 Sec 12 *Journal of Interdisciplinary Research*. 1972. Amsterdam, Swets & Zeitlinger. N V.

6 Sec 4 *Library Science with a Slant to Documentation*. V10, N2; 1973, June. Papers F to P.

7 Sec 62 NEELAMEGHAN (A). Primary basic subject by clustering. (Lib sc. 10; 1973; Paper K, Sec 53).

8 Sec 223 PIAGET (J). General problems of interdisciplinary research and common mechanisms. (*In* Main trends of research in the social and human sciences, Part 1. Social sciences. 1970. Chapter 9).

9 Sec 63 RANGANATHAN (S R). Conflict in classification for document retrieval. (Lib sc. 2; 1965; Paper K).

10 Sec 212 WHYTE (L L), WILSON (A G) and WILSON (D), *Ed.* Hierarchical structures. 1960. Epilogue.