

DEMATEL

Perceptions of the World Problematique

Report No 1

Communicating with those bearing collective responsibility

I. INTRODUCTION

The objectives of DEMATEL (Decision Making Trial and Evaluation Laboratory)

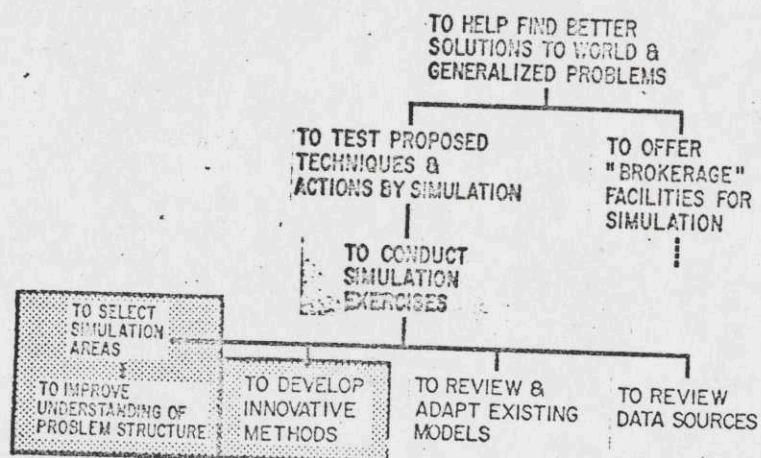
Growth in the Western World for the past 20 years has created a growing concern about the future of our society.

A variety of critical problems of considerable complexity has emerged. Among problems sharing a planetary dimension some have a world nature and require analysis and solutions at world level ; others are widespread and appear as "generalized", common to many areas of the world and requiring locally adjusted solutions ; most seem to be somehow interrelated, by multidimensional channels, in a world "problematique" which conditions the predicament of mankind.

Battelle, with its international and multidisciplinary research capabilities, has underway a significant number of thrusts toward the challenges that this situation presents to human ingenuity and scientific endeavour. These thrusts, for example, include the activities of the Human Affairs Research Centers in Seattle, a Research Center for Applied Behavioral and Social Sciences in Frankfurt, The Academy for Contemporary Problems (with the Ohio State University) in Columbus, and a Science and Human Affairs Program, within the framework of Battelle Institute*, while at the level of the laboratories there are mission-oriented activities in education, health, urbanization, environmental problems, and so on.

Within this extensive Battelle effort, DEMATEL is being developed in the belief that pioneering and appropriate use of scientific research methods can improve understanding of the world problematique and can contribute to identification of workable solutions at a global level.

DEMATEL OBJECTIVES



* A Battelle-funded set of research programs, consisting of specific research projects, conferences, publications, and appointments.

The idea of the DEMATEL project arose from the determination to acquire a better knowledge of the world society and its development. The latter in particular raises many problems at the level of individual or collective perception. There are believed to be two main reasons for this complexity.

The first is that the majority of individuals either knows of no purpose for the world or society, or at least does not agree on one. This can be expressed in another way by saying that there is no universally accepted ideal.

The second is the virtually infinite fragmentation of the world society. As revealed explicitly in its laws or implicitly in its customs, each fragment has particular goals reflecting more-or-less fundamental aspirations. The evolution of these fragments then has led to situations where the goals have drifted apart and lost part of their content, if they have not actually developed into conflicting situations.

The attainment of any goal depends on the solution of one or more problems. To qualify as being of worldwide import, a problem must fulfil the following conditions :

- (i) its solution is necessary to one or more important goals
- (ii) these goals must be of concern to a high proportion of the human race.

It is difficult to acquire knowledge of the aims of human beings. For this reason - and this constitutes the originality of the study - it was decided to take the problems of which people are aware as the starting-point of the search for a pattern(s) of goals. In other words, milestones of DEMATEL are to :

- analyze the problems of which groups or individuals are aware
- investigate the perceived and factual relations between these problems
- find the pattern(s) of goals which fits that of the problems.

The results of such a program can serve as a basis for a reappraisal of the goals and values of society in the light of new conditions, thus stimulating a better focusing of research effort on the important problems. To achieve this is one of the chief motivations of the research team. Once this point has been reached, the team will orient its work towards applying available techniques of modeling and simulation games to the evaluation of possible solutions to the problems set.

In this respect, the setting up of a "DEcision MAKing Trial and Evaluation Laboratory" for the simulation of world action programs must be considered as an ultimate objective and one of the possible concrete results of the study. Such a laboratory could offer :

- (i) facilities for carrying out simulation gaming exercises and developing new methods of helping to find and evaluate solutions
- (ii) "brokerage" facilities, i.e. a place for the exchange of experiences, models, information, etc.

The DEMATEL project was initiated at the end of 1971 under the Science and Human Affairs Program of Battelle Institute.

During its first two years of operation it has been concentrated on three major areas of research :

- the study of the world problem structure ("problematique");
- the development and adaptation of methodologies suitable to the analysis of complex world problems (dealing mainly with interactive man-model techniques and methods to evaluate qualitative and event-linked aspects of societal problems);
- the review of existing studies, models and data sources related to world problems.

The present report deals only with the first results of the study of the world problematique

In order to understand the relationships between problems, it was felt necessary to consult those who, in one way or another, bear collective responsibility (statesmen, leaders of opinion, scientists, philosophers, artists ...), and a procedure for communicating with them was established ; it is described in the next chapter of this Report No. 1.

The analytical tools developed in order to obtain an interpretation of the different perceptions of the world problematique are explained in Report No. 2, illustrated by some selected examples. This report also describes methods for identifying and analysing areas of agreement among groups of respondents' perceptions, and methods for making comparisons of problem structures.

Report No. 1 has been prepared by A. Gabus, chief investigator, DEMATEL project, with the assistance of Dr. E. Fontela and Dr. C. Velay, and other members of the DEMATEL team in Battelle-Geneva.

II COMMUNICATING WITH THOSE BEARING COLLECTIVE RESPONSIBILITY

a) A communication procedure

If the need for a dialogue between influential persons and the scientific and technical community has been recognized, ways remain to be defined to ensure its meaningfulness to improve the understanding of the World Problematique.

The DEMATEL team developed and tested a communication procedure in 1972. This procedure was started to be implemented in 1973. It has two main components :

- (i) a document inviting influential persons to communicate their thoughts in response to closed and open questions
- (ii) an interview based on the analysis of the written answers given under (i).

The document referred under (i) is to be compared with a questionnaire with blanks for written comments. It was published under the title WORLD PROBLEMS - AN INVITATION TO FURTHER THOUGHT in January 1973.

The preparation and the implementation of the whole procedure is described hereafter

b) Preparation of the communication procedure

Problem selection and definition

Content analysis of texts such as President Nixon's Report on the State of Union, Brejnev's declaration to the Annual

Meeting of the Soviet Trade Unions, Proceedings of the 1971 U.N. Conference on Tariffs and Development, etc., enabled us to retain 60 topics considered by various authors and organizations as critical issues of worldwide concern. These issues had to be expressed in terms of problems. It was therefore necessary to find a definition of the notion "problem" compatible with the multidimensional character of the selected topics. The retained definition evidenced that :

- the problems implicitly relate to a value system
- an existing situation judged as unacceptable can be improved (otherwise it is considered as a threat, but not a problem)
- the perceived approaches to solving a problem are numerous (at least for the world and generalized problems).

It followed that the candidate problems had to be stated not as goals to be attained but as unacceptable situations for which there are numerous perceived solutions.

Later, by building up a first interaction matrix of the 60 candidate problems, it was possible to exclude from the list those which were too general or too specific (e.g. the inability of man to adapt to rapid change, or the control of nuclear fusion for energy generation). A definition procedure was then developed and applied to the problems remaining. It was decided that definitions must : (1) contain only the key elements of the problem (in the interests of precision), and (2) be sufficiently broad so that respondents would not be repelled by too narrow a view.

After definitions of the selected problems had been drawn up and a second interaction matrix defined, a volume of definitions for 48 problems was produced which condensed all the information and efforts involved in this first round. The list of these 48 problems is given below.

List of 48 selected problems

A OBSTACLES TO WORLD ORGANISATION

- 1 Inadequacy of the institutional organization of international society
- 2 The difficulty experienced by major powers in defining their interests and responsibilities
- 3 The arms race
- 4 Inadequate regulation of use of the sea

B INFRINGEMENT OF THE RIGHTS OF NATIONS

- 5 Interference by foreign powers
- 6 Interference by multinational companies
- 7 Non-completion of decolonization

C INEFFECTIVENESS OF INSTITUTIONS

- 8 Inability of institutions to adapt to external change
- 9 Political instability, particularly in the less-developed countries
- 10 Insufficient personal involvement in political and economic life

D DIFFICULTIES IN IMPROVING THE STANDARD OF LIVING OF RAPIDLY GROWING POPULATIONS

- 11 Disproportion between the active and inactive population
- 12 Maladaptation of urban concentrations to individual and collective needs
- 13 Poor use of available land

E THE CRISIS OF ADVANCED INDUSTRIAL SOCIETIES

- 14 Physical and mental illnesses characteristic of advanced industrial civilisation
- 15 Loss of the sense of personal security
- 16 Obstacles to fulfilment of non-material aspirations

F SOCIAL DISCRIMINATION

- 17 Racial discrimination
- 18 Recurring threats to the existence of minorities
- 19 Social discrimination based on sex

G THE USE OF VIOLENCE

- 20 Physical violence in political and social conflict
- 21 Infringements of fundamental personal freedoms
- 22 Increase in criminality and delinquency
- 23 Hijacking and sabotage of aircraft

H SHORTCOMINGS IN EDUCATION AND COMMUNICATION

- 24 Communication difficulties due to complexity and multiplicity of jargon and languages
- 25 Intensification of political, economic and cultural propaganda in association with the development of mass media
- 26 Insufficient education of children and adults for an active life

I THE WEAKENING OF HUMAN MOTIVATIONS

- 27 Weakening of collective convictions (social, religious, etc.)
- 28 Difficulties of social advancement
- 29 Acute disparities between living conditions and aspirations
- 30 Production, traffic and use of drugs

J DEGRADATION AND DISFIGUREMENT OF THE ENVIRONMENT

- 31 Lasting damage to vital properties of water
- 32 Damage (including noise) to the properties of the atmosphere
- 33 Damage to vital properties of the soil
- 34 Disfigurement of the environment : destruction of cultural monuments, natural beauties, etc.
- 35 Attacks on man's genetic heritage

K SHORTCOMINGS IN PRODUCTION AND TECHNOLOGY

- 36 Wastage and underemployment of human resources
- 37 Fundamental waste of material and financial resources
- 38 Exhaustion of non-renewable mineral and energy reserves
- 39 Inadequate control of technological development
- 40 Insufficient efforts to anticipate the exhaustion of energy reserves and to produce less pollutant energy

L MONETARY INSTABILITY

- 41 Difficulty in checking inflation
- 42 Crises in the international monetary system

M OBSTACLES TO INTERNATIONAL ECONOMIC RELATIONS

- 43 Lack of capital for aid to the less-developed countries
- 44 Low and fluctuating prices of exports from less-developed countries
- 45 Changes in the flow of international trade due to the establishment of preferential areas

N FAILURE TO SATISFY THE BASIC NEEDS OF THE LESS-DEVELOPED COUNTRIES

- 46 Undernutrition and malnutrition in the less-developed countries
- 47 Endemic and epidemic disease in the less-developed countries
- 48 Housing shortages and deficiencies in less-developed countries

c) Testing the communication procedure

Besides the volume of definitions mentioned above a draft questionnaire was drawn up in 1972 in order to be tested among a small number of respondents. Its aims were

- (i) to obtain the respondent's spontaneous classification of the degree of gravity of the 48 problems proposed and others added by him to the list ;
- (ii) to invite the respondent to think out the links between these problems ;
- (iii) to convey his thinking, so that his perception of the world problematique could be better grasped.

The test included seven respondents to this initial draft questionnaire.

These first respondents found the draft questionnaire too long but were sufficiently interested by the approach to overcome this difficulty.

Their main critical remarks were the following :

- (i) the presentation was "boring" because of the repetitive character of the questions ; this explains probably the fact that only two social scientists were able to provide a non-stop set of answers ;
- (ii) a great ambiguity remained as to the dynamics of the response (is problem x likely to influence problem y "now" or "in the future" ?) ;

- (iii) a pilot respondent noted that in some cases the relation between two problems could be of opposite sign (an increase of ocean pollution (+) could contribute to the creation of new world institutions and therefore to the reduction of the problem created by their inadequacy (-)) ;
- (iv) other respondents added other problems to the list when they were answering the first part of the questionnaire which was dealing with the importance of the problems. However, in the process of answering the questionnaire they became better used to the definitions and abandoned their initial idea that these were additional problems in the same definitional space ; they probably understood that either the topics that they were proposing were already covered in the definitions or that they were at a different level of abstraction ;
- (v) some respondents rejected the existence of some of the 48 problems proposed ; they were not fully consistent with this rejection and used these rejected problems sometimes in the interaction matrix ;
- (vi) some respondents found great difficulties in answering a section of the questionnaire which was dealing with the interaction of themes, due to its high level of abstraction.

Two pilot respondents were interviewed after analysis of their answers to the draft questionnaire. The interviews lasted about three hours.

The pilot respondents were first confronted with the results of the analysis made of their answers to the questionnaire and they recognized that the presentation corresponded quite closely to their views of the world problematique. The discussion then

followed the detail of this previous analysis. Notes of the comments were written down. The interviewers tried as much as possible to avoid to introduce personal opinions, and tried to use the numerical analysis of the questionnaire as a neutral base for discussion.

Both respondents indicated at a later date that the questionnaire and interview procedure had been valuable for their own understanding of the problematique. They were delivered a small report.

- d) Changes in the communication procedure introduced as a result of the comments and criticisms received during the pilot test

The main changes introduced in 1973 deal with the simplification of the questionnaire part of the procedure :

- (i) the general opinion that having two separate booklets for "Definitions" and "Questionnaire" was too complicated lead to a reformed single document ;
- (ii) the considerable confusion created by the word Questionnaire, with its well known survey research connotations, was reduced by giving to this single booklet the following title: WORLD PROBLEMS - AN INVITATION TO FURTHER THOUGHT, a title much better adapted to the fundamental objective of the DEMATEL project ;
- (iii) each problem's definition was incorporated near to the questions relative to this problem ; in order to reduce the bias introduced by the authors of the initial

definition when giving their interpretation of the field of antecedents and consequents of each problem, this definition section was reduced to its intrinsic content ;

- (iv) some definitions were modified for semantic reasons and, as planned, the earlier English draft translations were reviewed and substantially modified by expert linguists ;
- (v) the respondent was given the possibility of immediately rejecting the problem if he did not conceive its existence ;
- (vi) the notions of gravity and urgency were separated ;
- (vii) the section of the draft questionnaire which was dealing with the interaction of themes was suppressed ;
- (viii) the relations were expressed in positive terms (will solution of problem x contribute to solution of problem y) and not on negative terms (will increase of problem x aggravate problem y), following in this way a more frequent thinking pattern ;
- (ix) the layout of the interaction sections relative to each problem was modified, introducing a graphical representation using arrows, and a maximum of seven interactions was explicitly suggested ; sufficient blank space was left for additional interactions and other comments ;
- (x) no answer was found to certain technical problems raised during the preliminary phase, in particular those of interactions with opposite sign, and those of the dynamics of the interactions ; the respondent was made aware of

these difficulties before receiving the questionnaire. It was suggested to him to use the "comments" sections whenever he found these conflicts, and the interviews tried later to put additional focus into them.

A specimen sheet of the revised questionnaire is shown next page.

HOW TO FILL IN THE FORM ?

HOW TO FILL IN THE FORM ?

- a specimen answer



The pattern of the form is as follows:

1. The form is divided into two main sections: a top section for the name and address, and a bottom section for the date and signature.

2. The top section contains a large rectangular box for the name and address, and a smaller box for the date.

3. The bottom section contains a line for the signature and a line for the date.

4. The form is filled in with the following information:

Name: Mr. J. K. Smith
 Address: 123 Main Street, New York, N.Y.
 Date: 1/1/50
 Signature: J. K. Smith
 Date: 1/1/50

denomination of
the problem →

5 Interference by foreign powers

definition

↓ A foreign state uses its power to influence the economic, social, cultural or foreign policy of another state.

States are most exposed to foreign interference when their social cohesion is weak, when their economic development depends on external aid, and when they are situated in the zone of influence of a great power. In order to promote their own interests, countries attempt to influence the policies of others. This may be done by supporting or undermining governments, or by bringing pressure to bear.

(A) Do you consider that interference by some countries in the affairs of others is a real problem? yes no (if not, please pass on to the next problem, p. 6)

- If so, is it mainly an authentic world problem ?
 - a generalized problem ?
 - neither ?

Character

(See Recommendation 5)

- How serious is it for the future of mankind ?

not very serious 1
fairly serious 2
serious 3
very serious 4

Seriousness

(See Recommendation 5)

- How urgent is it to find a solution to this problem ?

not very urgent 1
fairly urgent 2
urgent 3
very urgent 4

Urgency

(See Recommendation 5)

Further comment :

(For example as regards the time available for attempting a solution)

This problem is one of the toughest to solve, since the mere possession of power always creates a temptation to use it. On the other hand, it also confers responsibilities, and a powerful nation may sometimes be justified in intervening.

Analysis of problem 5

(B) The renunciation by the great powers of interference in the affairs of other countries could contribute directly:

Links
(See Recommendation 6)

code (page)	Degree of influence			
	low	medium	high	very high
2 - to providing a better definition by the great powers of their interests and responsibilities	1	2	3	4
7 - to giving political independence to colonies still in existence	1	2	3	4
9 - to reducing political instability in less-developed countries	1	2	3	4
10 - to increasing individual involvement in political and economic life	1	2	3	4
20 - to limiting recourse to physical violence in conflicts	1	2	3	4
25 - to limiting the abusive use of mass media	1	2	3	4
.. -	1	2	3	4

including those which you added to the list of 48 (Recommendation 3)

- other problems the solution of which is facilitated by alleviation of this one

1.8 Persistent threats to existence of minorities	1	2	3	4
2.1 Impingement of personal freedoms	1	2	3	4
.. Prices of exports from less-developed countries	1	2	3	4

- Put a cross in the above circles in cases where you consider that the problems are favourably and DIRECTLY influenced by an alleviation of the present problem 5.
- Next indicate the degree of influence that this problem 5 has on those you have chosen.

(C) Please give any comment you may wish to add concerning your analysis

The problem is rendered more acute by the existence of spirals of interference.

The most important thing seems to be to limit its extent by appeal to certain fundamental principles

e) Implementation of the final surveyCandidate respondents

At the beginning of 1973 a plan was established with a view to obtain participation from 50-80 influential persons within a wide range of schools of thought and cultures.

For this purpose the world was divided into 11 geographical areas covering developed and less-developed countries¹⁾.

In each of these areas, two major countries were selected, the other countries being included in a "rest of the world" group.

In each of the 23 groups finally retained, three main types of persons were selected, i.e.

- decision makers in government and public administration ;
- opinion makers in politics, business, trade unions, etc. ;
- other influential persons in science, art, religion, etc.

Participation

Table 1 shows that 65 prominent persons classified according to these categories and groups have accepted to participate by mid-June 1973. To date (Sept. 1973) 40% of the persons who accepted have returned their completed questionnaire. They originate from all the continents, but so far mainly from North America, France, and Japan. They pertain to the main categories considered : ministers of State, political leaders, presidents or executive secretary of trade-unions, recognized scientists, ...

1) North America, Western Europe, other westernized countries, Soviet Union, China, other socialist countries, North Africa, Black Africa, South America, LDC's in Asia, Japan.

Acceptance

On the basis of the so far received completed questionnaires a cleavage between two attitudes appears. Part of the respondents consider the completion as an interesting duty towards the intellectual community, while the others are enthusiastic. The position of the latter group is usually expressed by their numerous written comments. There is a consensus for recognizing that completing the document is a rewarding exercise.

f) Preliminary results of the survey in process

1. Researched information

Most of the proposed or implemented solutions to the contemporary problems are fragmentary, mainly because societal problems are closely interrelated. If then solutions are to be found for sets of problems, it seems appropriate

- (i) to identify such sets of problems ;
- (ii) to understand better their intrinsic structure and the interrelations between the sets ;
- (iii) to know better how contemporary issues defined in terms of world or generalized problems may develop when one wants to transform unacceptable states of affairs into acceptable situations.

Aims of the analysis

The DEMATEL survey may help to attain these goals by better identifying :

Table 1

STATUS OF THE PARTICIPATION TO THE DEMATEL SURVEY ON WORLD PROBLEMS by mid-June 1973

(most prominent persons only)

	Position	DEVELOPED COUNTRIES			LESS-DEVELOPED COUNTRIES				
		North America	Western Europe	Japan	South Asia	North Africa	Black Africa	South America	
GOVERNMENT AND PUBLIC ADMINISTRATION	Minister of Finance								1
	Minister of Economic Affairs								1
	Minister or Secretary of the Plan								5
	Minister of Education								1
	Minister of State								2
	Ex-Minister of Foreign Affairs								1
	Ex-Minister of Finance								1
	Ex-Minister of the Plan								1
	Ex-Minister of Agriculture								1
	Assistant or delegate to the Prime Minister								2
	Special Advisor to the Prime Minister								1
	Ambassador								3
	General								1
	President of public bank								2
	Executive Secretary								2
Ex-Director of a statistical office*								1	
Director of international organizations								4	
	<i>*member of many governmental committees</i>	3	9	1	7		8	2	30
POLITICS, BUSINESS, TRADE-UNIONS	Party leader of the majority								1
	Senator								3
	Brain trust of prominent party of the opposition								2
	President of big economic associations								5
	Bank Chairman								2
	President General Director								4
	Director of public service								1
	President of Trade Union								3
		1	5	6	3		4	2	21
SCIENCE, ART, RELIGION	Scientific director of national or international organizations								5
	Worldknown futurologist								2
	Worldknown economist								1
	Editorialist								1
	Music composer								1
	Scientific oriented monk								1
	Influent bishop								1
	Professor								2
		2	5	3	1		3		14
		6	19	10	11		15	4	65
Main Countries visited		United States Canada	France (Germany, Italy Switzerland)	Japan	Indonesia Thailand India	Egypt Algeria	Nigeria Ivory Coast	Brazil (1 count.)	

- (i) the objectives set up by influential persons for the world as a whole or a part of it (e.g., developed countries versus less-developed ones) ;
- (ii) the key problems to be solved better for achieving the intended objectives, some of which constitute privileged action fields for the respondents ;
- (iii) the meaningful relations for
 - the definition of sub-systems in the thought process of the respondents
 - a better knowledge of the functioning of society.

Identification of objectives, key problems, and selected relations are based on three types of results :

- (i) a classification of problems according to their degree of gravity and urgency as well as their predominant character (world or generalized) ;
- (ii) a hierarchy of problems according to their interrelations and the intensity of such interrelations ;
- (iii) graphs showing the hierarchy and interrelations.

Two distinct types of results must be considered :

- (i) the perception analysis of a given influential person (individual analysis) ;
- (ii) the identification and the comparison of the perception of different groups of persons (consensus and disagreement analysis).

The two types of analysis are conducted along rather similar lines.

2. Analysis procedure

In most cases the number of interrelations established by a respondent is very large, and many are cycled in one or several sub-systems. Consequently, a perfect directed graph or "digraph" cannot usually be produced. For this reason, various reductionist methods are used for analysing respondent's answers.

The analyst must turn round the mass of data to grasp the essential ; the sculpture's admirer is in a similar situation if he wants to appreciate a statue in its entirety.

For understanding the articulations of the respondent's thoughts, the analyst is obliged in addition to enter the system through the most convenient avenues.

Consequently there is no universal procedure for applying the various methods described in the second report in this series, Perceptions of the World Problematique, Report No 2, Analytical Methods. Realizing the potential hazards of introducing biases, each analyst of the DEMATEL team has therefore developed his own skill in using these various tools. At present, the various approaches show a tendency to converge. Hereafter are described the usual steps for attaining the objectives mentioned in the previous section.

These steps are illustrated by reference to the information derived from respondent 105 which is reproduced on Table 2 and Table 3.

Report No. 2 describes a variety of methods of analysis of respondents' answers which are used in the manner described below. The reader interested in the definition and content of these methods is invited to follow both reports in parallel from this point.

i) Overall structure

Inspection of the list where the respondent has mentioned the 10 major problems gives a first idea of his interests. Cultural issues in contemporary societies (16,21,24,27,34), the technological transformation of the most advanced ones (39,4,8) and the development of the poorer nations through a better remuneration of their exports (44) are among the major problems of serious concern for respondent 105 (see Table 2).

The rejected problems (-) which are reported on the first column of this list are warning signals of the possible distance between the views of the respondent and those implicitly contained in the initial problem definitions. In other cases, problems added by the respondent to the proposed list also help in the identification process of the respondent's major interests. Inspection of the matrix of the direct relations between problems gives a first idea of the orientation and the intricacy of the respondent's thought. The most influencing problems appear in reading the rows ; most influenced ones in reading the column, (see for example row 1, 16, 18 and column 14, 15, 22 of 105's matrix on Table 3). Similar rows and columns indicate themes grouping similar problems (e.g. rows 17 and 18 = discrimination). These themes considered as autonomous problem areas will eventually make easier the construction of the digraph by reducing the number of interrelations or by excluding evident cycles.

Inspection of the matrix of indirect relations and of the matrix of indirect links and loops (matrix C and diagram on page 30 in Report No. 2) may complete the idea of the overall structure. The cycled problems 14,15,22,30,35 constitute an area of convergence indicative of 105's concern about the attacks to individuals in advanced societies.

Table 2

List of 48 selected problems

105

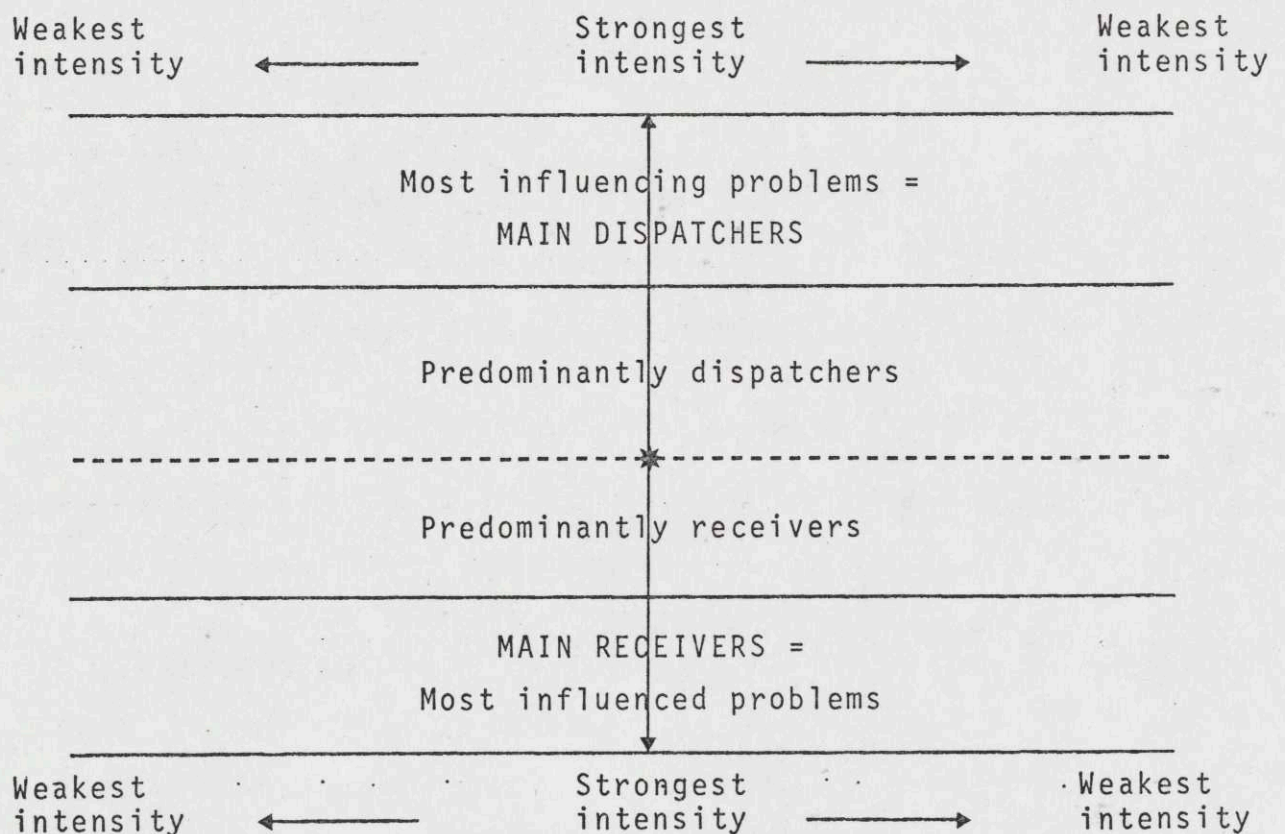
World or generalised problems and seriousness	Ten major problems		
		A OBSTACLES TO WORLD ORGANISATION	
W1	<input type="checkbox"/>	1	Inadequacy of the institutional organization of international society
—	<input type="checkbox"/>	2	The difficulty experienced by major powers in defining their interests and responsibilities
G3	<input type="checkbox"/>	3	The arms race
W3	X	4	Inadequate regulation of use of the sea
		B INFRINGEMENT OF THE RIGHTS OF NATIONS	
G3	<input type="checkbox"/>	5	Interference by foreign powers
W2	<input type="checkbox"/>	6	Interference by multinational companies
G1	<input type="checkbox"/>	7	Non-completion of decolonization
		C INEFFECTIVENESS OF INSTITUTIONS	
G4	X	8	Inability of institutions to adapt to external change
—	<input type="checkbox"/>	9	Political instability, particularly in the less-developed countries
G3	<input type="checkbox"/>	10	Insufficient personal involvement in political and economic life
		D DIFFICULTIES IN IMPROVING THE STANDARD OF LIVING OF RAPIDLY GROWING POPULATIONS	
—	<input type="checkbox"/>	11	Disproportion between the active and inactive population
G4	<input type="checkbox"/>	12	Maladaptation of urban concentrations to individual and collective needs
—	<input type="checkbox"/>	13	Poor use of available land
		E THE CRISIS OF ADVANCED INDUSTRIAL SOCIETIES	
G4	<input type="checkbox"/>	14	Physical and mental illnesses characteristic of advanced industrial civilisation
G1	<input type="checkbox"/>	15	Loss of the sense of personal security
W4	X	16	Obstacles to fulfilment of non-material aspirations
		F SOCIAL DISCRIMINATION	
G2	<input type="checkbox"/>	17	Racial discrimination
W4	X	18	Recurring threats to the existence of minorities
G2	<input type="checkbox"/>	19	Social discrimination based on sex
		G THE USE OF VIOLENCE	
G3	<input type="checkbox"/>	20	Physical violence in political and social conflict
G3	X	21	Infringements of fundamental personal freedoms
G2	<input type="checkbox"/>	22	Increase in criminality and delinquency
G1	<input type="checkbox"/>	23	Hijacking and sabotage of aircraft
		H SHORTCOMINGS IN EDUCATION AND COMMUNICATION	
G4	X	24	Communication difficulties due to complexity and multiplicity of jargon and languages
G2	<input type="checkbox"/>	25	Intensification of political, economic and cultural propaganda in association with the development of mass media
—	<input type="checkbox"/>	26	Insufficient education of children and adults for an active life
		I THE WEAKENING OF HUMAN MOTIVATIONS	
W4	X	27	Weakening of collective convictions (social, religious, etc.)
—	<input type="checkbox"/>	28	Difficulties of social advancement
W1	<input type="checkbox"/>	29	Acute disparities between living conditions and aspirations
G1	<input type="checkbox"/>	30	Production, traffic and use of drugs
		J DEGRADATION AND DISFIGUREMENT OF THE ENVIRONMENT	
G2	<input type="checkbox"/>	31	Lasting damage to vital properties of water
G3	<input type="checkbox"/>	32	Damage (including noise) to the properties of the atmosphere
G2	<input type="checkbox"/>	33	Damage to vital properties of the soil
G4	X	34	Disfigurement of the environment : destruction of cultural monuments, natural beauties, etc.
W2	<input type="checkbox"/>	35	Attacks on man's genetic heritage
		K SHORTCOMINGS IN PRODUCTION AND TECHNOLOGY	
—	<input type="checkbox"/>	36	Wastage and underemployment of human resources
G2	<input type="checkbox"/>	37	Fundamental waste of material and financial resources
—	<input type="checkbox"/>	38	Exhaustion of non-renewable mineral and energy reserves
W4	X	39	Inadequate control of technological development
G2	<input type="checkbox"/>	40	Insufficient efforts to anticipate the exhaustion of energy reserves and to produce less pollutant energy
		L MONETARY INSTABILITY	
W3	<input type="checkbox"/>	41	Difficulty in checking inflation
W3	<input type="checkbox"/>	42	Crises in the international monetary system
		M OBSTACLES TO INTERNATIONAL ECONOMIC RELATIONS	
—	<input type="checkbox"/>	43	Lack of capital for aid to the less-developed countries
W4	X	44	Low and fluctuating prices of exports from less-developed countries
W3	<input type="checkbox"/>	45	Changes in the flow of international trade due to the establishment of preferential areas
		N FAILURE TO SATISFY THE BASIC NEEDS OF THE LESS-DEVELOPED COUNTRIES	
G3	<input type="checkbox"/>	46	Undernutrition and malnutrition in the less-developed countries
—	<input type="checkbox"/>	47	Endemic and epidemic disease in the less-developed countries
G2	<input type="checkbox"/>	48	Housing shortages and deficiencies in less-developed countries

ii) Objectives and key problems

Two hierarchies based on the direct matrix indicate the most influencing and the most influenced problems. For the strongly connected matrices, the hierarchies based on the direct + indirect matrix are probably more indicative.

These two hierarchies are completed by a third one ranking the problems according the total of the received and dispatched influences (intensity of a problem).

These three hierarchies may be used for positioning the problems according to their dispatcher or receiver character and their intensity in partitioning space in the following manner :



All problems can be placed according to these coordinates. (See Fig. 1 positioning 105's problems according to these principles).

HUMAN RIGHTS

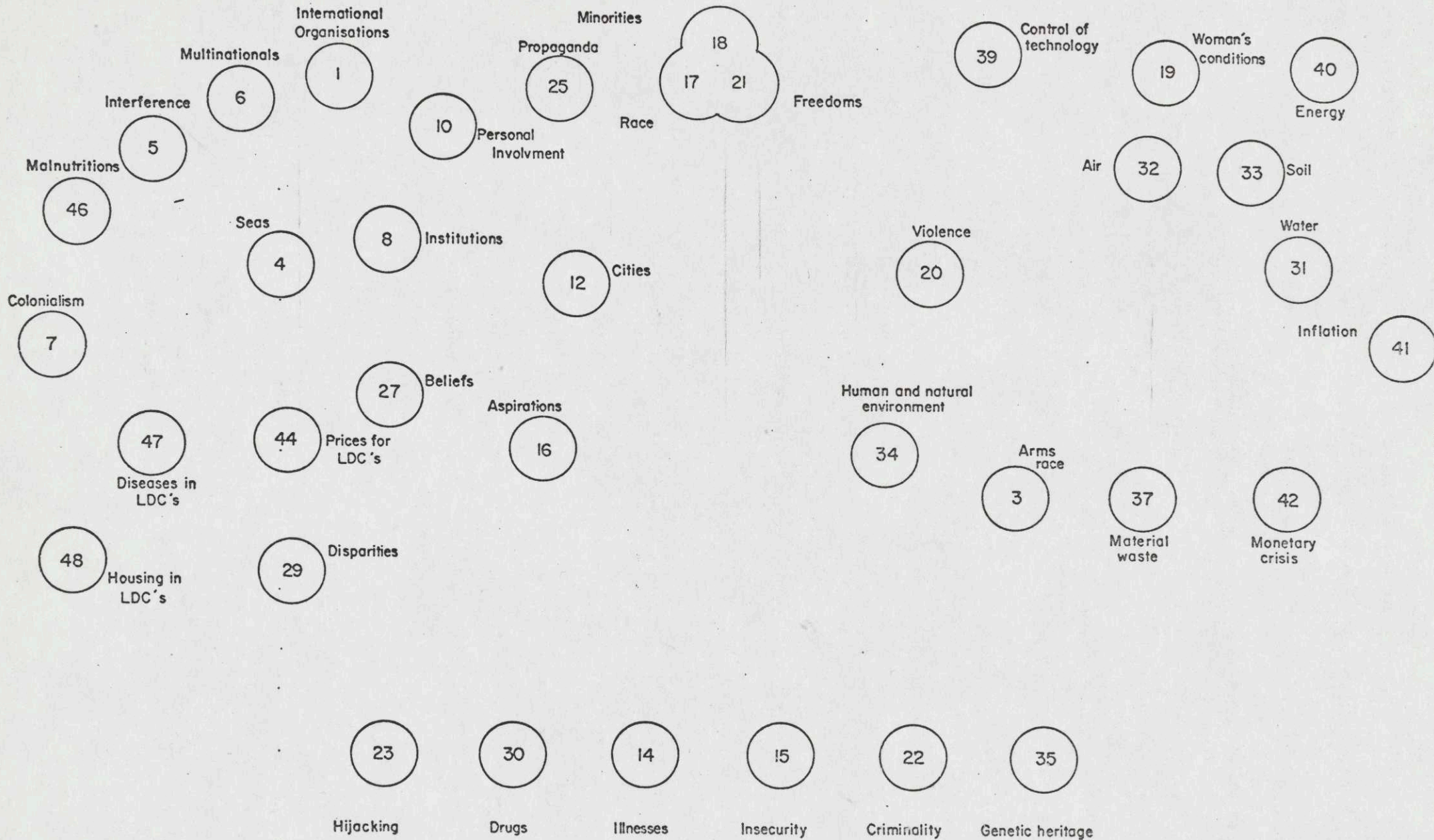


Fig. 1

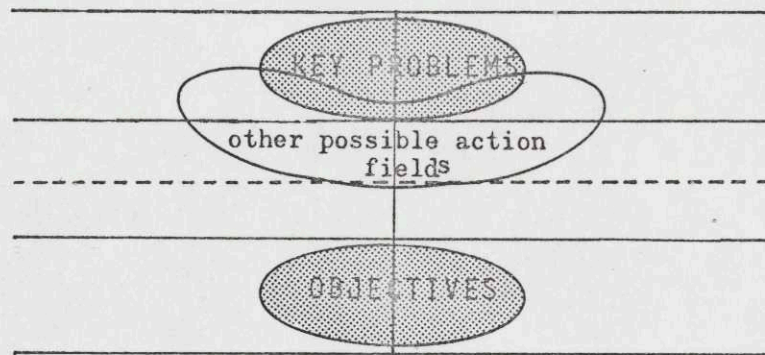
However those with the weakest intensities are often discarded for simplification purpose. Moreover some of them are regrouped because

- two of them constitute a loop (e.g., for 105, minorities (18) influence race (17) and (17) influences (18) ; same with (21) ;
- two or several of them constitute a single theme or a very similar problem (17 + 18 + 21 = human rights) ;
- a set of problems pertains to the same problematique (e.g. all the problems related to less-developed countries or the protection of man's material living conditions, etc.).

The so placed problems give a first indication of:

- (i) the objectives the respondent considers to be retained for improving the situation of mankind (problems with the highest intensity at the bottom and in the middle of the chart ; for 105 a physically and mentally healthier individual (14) more in peace with himself (relation 27 - 15) and being less aggressed in his security (relations 12-15, 20-15, 22-15) - see Fig. 2 showing the problems of higher intensity and their strongest interrelations with a degree of influence of 4 and 3).

- (ii) key problems for which the respondent considers that better answers should be given for attaining the identified objectives (problems with the highest intensity at the top and in the middle of the chart ; for 105, more respect of human rights (17,18,21) - see Fig. 2) ;



105

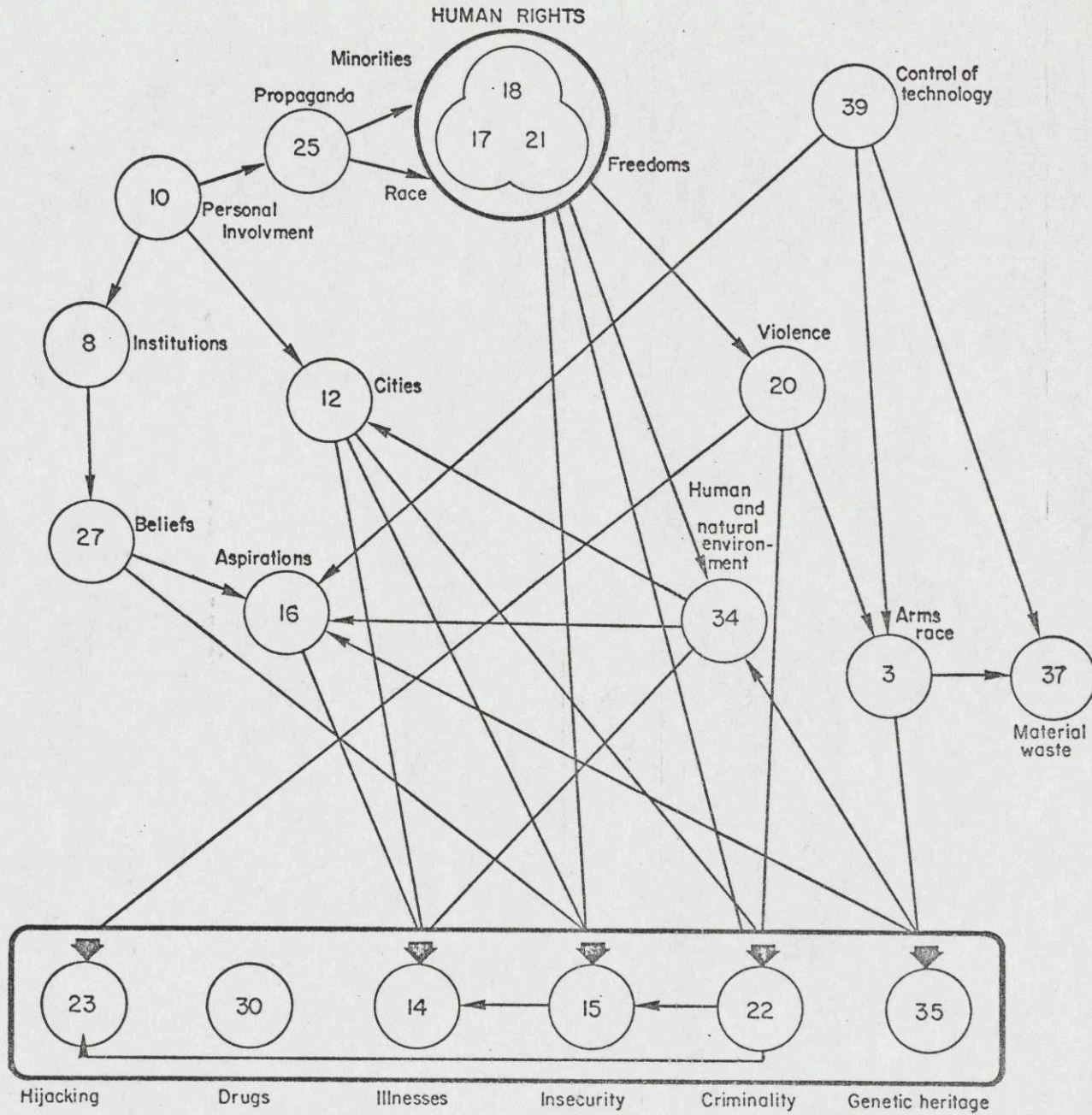


Fig. 2

TO RESTORE INDIVIDUAL BALANCE IN ADVANCED SOCIETIES

Key problems may be too general or too closely linked with human nature for offering action fields. The latter may be searched at a weaker intensity grade or at a lower level. Further analysis and the follow-up interview are usually required for identifying such action fields.

iii) Overall digraph

By indicating the strongest direct and indirect relations between the problems mapped according to the principles presented in the above section, one obtains a first digraph. It is an imperfect one because problems and relations of weaker intensity have been discarded. The overall digraph may still be too complex (see Fig. 3). Further analysis may then be applied for identifying sub-systems.

iv) Geodetic cycles

The matrix of the shortest-length cycles and their exhaustive listing helps to identify sub-systems. The shortest cycles often describe technical aspects of a set of relations (e.g. insufficient capital in LDC's leads to underemployment which in turn aggravate malnutrition, health, etc. and so contribute to political instability ; political instability is perceived as a cause to the lack of capital in LDC's, and so on). They may give further light on the views of the respondent about the functioning of society (see the diagram of Constituent 2 on page 37 of Report No 2 ; disparities among nations (29) hinder the cooperation within the international organisations (1) which are unable to obtain a better remuneration for LDC's exports, the latter being considered as a main source of the same disparities (29).

When such cycles involve key problems of high intensity, they may give some indications on the school of thought of the respondent.

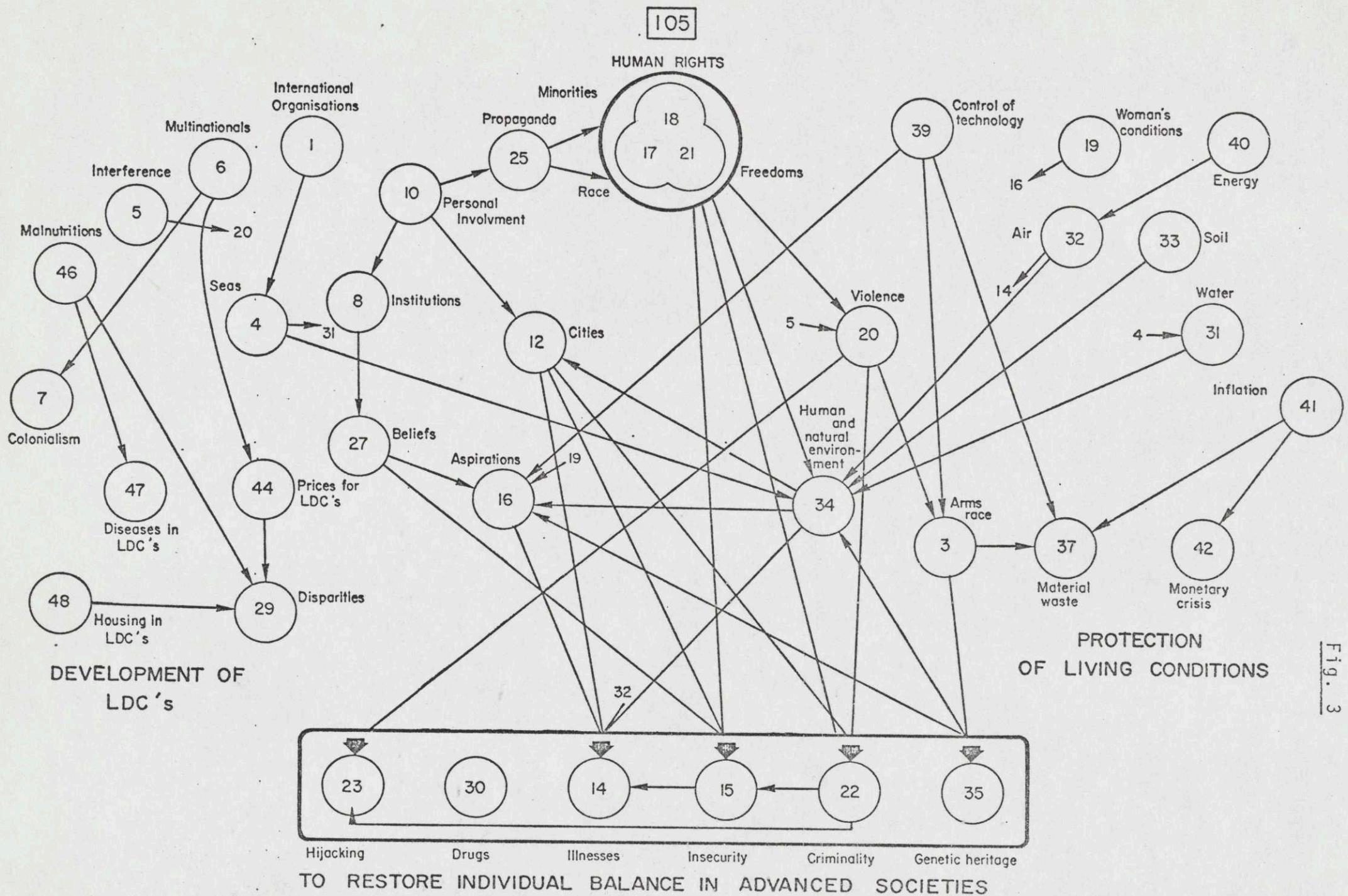


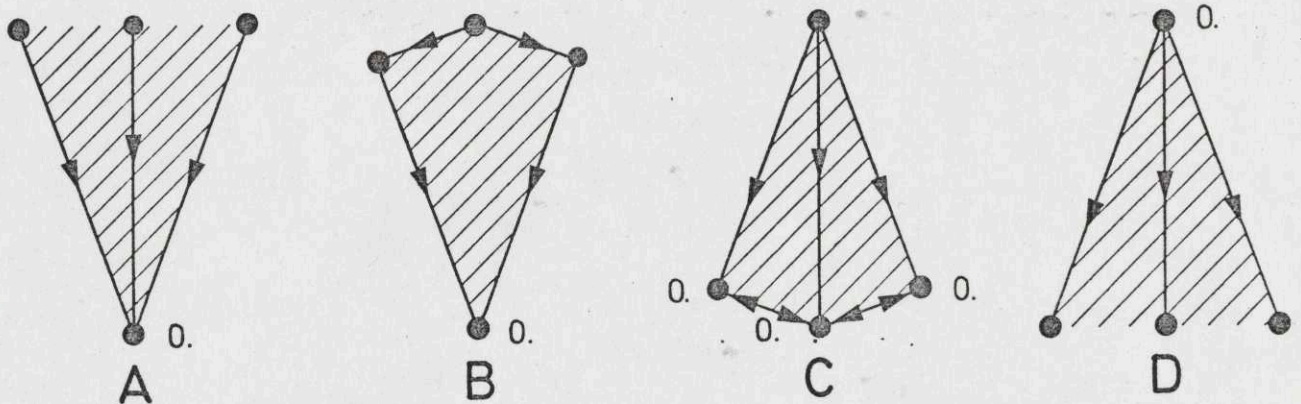
Fig. 3

For example, a cycle including key problems related to abuse of mass-media, institutions, personal involvement in political and economic life may indicate that the respondent attributes much responsibility to the functioning of the democratic system in its present form for the dissatisfaction with the contemporary state of affairs of the world.

Complementary digraphs and general patterns

The analysis of the geodetic cycles and the indirect relations may lead to the design of complementary digraphs portraying sub-systems or to redesign the overall digraph for pinpointing the main thought features of a respondent or a group of respondents.

Some patterns emerge from the various digraphs so far produced. Several connected or unconnected key problems may lead to one or two objectives (Fig. A and B) or conversely one or two key problems are commanding many connected or unconnected problems (Fig. C and D). Unconnected problems at the bottom



of the graph may not then be considered as objectives. They often are technical aspects or symptoms of major problems at a higher level of influence. In such a case the main objectives may be found at the top of the graph.

3) Individual reports

On the basis of the previously described analysis and designed graphs a report is produced to the attention of the respondent. It is presented in such a form that it encourages him to react.

At the same time, the report is written with the idea of preparing questions for the follow-up interview. It usually covers three main items

- overall structure and guiding thought
- objectives of the respondent
- key problems.

This format facilitates comparisons. Extensive use is made of the written comments of the respondents for quotations highlighting his thought.

These pre-interview reports are then completed with notes of the interviews presented using separate pages for each problem or relation dealt with during the interview.

The notes ordered by problems and relations will be used for illustrating the numerical analyses of the comparisons. These analyses and notes form the synthesis report.

g) Technical support to the synthesis of the survey

A permanent file and a large matrix register all the answers given by the respondents.

The file is organized in such a way that all the answers given by the respondents can be easily consulted.

For each problem, the file indicates its possible rejection as a real problem, its world or generalized character, its gravity and its urgency. For each relation, a listing of intensities is given for direct and indirect relations.

Table 4 shows a list of the most frequently rejected problems and an extensive example of the added ones.

The giant matrix indicates by the code number of the respondent whether or not he has identified a relation. It helps the analyst to elaborate working assumptions. For example, it appears at the present stage of the survey that respondents from highly industrialized nations are less inclined than the others to see the weakening of collective convictions (religious, social, etc.) (27) as a major factor contributing to the generalized sense of the loss of security (15) which is indeed characteristic of the advanced industrial societies.

Interview reports and written comments classified by problems and relations constitute a very rich file of qualitative remarks on the nature of each relation. Extracts are shown under Table 5.

This information is completed by documents on the factual relations (scientific papers, newspapers clips, etc.). Abstracts of non-published papers are produced on an experimental basis (see Table 6).

Information on endeavours similar to DEMATEL is collected. It covers methodological papers on the approach to complex societal problems.

The survey file, the permanent matrix, the qualitative comments, the documents on the factual relations, and the information on similar efforts constitute a start for a World Problematique Library.

November 30, 1973
9004-23/AG/EF/ch

Table 4

PROBLEMS FREQUENTLY DISCARDED BY RESPONDENTS*

Most frequently (40%)

Changes in the flow of international trade due to the establishment of preferential areas	(45)
Hijacking and sabotage of aircraft	(23)
Difficulties of social advancement	(28)

Frequently (25%)

Communication difficulties due to complexity and multiplicity of jargon and languages	(24)
Attacks on man's genetic heritage	(35)
Inadequate control of technological development	(39)
The difficulty experienced by major powers in defining their interests and responsibilities	(2)
Disproportion between the active and inactive population	(11)
Poor use of available land	(13)
Social discrimination based on sex	(19)
Intensification of political, economic and cultural propaganda in association with the development of mass media	(25)

PROBLEMS ADDED BY RESPONDENTS

Lack of a sense of solidarity and social communion
Integration of cultural systems
Monopolistic tendencies
To giving man back his dignity
Difficulties to establish responsibility systems
Weakening of a sense of effort
High rates of population growth
Weakening of human ties between parents and children
Difficulties of education for infants at home
Increasing need of care for aged people
Inadequate information systems
Lack of political ethic
Lack of integration of the natural and social sciences
Establishment of a rule of law among nations
To make LDC's to solve their own problems
World consciousness
Excessive reliance on scientific thought in developed countries
Institutional dependence and hierarchical organisation
Quality of life
International security and peace
Rigidity in structural adjustment of production and employment
Labour rights
Lack of purpose of education
More democratic power structure of international society
Lack of individual balance
Local armed conflicts
The growing evidence that mankind's current activities are beginning to modify global climatic conditions in an adverse manner
World shortage of food supply

* Status by November 1973 (03 - 129).

Table 5

Extracts of Interview Reports

Problem 6

Respondent 113

Multinationals have a double character. On the one hand, they are still closely linked with their mother countries and are instruments of the latter. On the other hand, they play an independent role in achieving their own objectives.

It may be expected that this independent role is going to increase. Moreover, the share of the United States in the origin of multinational companies is going to decrease. Thus the increasing independent role of the latter and their internationally widespread origin will contribute to deprive the super-powers of their leadership.

The resulting increased power of the multinational has to be balanced. Countermeasures taken by the developing countries (e.g. OPEC for fixing oil prices) show that a counter power is building up in a positive sense.

Problem 9

Respondent 124

Political stability is viewed as the most important factor for achieving better living conditions at a world level.

The present power structure may well be an hindrance to the pursuit of the 124's main goal of a better use of human resources. However this power structure may be improved without disorder.

Political disorder is a source of human alienation which constitutes a central theme for 124. Balanced relations of man with his human and natural environment is 124's main aspiration which justifies the place of political stability among the most desirable goals for the world at large.

Problem 15

Respondent 111

The loss of a sense of personal security is mainly the expression of the ills of our contemporary societies. Stability is not so much viewed as a remedy. Rather a feeling for more psychological and material security may be expected to be achieved through a new social impetus which would strengthen collective convictions and activate personal involvement.

Problem 15

Respondent 113

113 puts more emphasis on the psychological aspects of personal security than on the material ones.

A special feature of insecurity in advanced societies is the feeling of an "invisible power" watching and manipulating individuals with the help of computer technology and other advanced communication techniques.

Rapid economic development is another source of insecurity for large segments of population which are not keeping pace with it and are left apart, socially and economically (e.g. through inflation).

Table 6

2

1971

FAWLEY W.H.

FAO

How can there be secured food for all in this and the next century.

Lecture given at the Nordic Conference (NORRØNAKONFERENSEN) (Stavanger, Norway. 16 April 1971) 21 p. tables.

Stresses that to link the population problem primarily to food supplies is a mistake.

Considers the world being threatened by ecological damage, rising numbers of un- and under-employed, pressure of agricultural population, growing costs of education, such difficulties being able to lead to political break down.

Gives five models of demographic evolution in India. Suggests a transfer of GDP from DC's to LDC's.

8

1972

GANTZEL K.J.

The armament dynamics in the East-West conflict : an arms race. Presented at the 9th European Conference of the Peace Research Society in Rotterdam, Aug. 29-31 1972. 37 p.

After reviewing the different motivations to promote an armament policy, the author groups them in two main categories : the foreign induced armament policy and the self induced one. He concludes that armament dynamic and armament policy is a combination of internal and external factors. He then presents a historical sketch of East-West armament dynamics, breaking the period 1945-1970 in 5 sub-periods. The armament spendings are analyzed for each of the sub-periods and arguments are presented to explain the changes. Foreign induced and self-induced motivations vary in degree according to the sub-period considered. Technical innovations as well as political events have influenced the reactions which are responsible for these variations.

Interesting analysis/good presentation of events/valuable bibliography.

October 30, 1973 DRAFT

DEMATEL

Perceptions of the World Problematique

Report No 2

Analytical Methods

I. INTRODUCTION :

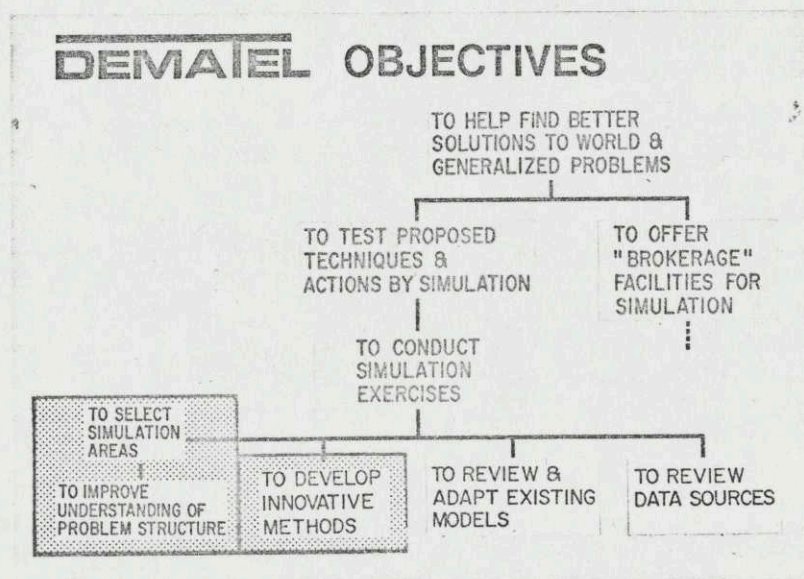
The objectives of DEMATEL (Decision Making Trial and Evaluation Laboratory)

Growth in the Western World for the past 20 years has created a growing concern about the future of our society.

A variety of critical problems of considerable complexity has emerged. Among problems sharing a planetary dimension some have a world nature and require analysis and solutions at world level; others are widespread and appear as "generalized", common to many areas of the world and requiring locally adjusted solutions; most seem to be somehow interrelated, by multidimensional channels, in a world "problematique" which conditions the predicament of mankind.

Battelle, with its international and multidisciplinary research capabilities, has underway a significant number of thrusts toward the challenges that this situation presents to human ingenuity and scientific endeavour. These thrusts, for example, include the activities of the Human Affairs Research Centers in Seattle, a Research Center for Applied Behavioral and Social Sciences in Frankfurt. The Academy for Contemporary Problems (with the Ohio State University) in Columbus, and a Science and Human Affairs Program, within the framework of Battelle Institute*, while at the level of the laboratories there are mission-oriented activities in education, health, urbanization, environmental problems, and so on.

Within this extensive Battelle effort, DEMATEL is being developed in the belief that pioneering and appropriate use of scientific research methods can improve understanding of the world problematique and can contribute to identification of workable solutions at a global level.



* A Battelle-funded set of research programs, consisting of specific research projects, conferences, publications, and appointments.

The idea of the DEMATEL project arose from the determination to acquire a better knowledge of the world society and its development. The latter in particular raises many problems at the level of individual or collective perception. There are believed to be two main reasons for this complexity.

The first is that the majority of individuals either knows of no purpose for the world or society, or at least does not agree on one. This can be expressed in another way by saying that there is no universally accepted ideal.

The second is the virtually infinite fragmentation of the world society. As revealed explicitly in its laws or implicitly in its customs, each fragment has particular goals reflecting more-or-less fundamental aspirations. The evolution of these fragments then has led to situations where the goals have drifted apart and lost part of their content, if they have not actually developed into conflicting situations.

The attainment of any goal depends on the solution of one or more problems. To qualify as being of worldwide import, a problem must fulfil the following conditions :

- (i) its solution is necessary to one or more important goals
- (ii) these goals must be of concern to a high proportion of the human race.

It is difficult to acquire knowledge of the aims of human beings. For this reason - and this constitutes the originality of the study - it was decided to take the problems of which people are aware as the starting-point of the search for a pattern(s) of goals. In other words, milestones of DEMATEL are to :

- analyze the problems of which groups or individuals are aware
- investigate the perceived and factual relations between these problems
- find the pattern(s) of goals which fits that of the problems.

The results of such a program can serve as a basis for a reappraisal of the goals and values of society in the light of new conditions, thus stimulating a better focusing of research effort on the important problems. To achieve this is one of the chief motivations of the research team. Once this point has been reached, the team will orient its work towards applying available techniques of modeling and simulation games to the evaluation of possible solutions to the problems set.

In this respect, the setting up of a "DEcision MAKing Trial and Evaluation Laboratory" for the simulation of world action programs must be considered as an ultimate objective and one of the possible concrete results of the study. Such a laboratory could offer :

- (i) facilities for carrying out simulation gaming exercises and developing new methods of helping to find and evaluate solutions
- (ii) "brokerage" facilities, i.e. a place for the exchange of experiences, models, information, etc.

The DEMATEL project was initiated at the end of 1971 under the Science and Human Affairs Program of Battelle Institute.

During its first two years of operation it has been concentrated on three major areas of research :

- the study of the world problem structure ("problematique");
- the development and adaptation of methodologies suitable to the analysis of complex world problems (dealing mainly with interactive man-model techniques and methods to evaluate qualitative and event-linked aspects of societal problems);
- the review of existing studies, models and data sources related to world problems.

The present report deals only with the first results of the study
of the world problematique

In order to understand the relationship between problems it was felt necessary to consult those who, in one way or another, bear collective responsibility (statesmen, leaders of opinion, scientists, philosophers, artists ...) and a procedure for communicating with them was established and described in Report No 1.

The analytical tools developed in order to obtain an interpretation of the different perceptions of the world problematique are explained in the next section of this report. Section III describes methods for identifying and analysing areas of agreement among groups of respondents' perceptions and methods for making comparisons of problem structures.

Report No 2 has been prepared by Dr. E. Fontela, Project Director of DEMATEL. The author benefited of advices received from Prof. Richard Stone and Dr. J. Warfield and from A. Gabus and A. Duval. J.M. Feissel has elaborated all the computer programmes used.

MATRIX NOTATION

Small letters designate vectors or scalars. Vectors are always written in column form so that a row-vector is written as the transpose of a column vector.

Capital letters designate matrices. For a matrix of $m \times n$ (m rows, n columns), the following abbreviated notation has been adopted :

$$A = \begin{vmatrix} | & | & | \\ | & a_{ij} & | \\ | & | & | \end{vmatrix} \quad \begin{array}{l} i = 1, 2, \dots, m \\ j = 1, 2, \dots, n \end{array}$$

The sign $'$ is the symbol used for transposition of a vector or matrix.

The sign $\hat{}$ denotes a diagonal matrix where the diagonal elements for a matrix \hat{a} are those of the vector a and the remaining elements are zeros.

I and i always denote the unit matrix and the unit vector, respectively.

II. ANALYTICAL TOOLS FOR THE STUDY OF INDIVIDUAL PERCEPTIONS OF
THE WORLD PROBLEMATIQUE

The presentation of the analytical tools for the study of individual perceptions of the World Problematique will be illustrated with data derived from one respondent, 105.

a) The Direct Matrix (X^*)

The answers to the questions included in the document "World problems : an invitation to further thought" provide information concerning the relations among problems perceived by each respondent.

Respondents are given a number of problems and are asked to indicate the direct influence that they believe each problem to exert on each of the others according to a scale running by integers from 0 to 4.

The answers of each respondent can be arranged in a matrix, X^* say, of order equal to the number of problems. The typical element in this matrix, x_{jk}^* say, indicates the direct influence that the respondent believes problem j to exert on problem k : if $x_{jk}^* = 0$, j is

believed to exert no direct influence on k ; and if $x_{jk}^* = 4$, j is believed to exert the strongest possible direct influence on k .

In the direct matrix of 105 (table 1), for instance, at the intersection of row 10 and column 8, the element $x_{10,8}^* = 4$ indicates that the respondent has expressed that the insufficient personal involvement in political and economic life (10) exerts the strongest possible direct influence on the inability of institutions to adapt to external change (8), or, in positive terms, that greater personal participation is required to improve the ability of institutions to adapt to change.

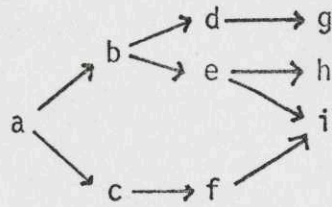
The usual direct matrices have a dimension of 48 x 48 corresponding to the initial problem's list⁽¹⁾; when problems were added by the respondent, the dimensions were increased accordingly.

b) The Direct / Indirect Matrix $(X (I-X)^{-1})$

The respondents are requested to indicate only direct links. Empirical observation suggests that there are transitive properties in the system

(1) The list of the 48 problems is reproduced in Annex 5, at the last page

of World Problems such that most problems are indirectly interrelated



In the directed graph represented here, problem a influences directly only problems b and c; indirectly, it also affects first d, e and f and, secondly, g, h and i

In a matrix notation, the direct links (ab, ac, bd, be, cf, dg, eh, ei, fi) are recorded on a binary matrix: A

	a	b	c	d	e	f	g	h	i
a		1	1						
b				1	1				
c						1			
d							1		
e								1	1
f									1

(1)

the first order indirect links (ad, ae, af, bg, bh, bi, ci) in the square of this matrix: A^2

	a	b	c	d	e	f	g	h	i
a				1	1	1			
b							1	1	1
c									1

(2)

and the second order indirect links (ag, ah, ai,) in the next power of the matrix : A^3

	a	b	c	d	e	f	g	h	i
a							1	1	1

(3)

using in this process matrix multiplications by which the element in the j th row and k th column of A^2 is the sum of the product of each element in the j th row of A with the corresponding element of its k th column.

It seems reasonable to assume for the system of world problems that, in a configuration like the one described above, the influence exerted by problem a on problem h will be smaller than the one that it exerts on problem e, and again smaller than the one exerted on problem b.

We can obtain a process compatible with this assumption without distorting the respondents pattern of responses, by multiplying each element of X^* by the reciprocal of the largest row sum of X^* , λ ,

$$X \equiv \lambda X^* \quad (4)$$

and by defining elements of a matrix X^2 as been the sum of the products of each element in the i th row of X with the corresponding element of the j th column of X (and so on for the following powers of X).

This definitional assumption was required by the fact that the respondents were asked to give their own evaluation of direct effects only.

It assumes a continuous decrease of the indirect effects of problems along the chains, and therefore guaranties convergent solutions to matrix inversion. This being so, the infinite series of direct and indirect effects

$$X, X^2, X^3, X^4 \dots\dots X^\theta$$

where $X^\theta \rightarrow 0$ when $\theta \rightarrow \infty$

has a finite sum given by the expression :

$$X + X^2 + X^3 + \dots\dots = X (I - X)^{-1} \quad (5)$$

where X is the normalized matrix defined in (4), I is the unit matrix and $(I - X)^{-1}$ the inverse matrix of $(I - X)$.

This expression measures the direct and indirect effects of the problems as implied by the answers of the respondent, under the assumptions described above.

If the indirect effects are to be traced round by round it is necessary only to raise X to successively higher powers. The sum of the first r terms of $X(I - X)^{-1}$ is $(I - X^r) X (I - X)^{-1}$.

A simple numerical example may make it easier to follow what has been said above.

Suppose that there are three problems and that

$$X^* = \begin{bmatrix} 0 & 1 & 4 \\ 2 & 0 & 3 \\ 3 & 0 & 0 \end{bmatrix} \quad (6)$$

The largest row sum of (6) is 5 (row 1 or 2) and so $\lambda = 0.2$ Accordingly

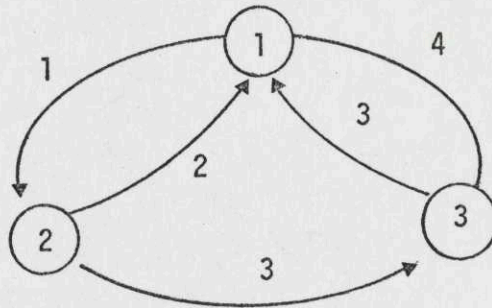
$$X = \begin{bmatrix} 0 & 0.2 & 0.8 \\ 0.4 & 0 & 0.6 \\ 0.6 & 0 & 0 \end{bmatrix} \quad (7)$$

$$(I - X)^{-1} = \begin{bmatrix} 2.713 & 0.543 & 2.500 \\ 2.062 & 1.411 & 2.500 \\ 1.628 & 0.326 & 2.500 \end{bmatrix} \quad (8)$$

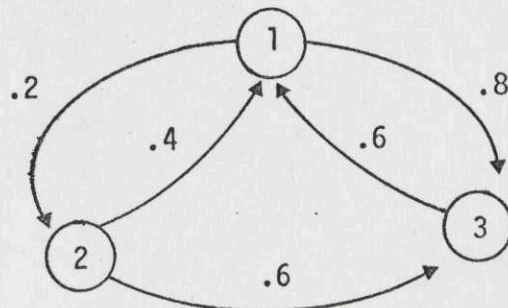
approximately,

$$X(I - X)^{-1} = \begin{bmatrix} 1.713 & 0.543 & 2.500 \\ 2.062 & 0.411 & 2.500 \\ 1.628 & 0.326 & 1.500 \end{bmatrix} \quad (9)$$

A graphical presentation of matrix X^*



and of the normalized matrix X :



In the case of respondent 105 the direct and indirect matrix is reproduced below (Table 2) after been normalized along a scale of 0 to 9 by giving the value of 9 to the largest element on $X (I - X)^{-1}$

In annex are reproduced both the direct matrix (annex 1) normalized by the reciprocal of the largest row sum, ($\lambda = 1/18$) and the direct + indirect matrix $X (I - X)^{-1}$ (annex 2)

Below are given the equivalents between the tables in annex 1 and 2 and tables 1 and 2 in the text, respectively.

X^*	X	$X (I - X)^{-1}$	norm. to 9
4	= . 211	.280 - .315	≅ 9
3	= . 158	.245 - .280	≅ 8
2	= . 105	.210 - .245	≅ 7
1	= . 053	.175 - .210	≅ 6

c) The Indirect Matrix $(X^2 (I - X)^{-1})$

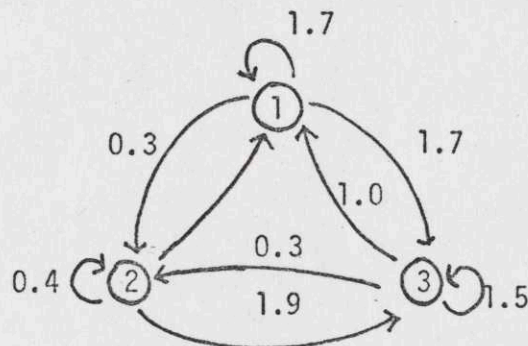
If the matrix of direct effects is subtracted from the matrix of direct and indirect effects, a measurement of indirect effects is obtained. The mathematical expression of the matrix of indirect effect is derived from equation (5) by premultiplying by X :

$$X^2 + X^3 + X^4 \dots\dots\dots = X^2 (I - X)^{-1} \quad (10)$$

Continuing the example developed on equations (6), (7), (8) and (9) above, the expression for the matrix of indirect effects becomes

$$X^2 (I - X)^{-1} = \begin{bmatrix} 1.715 & 0.343 & 1.700 \\ 1.662 & 0.413 & 1.900 \\ 1.028 & 0.326 & 1.500 \end{bmatrix} \quad (11)$$

and the graphical presentation for the indirect effects only



For respondent 105, the indirect matrix is given in annex 3. As will be seen later, the perception of the World Problematique by respondent 105 contains only a small number of interactions, loops and cycles⁽¹⁾, and therefore indirect effects are relatively small. Table 3 presents a simplified version of the indirect matrix of 105 in which the values have been made equivalent to those in the direct matrix on Table 1, by defining :

<u>value of indirect effect</u>	<u>direct equivalent</u>
0 to 0.025 (around 0)	0
0.026 to 0.085 (around 0.053)	1
0.086 to 0.130 (around 0.105)	2
0.131 to 0.185 (around 0.158)	3

(1) For definitions see point e) below

d) Hierarchies

By providing a matrix of interrelations, the respondent is delivering an oriented graph, generally very complex due to the large number of problems and interactions considered and to the existence of many loops and cycles. Knowledge about the order in which problems influence other problems or are influenced by them, can improve the understanding of the structure. This knowledge can be obtained by computing the row and column sums of the direct, direct-indirect, and indirect matrices.

In the simple numerical example developed previously in (6), (7), (8), (9) and (11), this computation gives the following results :

- for the normalized matrix of direct links :

$$\text{row sum} : X i = \begin{Bmatrix} 1.0 & 1.0 & 0.6 \end{Bmatrix}^* \quad (12)$$

$$\text{column sum} : X' i = \begin{Bmatrix} 1.0 & 0.2 & 1.4 \end{Bmatrix}^* \quad (13)$$

- for the direct - indirect matrix

$$\text{row sum} : X (I - X)^{-1} i = \begin{Bmatrix} 4.768 & 4.975 & 4.454 \end{Bmatrix}^* \quad (14)$$

$$\text{column sum} : (I - X')^{-1} X' i = \begin{Bmatrix} 5.405 & 1.282 & 6.500 \end{Bmatrix}^* \quad (15)$$

* column vector shown as row vector

- for the indirect matrix :

$$\text{row sum} : X^2 (I - X)^{-1} i = \{3.758 \quad 3.975 \quad 2.854\}^* \quad (16)$$

$$\text{column sum} : (I - X^1)^{-1} X^2 i = \{4.405 \quad 1.083 \quad 5.100\}^* \quad (17)$$

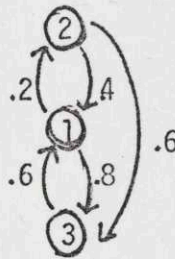
It appears from these results that if only the direct links are retained, both 1 and 2 are the more influencing problems and 3 the most influenced problem. The inclusion in the analysis of indirect links helps in this particular case to further clarify the positioning on top of the hierarchy of influences, by identifying the greater importance of problem 2.

The hierarchy, in the special terminology adopted here, gives the ordering of the problems, either by their influencing capacity over others or by the degree by which they are influenced by them.

In the above example both hierarchies coincide, 2 being at the same time the most influencing and the least influenced and 3 the least influencing and the more influenced.

* column vector shown as row vector

In graphical form, this conclusion is presented in the following way, with only direct links being shown :



For respondent 105, tables 4, 5 and 6 show both types of hierarchies, as well as a hierarchy derived from the sum of both rows and columns, for all three matrices of direct, direct-indirect and indirect relations, respectively. An inspection of these tables will show for instance that some problems are typically "dispatchers" (strongly influencing others) like problem 18, and are therefore on top of a hierarchy of influences, and others are typically "receivers" (strongly influenced by others), like problems 15 and 14, and are therefore at the bottom of the said hierarchy.

Table 4 : Orders derived from the sum of the rows, the sum of the columns and the sum of both rows and columns for the normalized matrix of direct links, X, for respondent 105

1	18	1.000	15	1.316	18	1.684
2	20	.789	14	1.263	14	1.684
3	21	.684	16	.947	16	1.632
4	10	.684	34	.895	15	1.632
5	34	.684	22	.842	34	1.579
6	6	.684	30	.789	20	1.368
7	16	.684	18	.684	21	1.316
8	12	.632	21	.632	17	1.211
9	39	.632	29	.579	22	1.158
10	17	.632	37	.579	25	1.000
11	1	.632	17	.579	10	1.000
12	25	.579	20	.579	12	.947
13	32	.474	35	.474	39	.947
14	8	.474	3	.474	3	.895
15	27	.474	44	.421	30	.895
16	3	.421	42	.421	37	.842
17	14	.421	25	.421	29	.842
18	4	.368	23	.368	1	.737
19	41	.368	12	.316	27	.684
20	40	.368	10	.316	8	.684
21	22	.316	39	.316	44	.684
22	46	.316	31	.263	6	.684
23	19	.316	47	.263	35	.632
24	5	.316	9	.263	32	.632
25	15	.316	8	.211	42	.579
26	33	.263	27	.211	4	.526
27	44	.263	38	.211	41	.526
28	37	.263	41	.158	23	.474
29	48	.263	32	.158	31	.474
30	29	.263	4	.158	5	.421
31	31	.211	7	.158	40	.368
32	7	.158	43	.105	47	.368
33	35	.158	5	.105	46	.316
34	42	.158	1	.105	7	.316
35	30	.105	2	.053	19	.316
36	47	.105	36	.000	33	.263
37	23	.105	28	.000	48	.263
38	24	.053	6	.000	9	.263
39	13	.000	19	.000	38	.211
40	26	.000	40	.000	43	.105
41	2	.000	24	.000	2	.053
42	28	.000	13	.000	24	.053
43	43	.000	33	.000	13	.000
44	11	.000	26	.000	26	.000
45	45	.000	45	.000	45	.000
46	36	.000	46	.000	11	.000
47	9	.000	11	.000	36	.000
48	38	.000	48	.000	28	.000

Table 5 : Orders derived from the sum of the rows, the sum of the columns and the sum of both rows and columns for the matrix of direct and indirect links, $X(I - X)^{-1}$, for respondent 105

1	18	2.134	15	2.952	18	3.598
2	21	1.634	14	2.583	15	3.384
3	17	1.506	22	2.047	14	3.127
4	10	1.445	30	1.937	21	2.969
5	25	1.412	18	1.463	17	2.756
6	16	1.257	16	1.449	16	2.706
7	34	1.250	21	1.335	34	2.569
8	20	1.230	34	1.319	22	2.455
9	39	1.141	17	1.250	20	2.331
10	6	1.004	20	1.101	30	2.092
11	1	.909	35	1.023	25	1.932
12	8	.900	23	.924	10	1.862
13	12	.895	37	.864	39	1.721
14	27	.823	3	.788	12	1.485
15	32	.811	29	.679	3	1.448
16	19	.739	12	.590	37	1.367
17	3	.659	39	.581	35	1.266
18	5	.659	42	.522	8	1.198
19	4	.641	25	.520	27	1.096
20	14	.544	44	.455	29	1.091
21	40	.536	10	.418	1	1.036
22	33	.510	9	.317	23	1.074
23	37	.503	8	.298	6	1.004
24	41	.498	31	.292	32	.969
25	31	.474	27	.273	4	.826
26	15	.432	38	.266	44	.784
27	29	.413	47	.263	31	.766
28	22	.408	41	.240	5	.764
29	46	.404	4	.186	42	.758
30	48	.344	1	.177	19	.739
31	44	.328	32	.158	41	.738
32	35	.244	7	.158	40	.536
33	42	.236	43	.124	33	.510
34	7	.210	5	.105	47	.412
35	30	.155	2	.062	46	.404
36	23	.151	36	.000	7	.368
37	47	.149	28	.000	48	.344
38	24	.129	6	.000	9	.317
39	13	.000	19	.000	38	.266
40	26	.000	40	.000	24	.129
41	2	.000	24	.000	43	.124
42	28	.000	13	.000	2	.062
43	43	.000	33	.000	13	.000
44	11	.000	26	.000	26	.000
45	45	.000	45	.000	45	.000
46	36	.000	46	.000	11	.000
47	9	.000	11	.000	36	.000
48	38	.000	48	.000	28	.000

Table 6 : Orders derived from the sum of the rows, the sum of the columns and the sum of both rows and columns for the matrix of indirect links, $X^2 (I - X)^{-1}$, for respondent 105

1	18	1.134	15	1.636	18	1.913
2	21	.950	14	1.320	15	1.752
3	17	.875	22	1.205	21	1.653
4	25	.833	30	1.147	17	1.546
5	10	.760	18	.779	14	1.443
6	16	.573	21	.703	22	1.297
7	34	.566	17	.671	30	1.197
8	39	.509	23	.555	16	1.074
9	20	.440	35	.549	34	.990
10	8	.426	20	.522	20	.963
11	19	.423	16	.501	25	.932
12	27	.349	34	.424	10	.862
13	5	.343	3	.315	39	.774
14	32	.338	37	.285	35	.635
15	6	.320	12	.274	23	.601
16	1	.277	39	.265	3	.553
17	4	.272	10	.102	12	.538
18	12	.264	42	.101	37	.525
19	31	.263	29	.100	8	.514
20	33	.247	25	.099	19	.423
21	37	.240	8	.088	27	.412
22	3	.238	41	.082	1	.349
23	40	.167	1	.071	5	.343
24	29	.149	27	.063	32	.338
25	41	.129	38	.055	6	.320
26	14	.123	9	.053	4	.300
27	15	.117	44	.034	31	.293
28	22	.092	31	.029	29	.249
29	46	.089	4	.028	33	.247
30	35	.086	43	.019	41	.212
31	48	.081	2	.009	42	.179
32	42	.079	32	.000	40	.167
33	24	.076	33	.000	44	.099
34	44	.065	5	.000	46	.089
35	7	.052	24	.000	48	.081
36	30	.050	36	.000	24	.076
37	23	.046	13	.000	38	.055
38	47	.043	26	.000	9	.053
39	13	.000	19	.000	7	.052
40	26	.000	40	.000	47	.043
41	2	.000	28	.000	43	.019
42	28	.000	6	.000	2	.009
43	43	.000	7	.000	13	.000
44	11	.000	11	.000	26	.000
45	45	.000	45	.000	45	.000
46	36	.000	46	.000	11	.000
47	9	.000	47	.000	36	.000
48	38	.000	48	.000	28	.000

e) Matrix partitioning

The analysis of the matrix of direct-indirect links $(X(I - X)^{-1})$ shows that in many cases there is an influence of a problem i on a problem j together with an influence of the same problem j on problem i . If both links are also found in the direct matrix X , we say that there is a loop between problem i and problem j ; if one of the links is indirect, we say that there is a cycle connecting problem i and problem j .

If all the cells of the matrix $X(I - X)^{-1}$ containing a relation are given a value of 1, and all the empty cells a value of 0, a binary matrix B is obtained.

By adding to B its transpose B' we obtain a matrix \bar{C} . Using both B and \bar{C} a matrix C can be constructed in which the elements are :

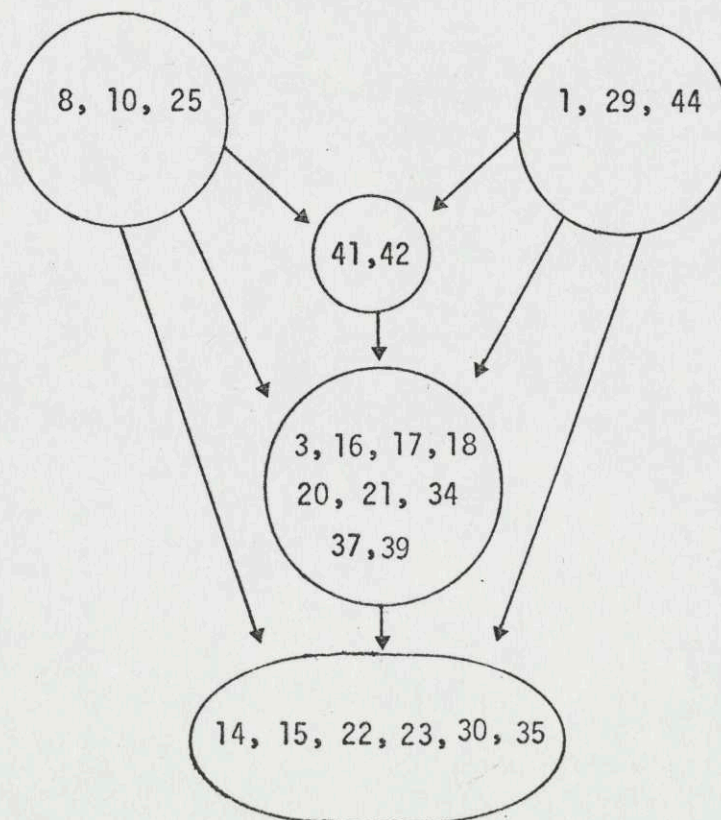
$$\begin{aligned}
 c_{ij} &= 0 \text{ if no link exists between } i \text{ and } j \text{ (} b_{ij} = b_{ji} = 0 \text{)} \\
 c_{ij} &= 1 \text{ if problem } i \text{ influences problem } j, \text{ but} \\
 &\quad \text{problem } j \text{ does not influence problem } i \text{ (} b_{ij}=1 ; b_{ji} = 0 \text{)} \\
 c_{ij} &= 2 \text{ if problems } i \text{ and } j \text{ are interrelated in} \\
 &\quad \text{a cycle (} \bar{c}_{ij} = 2 \text{)}
 \end{aligned}$$

Table 7 reproduces the matrix C for respondent 105

By inspection of matrix C it appears that five groups of problems are in different connected interactive cycles, the rest of the problems being antecedents or consequents to these cycles, which are the following :

- 1, 29, 44 :
- 3, 16, 17, 18, 20, 21, 34, 37, 39 :
- 8, 10, 25
- 14, 15, 22, 23, 30, 35
- 41, 42

Further examination of the connections between these cycles shows the following orientation



The matrix of respondent 105 can therefore be partitioned into these groups of problems or "constituents" between which there are no feed-backs. J Warfield in "Binary matrices in system modeling", 1973, has shown the premutational procedure required to make this matrix bloc-diagonal.

f) Cycles

Further analysis of the "geodetic cycles" (shortest cycle connecting two problems) included in the constituents of a partitioned matrix can clarify the functioning of the structure of problems perceived by the respondent.

The method used to derive geodetic cycles is described by J. Warfield in "Theory of cycles IV, Geodetic cycles" and can be summarized as follows :

- transform the original matrix X^* into a binary matrix \bar{X} in which the existence of a relation is noted by 1 and its absence by 0 ;

- use Boolean powers of \bar{X} to compute a distance matrix G indicating in its elements g_{ij} the minimum number of steps required to relate problem i to problem j ; for instance, a 1 in the G matrix will indicate a direct link between two problems;
- compute the circumference (length) of geodetic cycles by adding g_{ij} to its counterpart g_{ji} , when both are non zero elements of G ;
- further compute the sequence for each geodetic cycle using matrix G in order to identify each step.

For respondent 105 table 8 reproduces the binary matrix \bar{X} and table 9 the G matrix derived from it.

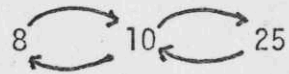
Table 10 : Geodetic cycles, circumferences and sequences, for respondent 105

Nº	1	BOUCLE DE	2	NŒUDS (10 8)	10	8	10						
Nº	2	BOUCLE DE	2	NŒUDS (15 14)	15	14	15						
Nº	3	BOUCLE DE	5	NŒUDS (16 3)	16	17	20	3	39	16			
Nº	4	BOUCLE DE	5	NŒUDS (17 3)	17	20	3	39	16	17			
Nº	5	BOUCLE DE	4	NŒUDS (17 16)	17	18	34	16	17				
Nº	6	BOUCLE DE	5	NŒUDS (18 3)	18	20	3	39	16	18			
Nº	7	BOUCLE DE	3	NŒUDS (18 16)	18	34	16	18					
Nº	8	BOUCLE DE	2	NŒUDS (18 17)	18	17	18						
Nº	9	BOUCLE DE	5	NŒUDS (20 3)	20	3	39	16	17	20			
Nº	10	BOUCLE DE	5	NŒUDS (20 16)	20	3	39	16	17	20			
Nº	11	BOUCLE DE	3	NŒUDS (20 17)	20	21	17	20					
Nº	12	BOUCLE DE	3	NŒUDS (20 18)	20	21	18	20					
Nº	13	BOUCLE DE	6	NŒUDS (21 3)	21	20	3	39	16	17	21		
Nº	14	BOUCLE DE	5	NŒUDS (21 16)	21	18	34	16	17	21			
Nº	15	BOUCLE DE	2	NŒUDS (21 17)	21	17	21						
Nº	16	BOUCLE DE	2	NŒUDS (21 18)	21	18	21						
Nº	17	BOUCLE DE	2	NŒUDS (21 20)	21	20	21						
Nº	18	BOUCLE DE	4	NŒUDS (22 14)	22	15	14	15	22				
Nº	19	BOUCLE DE	2	NŒUDS (22 15)	22	15	22						
Nº	20	BOUCLE DE	5	NŒUDS (23 14)	23	15	14	15	22	23			
Nº	21	BOUCLE DE	3	NŒUDS (23 15)	23	15	22	23					
Nº	22	BOUCLE DE	3	NŒUDS (23 22)	23	15	22	23					
Nº	23	BOUCLE DE	4	NŒUDS (25 8)	25	10	8	10	25				
Nº	24	BOUCLE DE	2	NŒUDS (25 10)	25	10	25						
Nº	25	BOUCLE DE	3	NŒUDS (29 1)	29	1	44	29					
Nº	26	BOUCLE DE	2	NŒUDS (30 14)	30	14	30						
Nº	27	BOUCLE DE	3	NŒUDS (30 15)	30	14	15	30					
Nº	28	BOUCLE DE	3	NŒUDS (30 22)	30	22	15	30					
Nº	29	BOUCLE DE	4	NŒUDS (30 23)	30	22	23	15	30				
Nº	30	BOUCLE DE	8	NŒUDS (34 3)	34	16	17	20	3	39	16	18	34

NØ 31	BØUCLE DE	3 NØEUDS (34 16)	34	16	18	34														
NØ 32	BØUCLE DE	4 NØEUDS (34 17)	34	16	17	18	34													
NØ 33	BØUCLE DE	3 NØEUDS (34 18)	34	16	18	34														
NØ 34	BØUCLE DE	6 NØEUDS (34 20)	34	16	17	20	21	18	34											
NØ 35	BØUCLE DE	5 NØEUDS (34 21)	34	16	17	21	18	34												
NØ 36	BØUCLE DE	2 NØEUDS (35 14)	35	14	35															
NØ 37	BØUCLE DE	4 NØEUDS (35 15)	35	14	15	14	35													
NØ 38	BØUCLE DE	6 NØEUDS (35 22)	35	14	15	22	15	14	35											
NØ 39	BØUCLE DE	7 NØEUDS (35 23)	35	14	15	22	23	15	14	35										
NØ 40	BØUCLE DE	4 NØEUDS (35 30)	35	14	30	14	35													
NØ 41	BØUCLE DE	3 NØEUDS (37 3)	37	39	3	37														
NØ 42	BØUCLE DE	6 NØEUDS (37 16)	37	39	16	17	20	3	37											
NØ 43	BØUCLE DE	6 NØEUDS (37 17)	37	39	16	17	20	3	37											
NØ 44	BØUCLE DE	6 NØEUDS (37 18)	37	39	16	18	20	3	37											
NØ 45	BØUCLE DE	6 NØEUDS (37 20)	37	39	16	17	20	3	37											
NØ 46	BØUCLE DE	7 NØEUDS (37 21)	37	39	16	17	21	20	3	37										
NØ 47	BØUCLE DE	9 NØEUDS (37 34)	37	39	16	18	34	16	17	20	3	37								
NØ 48	BØUCLE DE	2 NØEUDS (39 3)	39	3	39															
NØ 49	BØUCLE DE	5 NØEUDS (39 16)	39	16	17	20	3	39												
NØ 50	BØUCLE DE	5 NØEUDS (39 17)	39	16	17	20	3	39												
NØ 51	BØUCLE DE	5 NØEUDS (39 18)	39	16	18	20	3	39												
NØ 52	BØUCLE DE	5 NØEUDS (39 20)	39	16	17	20	3	39												
NØ 53	BØUCLE DE	6 NØEUDS (39 21)	39	16	17	21	20	3	39											
NØ 54	BØUCLE DE	8 NØEUDS (39 34)	39	16	18	34	16	17	20	3	39									
NØ 55	BØUCLE DE	2 NØEUDS (39 37)	39	37	39															
NØ 56	BØUCLE DE	2 NØEUDS (42 41)	42	41	42															
NØ 57	BØUCLE DE	3 NØEUDS (44 1)	44	29	1	44														
NØ 58	BØUCLE DE	3 NØEUDS (44 29)	44	29	1	44														

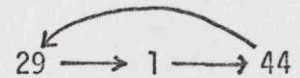
Table 10 reproduces the geodetic cycles identified and therefore allows for a clearer understanding of the constituents described above :

Constituent 1 : 8, 10, 25



loops 1, 23, 24

Constituent 2 : 1, 29, 44



cycles 25, 57, 58

Constituent 3 : 41, 42



loop 56

Constituent 4 : 3, 16, 17, 18, 20

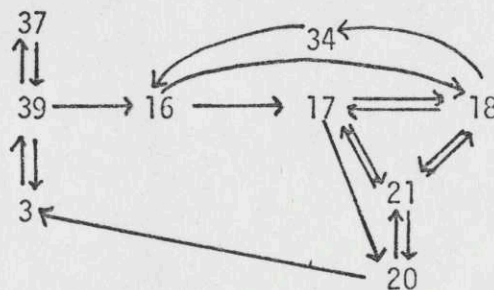
21, 34, 37, 39

cycles 4, 5, 6, 7, 8, 9, 10, 11

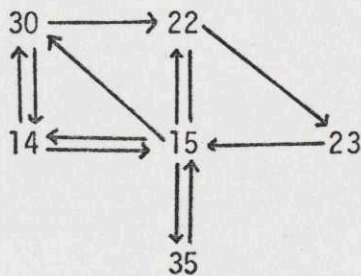
12, 13, 14, 15, 16, 17, 30, 31, 32

33, 34, 35, 42, 43, 44, 45, 46, 47

48, 49, 50, 51, 52, 53, 54, 55



Constituent 5 : 14, 15, 22, 23, 30, 35
 cycles 2, 18, 19, 20, 21, 22
 26, 27, 28, 29, 36, 37, 38, 39, 40

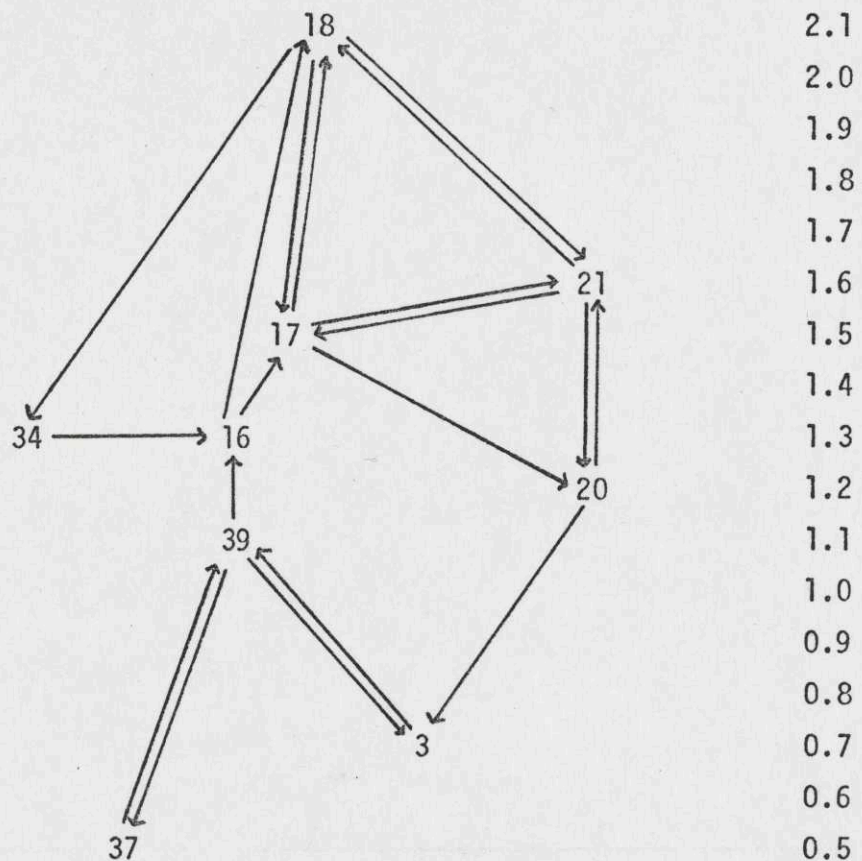


At this point, it becomes possible to combine the study of hierarchies which gives the positioning of the different problems in the overall directed graph of the respondent and the study of cycles within a given sub-system (constituent). The hierarchies give an ordered statement of each of the problems of the sub-system in relation to the total system and therefore help to identify the internal functioning of the cycles.

As an example, we can see for the problems in constituent 4 above that in the hierarchy of influences on table 5 they are ordered with the following values :

18	:	2.1
21	:	1.6
17	:	1.5
16, 34	:	1.3
20	:	1.2
39	:	1.1
3	:	0.7
37	:	0.5

This suggests therefore that a representation of this sub-system which respects the hierarchical structure can be the following :



III. ANALYTICAL TOOLS FOR COMPARISONS OF INDIVIDUAL PERCEPTIONS OF
THE WORLD PROBLEMATIQUE

The presentation of the analytical tools for comparisons of individual perceptions of the World Problematique will be illustrated with data derived from 12 respondents numbered : 003, 004, 006, 104, 105, 107, 108, 109, 110, 111, 112 and 113. It is important to note that the first three on this list answered to the draft questionnaire and the rest of them to the final documents "The World Problematique, an invitation to further thought"; thus, apparent differences between the results of the first three and those of the others may be directly due to the different characteristics of the two questionnaires, not problem perceptions.

a) The average matrix (M)

From any group of direct matrices of respondents it is possible to derive an average matrix M; each element m_{ij} of this average matrix will be in this case the mean of the same elements in the different direct matrices of the respondents.

$$\bar{m}_{ij} = \frac{\sum_k x_{ij}(k)}{n} \quad \begin{array}{l} 1, \dots, k, \dots, n \text{ respondents} \\ 1, \dots, i, \dots, j, \dots, 48 \text{ problems} \end{array} \quad (18)$$

The average matrix computed in this way, for the 12 respondents selected, is shown in annex 4; it contains 275 elements equal or greater than 1, of which 51 equal or greater than 2, 12 equal or greater than 2.5 and 2 equal to 3.

Table II shows this information normalized in a scale of 0 to 4 , by multiplying each element of \bar{M} by 4 times the reciprocal of the highest m_{ij} (in the example this reciprocal is $1/3$), and rounding the result to the closest integer. The matrix so derived, matrix M, is presented in a similar way than an initial respondent's matrix and can therefore be submitted to the same analytical process (computation of normalized direct, direct-indirect and indirect matrices, hierarchies, cycles, ...)

The correspondence between \bar{m}_{ij} and m_{ij} (an element of M) is given below

\bar{m}_{ij}		m_{ij}
less than 0.4	=	0
from 0.4 to 1.15	=	1
from 1.15 to 1.9	=	2
from 1.9 to 2.625	=	3
2.625 and over	=	4

As the process of normalization described distorts the initial information, it has been felt useful to present in Table 12 the same average matrix \bar{M} with its elements \bar{m}_{ij} rounded to the closest integer.

b) The directed graph of consensus

Inspection of the results of the application of the analytical methods developed in part II of this report to the normalized average matrix M show a system of an extreme complexity. All the 48 problems are in a single cycle as shown in table 13. In a way, this result confirms the need for the individual analysis and the development of major studies aiming at a clarification of the World Problematique. Further inspection of the original average matrix shows however certain elements of consensus among the 12 respondents.

Below are listed the relations showing the highest averages :

i : average of 2.5 or more

41 to 42	} average equal to 3
44 to 9	
3 to 37	
12 to 14	
14 to 15	
17 to 18 and 18 to 17	
20 to 21	
37 to 38	
43 to 36	
46 to 47	

The intellectual content of these relations of very great importance is discussed in Report No 1.

ii : average of 2.0 or more

The 51 relations with an average of 2.0 or more have been arranged in a binary matrix with 1 indicating those relations and 0 being elements with no relations or averages lower than 2. This matrix is shown on table 14. It so happens that the system so described is perfectly hierarchical and its levels can be identified using the procedure described by J. Warfield in "Binary matrices in system modelling", Battelle 1973.

The application of this procedure gives the following results :

Disconnected problems : 7, 11, 23, 24, 27, 35, 45, 48

Disconnected relations : 8 to 10 and 41 to 42

First level : 2, 6

Second level : 1, 5

Third level : 20

Fourth level : 3, 13, 39

Fifth level : 37

Sixth level : 12, 38, 40

Seventh level: 4, 17, 18, 30, 32, 43, 44, 46

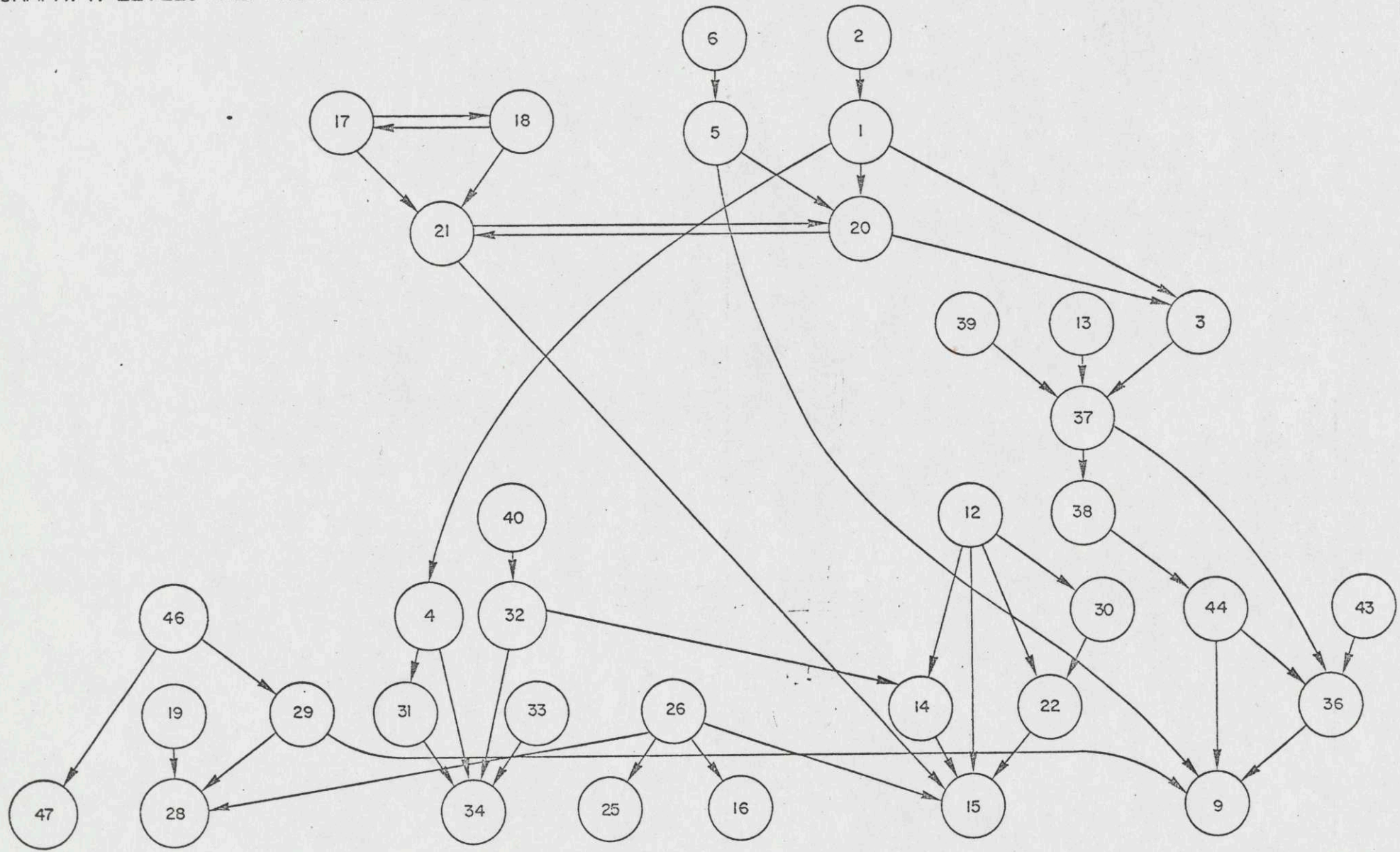
Eighth level : 14, 19, 21, 22, 26, 29, 31, 33, 36

Ninth level : 9, 15, 16, 25, 28, 34, 47,

The directed graph obtained by the introduction of the links existing between these levels is reproduced below.

A similar directed graph is reproduced in Report No 1 but this time replacing the positioning given by the levels, by the positioning given by the hierarchies derived from the normalized matrix M . In this Report No 1 is also given an interpretation of interesting parts of the system so described.

GRAPH. 1. LEVELS AND RELATIONS OF THE DIRECTED GRAPH OF 12 RESPONDENTS



1
2
3
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5
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7
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9

c) Statistical comparisons of the assessments of respondents

In section II of this Report we have seen how to calculate the implications of the answers made by a single respondent and embodied in X^* . We may now wish to compare the assessment of two respondents, r and s say. If we can ignore the fact that, in general, $\lambda_r \neq \lambda_s$ (λ being the reciprocal of the largest row sum used for normalization as described in II a, above) it would seem reasonable to do this comparison in terms of distance measures.

The general measure of distance adopted is the square root of the sum of the squared differences between each element of the matrices compared divided by the total number of elements in the matrices, v^2 :

$$\delta_{rs} = \sqrt{\frac{\sum (u_{ij}(r) - u_{ij}(s))^2}{v^2}} \quad (18)$$

It is possible to compute the distances between direct matrices or between direct / indirect matrices; u_{ij} will be elements of X^* or of $(X(I - X))^{-1}$ respectively.

It is interesting to notice that the three respondents who used the initial draft questionnaire (003, 004 and 006) are consistently the most distant from all the others, a result which is most probably due to the changes in the presentation introduced after the first pilot tests (see Report No 1).

It is possible to represent these measurements of relative distances in a graphic form in which each respondent is represented by a point and the distance between two points corresponds to the distance measured previously.

In order to do so, we suppose that the position of a respondent r in this graphic is given by two coordinates x_r and y_r . These coordinates will be the result of the following optimization problem :

$$\text{Min !} = \sum_{rs} \frac{1}{\delta_{rs}} (x_r - x_s)^2 + (y_r - y_s)^2 \quad (19)$$

$$\text{with constraints} \quad \sum x_r^2 = \lambda_1 \quad (20)$$

$$\sum y_r^2 = \lambda_2 \quad (21)$$

This is a problem of eigen values and the solutions x_r, y_r are the eigen vectors of the matrix $\left\| \frac{1}{\delta_{rs}} \right\|$ showing the lowest eigen values.

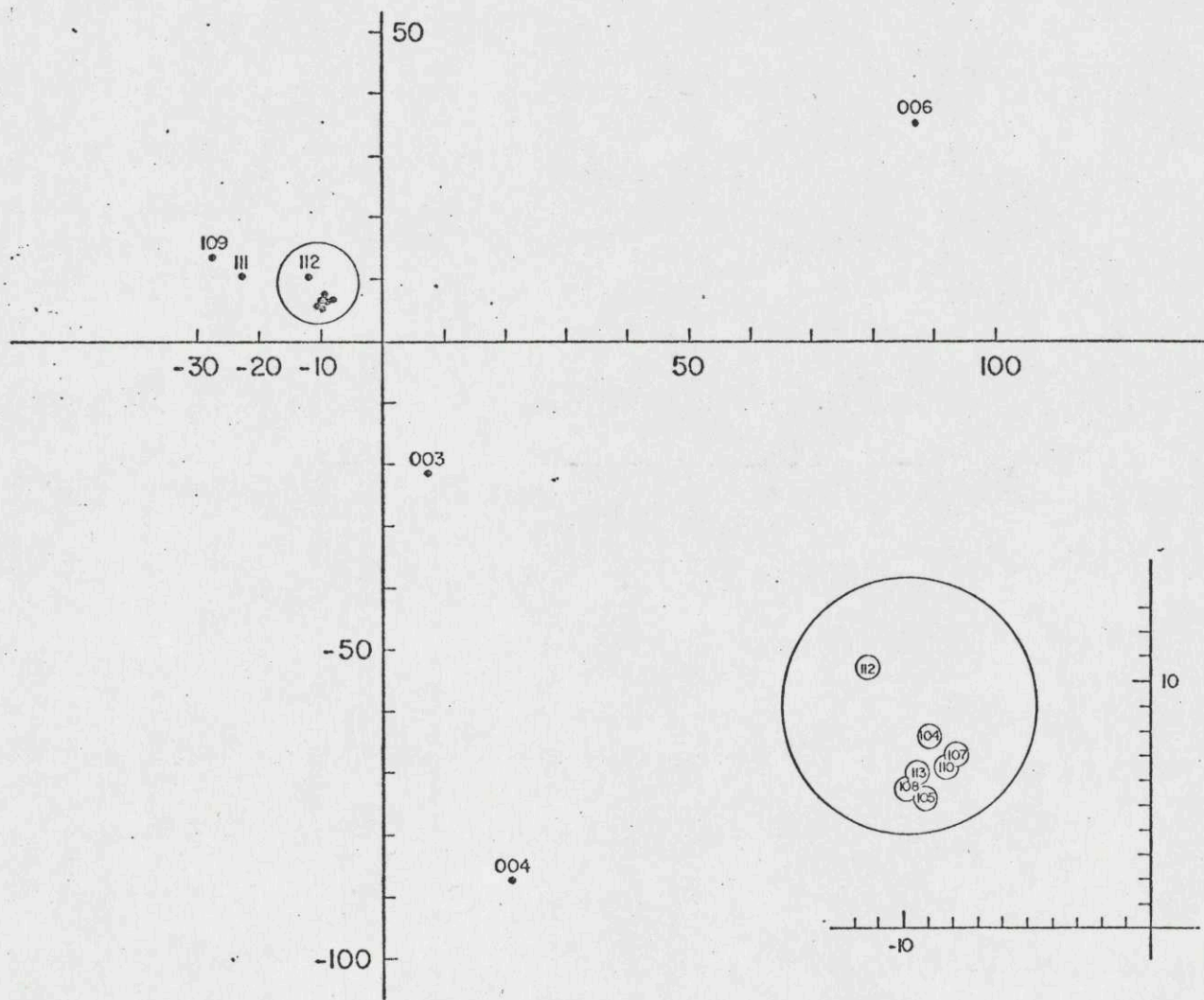
The eigen vectors with lowest eigen values, for the distances among the 12 respondents shown on table 15, are :

respondent	x	y
003	.0740	-.2141
004	.2110	-.8734
006	.8723	.3538
104	-.0902	.0784
105	-.0928	.0532
107	-.0799	.0676
108	-.0994	.0573
109	-.2773	.1363
110	-.0841	.0651
111	-.2229	.1081
112	-.1149	.1045
113	-.0957	.0631

and the graphical representation on the following page portrays this information.

Computations of distances from the average matrices to the matrices of each respondent have also been made with the methods described previously.

GRAPH. 2. REPRESENTATION OF DISTANCES BETWEEN RESPONDENTS



Annex 1 : Normalized matrix of direct relations, X, for respondent 105
 (rows : influencing problems; columns : influenced problems)

R9W NR 1	.000	.053	.105	.158	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.053
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.105	.105	.053	.000	.000	.000	.000	.000	.000
R9W NR 2	.000									
R9W NR 3	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.158	.000	.158	.000	.105	.000
	.000	.000	.000	.000	.000	.000	.000	.000		
R9W NR 4	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.158	.000	.000	.158	.000	.000	.000	.053	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000		
R9W NR 5	.000	.000	.000	.000	.000	.000	.000	.000	.053	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.158
	.000	.000	.000	.000	.105	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
R9W NR 6	.000	.000	.000	.000	.105	.000	.158	.000	.105	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.105	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.211	.000	.000	.000	.000	.000	.000
R9W NR 7	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.158	.000	.000	.000	.000	.000	.000
R9W NR 8	.000	.000	.000	.000	.000	.000	.000	.000	.000	.158
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.211	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.105	.000	.000	.000	.000	.000	.000	.000	.000
R9W NR 9	.000									
R9W NR 10	.000	.000	.000	.000	.000	.000	.000	.211	.000	.000
	.000	.158	.000	.000	.000	.105	.000	.000	.000	.000
	.000	.000	.000	.000	.211	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
R9W NR 11	.000									
R9W NR 12	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.211	.158	.000	.000	.000	.000	.000
	.000	.158	.000	.000	.000	.000	.000	.000	.000	.105
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

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•000	•000	•000	•000	•000	•000	•000	•000	•000	•000
•000	•000	•000	•000	•000	•000	•105	•000		

Annex 2 : Matrix of direct and indirect relations, $X(I - X)^{-1}$, for respondent 105
 (rows : influencing problems; columns : influenced problems)

ROW NR 1	.001 .000 .007 .025 .017	.053 .005 .014 .000 .109	.118 .000 .014 .000 .105	.158 .015 .000 .031 .033	.000 .021 .000 .021 .000	.000 .010 .000 .000 .000	.000 .003 .000 .025 .000	.000 .003 .000 .010 .000	.006 .000 .008 .018	.000 .054 .006 .000
ROW NR 2	.000									
ROW NR 3	.000 .000 .002 .000 .000	.000 .000 .008 .000 .000	.032 .000 .001 .000 .000	.000 .033 .000 .001 .000	.000 .009 .000 .168 .000	.000 .032 .000 .000 .000	.000 .005 .000 .194 .000	.000 .005 .000 .010 .000	.000 .000 .000 .150	.000 .001 .009 .000
ROW NR 4	.000 .000 .002 .158 .000	.000 .030 .018 .000 .000	.000 .000 .003 .000 .000	.000 .060 .000 .192 .000	.000 .040 .000 .010 .000	.000 .041 .000 .000 .000	.000 .006 .000 .000 .000	.000 .006 .000 .053 .000	.000 .000 .000 .000	.000 .002 .019 .000
ROW NR 5	.000 .000 .043 .000 .000	.000 .003 .039 .000 .000	.028 .000 .042 .000 .000	.000 .027 .000 .006 .000	.000 .050 .108 .009 .000	.000 .003 .000 .000 .000	.000 .013 .001 .005 .000	.002 .029 .000 .000 .000	.053 .000 .000 .004	.012 .169 .013 .000
ROW NR 6	.004 .000 .029 .000 .000	.000 .003 .013 .000 .001	.005 .000 .007 .000 .000	.001 .025 .000 .006 .236	.105 .020 .119 .005 .000	.000 .003 .000 .000 .000	.158 .011 .001 .001 .000	.003 .027 .000 .000 .000	.136 .000 .037 .001	.013 .025 .011 .000
ROW NR 7	.003 .000 .000 .000 .000	.000 .000 .000 .000 .000	.000 .000 .000 .000 .000	.000 .000 .000 .000 .158	.000 .003 .000 .000 .000	.000 .000 .000 .000 .000	.000 .000 .000 .000 .000	.000 .000 .000 .000 .000	.017 .000 .025 .000	.000 .000 .002 .000
ROW NR 8	.000 .000 .012 .000 .018	.000 .027 .027 .000 .113	.001 .000 .005 .000 .000	.000 .031 .000 .004 .000	.000 .055 .035 .005 .000	.000 .064 .000 .000 .000	.000 .012 .218 .003 .000	.035 .017 .000 .000 .000	.000 .000 .000 .001	.167 .005 .045 .000
ROW NR 9	.000									
ROW NR 10	.000 .000 .057 .000 .004	.000 .169 .075 .000 .024	.003 .000 .016 .000 .000	.000 .109 .000 .014 .000	.000 .085 .223 .018 .000	.000 .124 .000 .000 .000	.000 .036 .047 .001 .000	.223 .058 .000 .000 .000	.000 .000 .000 .001	.059 .020 .067 .000
ROW NR 11	.000									
ROW NR 12	.000 .000 .000 .000	.000 .000 .190 .000	.000 .000 .030 .000	.000 .249 .000 .000	.000 .230 .000 .000	.000 .000 .000 .000	.000 .000 .000 .000	.000 .000 .000 .000	.000 .000 .000	.000 .000 .156

	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
RBW NR 13	.000									
RBW NR 14	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.051	.170	.000	.000	.000	.000	.000
	.000	.025	.004	.000	.000	.000	.000	.000	.000	.129
	.000	.000	.000	.000	.166	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
RBW NR 15	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.119	.039	.000	.000	.000	.000	.000
	.000	.116	.018	.000	.000	.000	.000	.000	.000	.122
	.000	.000	.000	.000	.019	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
RBW NR 16	.000	.000	.007	.000	.000	.000	.000	.000	.000	.000
	.000	.005	.000	.196	.143	.007	.147	.149	.000	.040
	.059	.222	.044	.000	.000	.000	.000	.000	.000	.173
	.000	.000	.000	.031	.032	.000	.001	.000	.001	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
RBW NR 17	.000	.000	.030	.000	.000	.000	.000	.000	.000	.000
	.000	.010	.000	.040	.116	.014	.102	.287	.000	.186
	.254	.157	.064	.000	.000	.000	.000	.000	.000	.165
	.000	.000	.000	.060	.011	.000	.006	.000	.004	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
RBW NR 18	.000	.000	.032	.000	.000	.000	.000	.000	.000	.000
	.000	.038	.000	.098	.120	.051	.292	.131	.000	.198
	.305	.268	.084	.000	.000	.000	.000	.000	.000	.188
	.000	.000	.000	.238	.021	.000	.006	.000	.005	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
RBW NR 19	.000	.000	.005	.000	.000	.000	.000	.000	.000	.000
	.000	.002	.000	.045	.042	.213	.147	.062	.000	.028
	.039	.063	.016	.000	.000	.000	.000	.000	.000	.054
	.000	.000	.000	.013	.008	.000	.001	.000	.001	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
RBW NR 20	.000	.000	.167	.000	.000	.000	.000	.000	.000	.000
	.000	.001	.000	.035	.244	.006	.026	.031	.000	.025
	.119	.197	.247	.000	.000	.000	.000	.000	.000	.036
	.000	.000	.000	.007	.032	.000	.031	.002	.024	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
RBW NR 21	.000	.000	.038	.000	.000	.000	.000	.000	.000	.000
	.000	.010	.000	.051	.259	.014	.239	.288	.000	.233
	.123	.131	.070	.000	.000	.000	.000	.000	.000	.091
	.000	.000	.000	.061	.014	.000	.007	.000	.005	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
RBW NR 22	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.021	.181	.000	.000	.000	.000	.000
	.000	.020	.161	.000	.000	.000	.000	.000	.000	.021
	.000	.000	.000	.000	.003	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
RBW NR 23	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.012	.109	.000	.000	.000	.000	.000
	.000	.012	.000	.000	.000	.000	.000	.000	.000	.013
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

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.011
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Annex 3 : Matrix of indirect relations $X^2 (I - X)^{-1}$, for respondent 105
 (rows : influencing problems; columns : influenced problems)

RBW NR 1	.001 .000 .007 .025 .017	.000 .005 .014 .000 .004	.012 .000 .014 .000 .000	.000 .015 .000 .031 .000	.000 .021 .000 .021 .000	.000 .010 .000 .000 .000	.000 .003 .000 .025 .000	.000 .003 .000 .010 .000	.006 .000 .008 .018 .000	.000 .002 .006 .000
RBW NR 2	.000									
RBW NR 3	.000 .000 .002 .000 .000	.000 .000 .008 .000 .000	.032 .000 .001 .000 .000	.000 .033 .000 .001 .000	.000 .009 .000 .010 .000	.000 .032 .000 .000 .000	.000 .005 .000 .036 .000	.000 .005 .000 .010 .000	.000 .000 .000 .044 .000	.000 .001 .009 .000 .000
RBW NR 4	.000 .000 .002 .000 .000	.000 .030 .018 .000 .000	.000 .000 .003 .000 .000	.000 .060 .000 .035 .000	.000 .040 .000 .010 .000	.000 .041 .000 .000 .000	.000 .006 .000 .000 .000	.000 .006 .000 .000 .000	.000 .000 .000 .000 .000	.000 .002 .019 .000 .000
RBW NR 5	.000 .000 .043 .000 .000	.000 .003 .039 .000 .000	.028 .000 .042 .000 .000	.000 .027 .000 .006 .000	.000 .050 .002 .009 .000	.000 .003 .000 .000 .000	.000 .013 .001 .005 .000	.002 .029 .000 .000 .000	.000 .000 .000 .004 .000	.012 .011 .013 .000 .000
RBW NR 6	.004 .000 .029 .000 .000	.000 .003 .013 .000 .001	.005 .000 .007 .000 .000	.001 .025 .000 .006 .025	.000 .020 .014 .005 .000	.000 .003 .000 .000 .000	.000 .011 .001 .001 .000	.003 .027 .000 .000 .000	.030 .000 .037 .001 .000	.013 .025 .011 .000 .000
RBW NR 7	.003 .000 .000 .000 .000	.000 .000 .000 .000 .000	.000 .000 .000 .000 .000	.000 .000 .000 .000 .000	.000 .003 .000 .000 .000	.000 .000 .000 .000 .000	.000 .000 .000 .000 .000	.000 .000 .000 .000 .000	.017 .000 .025 .000 .000	.000 .000 .002 .000 .000
RBW NR 8	.000 .000 .012 .000 .018	.000 .027 .027 .000 .007	.001 .000 .005 .000 .000	.000 .031 .000 .004 .000	.000 .055 .035 .005 .000	.000 .064 .000 .000 .000	.000 .012 .007 .003 .000	.035 .017 .000 .000 .000	.000 .000 .000 .001 .000	.009 .005 .045 .000 .000
RBW NR 9	.000									
RBW NR 10	.000 .000 .057 .000 .004	.000 .012 .075 .000 .024	.003 .000 .016 .000 .000	.000 .109 .000 .014 .000	.000 .085 .012 .018 .000	.000 .019 .000 .000 .000	.000 .036 .047 .001 .000	.012 .068 .000 .000 .000	.000 .000 .000 .001 .000	.059 .020 .067 .000 .000
RBW NR 11	.000									
RBW NR 12	.000 .000 .000 .000	.000 .000 .032 .000	.000 .000 .030 .000	.000 .039 .000 .000	.000 .073 .000 .039	.000 .000 .000 .000	.000 .000 .000 .000	.000 .000 .000 .000	.000 .000 .000 .000	.000 .000 .050 .000

	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
R&W NR 13	.000									
R&W NR 14	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.051	.012	.000	.000	.000	.000	.000
	.000	.025	.004	.000	.000	.000	.000	.000	.000	.023
	.000	.000	.000	.000	.003	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
R&W NR 15	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.013	.039	.000	.000	.000	.000	.000
	.000	.011	.018	.000	.000	.000	.000	.000	.000	.017
	.000	.000	.000	.000	.019	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
R&W NR 16	.000	.000	.007	.000	.000	.000	.000	.000	.000	.000
	.000	.005	.000	.038	.091	.007	.041	.044	.000	.040
	.059	.064	.044	.000	.000	.000	.000	.000	.000	.068
	.000	.000	.000	.031	.032	.000	.001	.000	.001	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
R&W NR 17	.000	.000	.030	.000	.000	.000	.000	.000	.000	.000
	.000	.010	.000	.040	.116	.014	.102	.076	.000	.081
	.096	.105	.064	.000	.000	.000	.000	.000	.000	.060
	.000	.000	.000	.060	.011	.000	.006	.000	.004	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
R&W NR 18	.000	.000	.032	.000	.000	.000	.000	.000	.000	.000
	.000	.038	.000	.098	.180	.051	.081	.131	.000	.093
	.094	.110	.084	.000	.000	.000	.000	.000	.000	.083
	.000	.000	.000	.028	.021	.000	.006	.000	.005	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
R&W NR 19	.000	.000	.005	.000	.000	.000	.000	.000	.000	.000
	.000	.002	.000	.045	.042	.003	.042	.062	.000	.028
	.039	.063	.016	.000	.000	.000	.000	.000	.000	.054
	.000	.000	.000	.013	.003	.000	.001	.000	.001	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
R&W NR 20	.000	.000	.009	.000	.000	.000	.000	.000	.000	.000
	.000	.001	.000	.035	.086	.006	.026	.031	.000	.025
	.013	.039	.036	.000	.000	.000	.000	.000	.000	.036
	.000	.000	.000	.007	.032	.000	.031	.002	.024	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
R&W NR 21	.000	.000	.038	.000	.000	.000	.000	.000	.000	.000
	.000	.010	.000	.051	.101	.014	.082	.078	.000	.075
	.123	.131	.070	.000	.000	.000	.000	.000	.000	.091
	.000	.000	.000	.061	.014	.000	.007	.000	.005	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
R&W NR 22	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.021	.023	.000	.000	.000	.000	.000
	.000	.020	.003	.000	.000	.000	.000	.000	.000	.021
	.000	.000	.000	.000	.003	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
R&W NR 23	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.012	.004	.000	.000	.000	.000	.000
	.000	.012	.002	.000	.000	.000	.000	.000	.000	.013
	.000	.000	.000	.000	.002	.000	.000	.000	.000	.000

	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
RBW NR 24	.000	.000	.000	.000	.000	.000	.000	.012	.000	.003
	.000	.009	.000	.006	.004	.007	.002	.004	.000	.001
	.003	.004	.001	.000	.012	.000	.002	.000	.000	.004
	.000	.000	.000	.001	.001	.000	.000	.000	.000	.000
	.000	.001	.000	.000	.000	.000	.000	.000	.000	.000
RBW NR 25	.000	.000	.011	.000	.000	.000	.000	.023	.000	.006
	.000	.025	.000	.043	.105	.023	.088	.073	.000	.070
	.074	.075	.027	.000	.023	.000	.005	.000	.000	.071
	.000	.000	.000	.049	.034	.000	.002	.000	.002	.000
	.000	.003	.000	.000	.000	.000	.000	.000	.000	.000
RBW NR 26	.000									
RBW NR 27	.000	.000	.001	.000	.000	.000	.000	.000	.000	.000
	.000	.001	.000	.066	.038	.001	.031	.031	.000	.009
	.012	.071	.013	.000	.000	.000	.000	.000	.000	.057
	.000	.000	.000	.007	.011	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
RBW NR 28	.000									
RBW NR 29	.000	.006	.012	.017	.000	.000	.000	.000	.001	.000
	.000	.001	.000	.017	.007	.001	.000	.000	.000	.006
	.001	.017	.004	.000	.000	.000	.000	.000	.001	.014
	.003	.000	.000	.003	.005	.000	.003	.001	.002	.000
	.002	.011	.011	.006	.000	.000	.000	.000	.000	.000
RBW NR 30	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.004	.019	.000	.000	.000	.000	.000
	.000	.002	.009	.000	.000	.000	.000	.000	.000	.008
	.000	.000	.000	.000	.009	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
RBW NR 31	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.033	.000	.066	.045	.045	.007	.007	.000	.002
	.003	.020	.004	.000	.000	.000	.000	.000	.000	.021
	.000	.000	.000	.001	.010	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
RBW NR 32	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.025	.000	.078	.072	.033	.005	.005	.000	.001
	.002	.020	.004	.000	.000	.000	.000	.000	.000	.045
	.000	.000	.000	.001	.046	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
RBW NR 33	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.029	.000	.057	.038	.038	.006	.006	.000	.002
	.002	.017	.003	.000	.000	.000	.000	.000	.000	.018
	.000	.000	.000	.023	.009	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
RBW NR 34	.000	.000	.001	.000	.000	.000	.000	.000	.000	.000
	.000	.001	.000	.104	.106	.001	.031	.031	.000	.009
	.012	.094	.017	.000	.000	.000	.000	.000	.000	.101
	.000	.000	.000	.007	.050	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
RBW NR 35	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.008	.027	.000	.000	.000	.000	.000

	.000	.004	.001	.000	.000	.000	.000	.000	.000	.020
	.000	.000	.000	.000	.026	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
RSW NR 36	.000									
RSW NR 37	.000	.000	.048	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.011	.007	.048	.007	.007	.000	.002
	.003	.011	.002	.000	.000	.000	.000	.000	.000	.008
	.000	.000	.000	.002	.009	.000	.055	.003	.017	.000
	.000	.000	.000	.000	.000	.000	.000	.000		
RSW NR 38	.000									
RSW NR 39	.000	.000	.018	.000	.000	.000	.000	.000	.000	.000
	.000	.001	.000	.050	.034	.018	.033	.034	.000	.009
	.013	.050	.010	.000	.000	.000	.000	.000	.000	.040
	.000	.000	.000	.007	.044	.000	.053	.014	.030	.000
	.000	.000	.000	.000	.000	.000	.000	.000		
RSW NR 40	.000	.000	.003	.000	.000	.000	.000	.000	.000	.000
	.000	.004	.000	.055	.013	.008	.001	.001	.000	.000
	.000	.004	.001	.000	.000	.000	.000	.000	.000	.009
	.000	.000	.000	.025	.026	.000	.003	.003	.012	.000
	.000	.000	.000	.000	.000	.000	.000	.000		
RSW NR 41	.000	.000	.008	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.002	.001	.008	.001	.001	.000	.000
	.000	.002	.000	.000	.000	.000	.000	.000	.000	.001
	.000	.000	.000	.000	.002	.000	.014	.009	.037	.000
	.034	.007	.000	.000	.000	.000	.000	.000		
RSW NR 42	.000	.000	.001	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.001	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.027	.001	.006	.000
	.005	.034	.000	.000	.000	.000	.000	.000		
RSW NR 43	.000									
RSW NR 44	.017	.001	.002	.003	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.003	.018	.000	.000	.000	.000	.001
	.000	.003	.001	.000	.000	.000	.000	.000	.000	.011
	.000	.000	.000	.001	.001	.000	.000	.000	.000	.000
	.000	.002	.002	.001	.000	.000	.000	.000		
RSW NR 45	.000									
RSW NR 46	.018	.001	.002	.003	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.003	.020	.000	.000	.000	.000	.001
	.000	.003	.001	.000	.000	.000	.000	.000	.017	.012
	.000	.000	.000	.001	.001	.000	.000	.000	.000	.000
	.000	.002	.002	.001	.000	.000	.000	.000		
RSW NR 47	.011	.001	.001	.002	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.002	.012	.000	.000	.000	.000	.001
	.000	.002	.000	.000	.000	.000	.000	.000	.000	.007
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.001	.001	.001	.000	.000	.000	.000		
RSW NR 48	.018	.001	.002	.003	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.003	.019	.000	.000	.000	.000	.001

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Annex 4 : Average matrix \bar{M} of 12 respondents

R0W NR 1	.000 .083 .167 .583 .083	1.833 .000 .083 .500 1.583	2.417 .083 .750 .083 1.917	2.000 .083 .583 .083 1.667	.667 .083 .167 .083 .583	.167 .083 .417 .667 .500	.250 .083 .083 .083 .417	.083 .167 .083 .083 .000	.417 .083 .083 .583	.000 2.000 .500 .083
R0W NR 2	2.000 .000 .333 .000 .083	.000 .000 .083 .000 1.167	1.500 .000 .500 .000 .083	.750 .083 .500 .000 .167	1.333 .000 .083 .000 .167	.250 .000 .000 .333 .083	.167 .083 .000 .083 .083	.083 .083 .250 .167 .000	.083 .000 .083 .750	.250 1.000 .167 .083
R0W NR 3	.583 .000 .167 .083 .417	1.917 .000 .000 .083 .333	.000 .000 .000 .000 .500	.083 .083 .000 .083 .000	1.583 1.250 .083 .833 .000	.083 .000 .000 .167 .250	.417 .000 .083 .167 .250	.083 .000 .000 .250 .250	.167 .000 .000 .250 .250	.000 1.167 .000 .583
R0W NR 4	.500 .000 .000 2.250 .000	.000 .000 .000 .000 .000	.033 .000 .000 .000 .333	.000 .083 .000 2.167 .000	.167 .000 .000 .083 .000	.083 .000 .000 .000 .083	.250 .000 .000 .833 .083	.083 .000 .000 .917 .000	.000 .000 .000 .083 .000	.000 .000 .000 .000 .000
R0W NR 5	.750 .000 .250 .000 .083	.500 .000 .000 .000 .000	.833 .000 .000 .000 .000	.000 .417 .000 .333 .000	.000 .333 .583 .000 .000	.083 .250 .250 .000 .000	1.000 .417 .250 .083 .000	.083 .667 .500 .083 .000	2.000 .000 .000 .000	.417 2.000 .000 .000
R0W NR 6	.083 .000 .000 .000 .250	.167 .000 .000 .000 .583	.000 .000 .000 .000 .000	.000 .000 .000 .000 .833	2.000 .000 .417 .000 .083	.000 .000 .000 .167 .000	.833 .000 .000 .000 .000	.083 .000 .000 .333 .000	1.667 .000 .250 .500	.000 .000 .000 .000
R0W NR 7	.917 .167 1.417 .000 .000	.417 .000 .000 .000 .000	.167 .000 .000 .000 .000	.000 .000 .000 .000 .417	.750 .000 .000 .000 .000	.083 .083 .167 .000 .000	.000 .583 .583 .000 .000	.083 .000 .917 .167 .000	.083 .000 .000 .083	.250 1.083 .000 .000
R0W NR 8	.667 .000 .083 .000 .833	.000 .083 .083 .000 .750	.167 .000 .000 .000 .000	.000 .167 .083 .167 .000	.250 .417 .000 .000 .000	.500 .417 1.750 .333 .000	.000 .083 1.417 .333 .000	.000 .083 .583 .000 .000	1.750 .083 .583 .000	1.583 .417 .000 .250
R0W NR 9	.250 .167 .917 .000 .000	.000 .000 .417 .000 .167	.000 .000 .000 .000 1.417	.000 .000 .000 .083 .000	1.583 .667 .000 .000 .000	.750 .083 .333 1.583 .417	.083 .000 .333 .333 .167	.083 .417 .583 .000 .500	.000 .000 .750 .000	.833 1.417 .000 .000
R0W NR 10	.000 .000 .333 .000 .000	.000 1.250 .000 .000 .000	.000 .000 .000 .000 .000	.000 .167 .000 .000 .000	.500 .333 1.000 .000 .000	.083 1.333 .250 .417 .000	.083 .000 .750 .000 .000	2.083 .250 1.500 .000 .000	1.083 .000 .000 .000	.000 .000 .000 .000

RBW NR 11	.083 .000 .083 .000 .250	.000 .667 .000 .000 .000	.000 .000 .000 .000 .000	.000 .167 .000 .167 .000	.000 .167 .000 .167 .000	.167 .167 1.333 1.000 1.333	.000 .000 .083 .250 .417	.167 .000 .583 .000 .417	1.250 .000 .583 .000	.167 .167 .000 .000
RBW NR 12	.000 .167 .157 .667 .000	.000 .000 2.750 .750 .000	.000 .500 .000 .333 .000	.000 2.833 .000 .667 .000	.000 2.333 .000 .167 .000	.000 .417 .167 .500 .167	.000 .333 .417 .167 .500	.167 .000 .667 .000 .750	.250 .000 .667 .000	.167 .250 2.167 .167
RBW NR 13	.000 .157 .000 .333 .000	.000 1.833 .000 .167 .000	.000 .000 .000 .917 .000	.000 .333 .000 1.917 .000	.000 .083 .000 .083 .000	.000 .417 .000 .167 .500	.000 .000 .167 2.000 .167	.333 .167 .333 .250 .000	.000 .000 .750 .000	.083 .083 .000 .000
RBW NR 14	.167 .083 .000 .000 .000	.000 .167 .333 .000 .000	.000 .000 .250 .000 .000	.000 .000 .250 .417 .000	.000 2.500 .000 1.667 .000	.000 1.083 .000 .000 .000	.000 .000 .167 .167 .083	.167 .000 .167 .000 .000	.167 .083 .250 .000	.000 .167 1.250 .167
RBW NR 15	.250 .083 .000 .000 .250	.000 .000 .833 .000 .000	.000 .000 .000 .000 .000	.000 1.667 .167 .250 .000	.000 .000 .000 .000 .000	.000 1.417 .000 .000 .000	.000 .250 .333 .000 .000	.167 .500 .000 .000 .000	.083 .000 1.333 .000	.083 .333 1.333 .000
RBW NR 16	.000 .000 .000 .000 .000	.000 .667 1.833 .000 .000	.000 .000 .000 .000 .000	.000 1.417 .000 .667 .000	.000 1.750 .000 .000 .000	.000 .000 .083 .000 .250	.000 .667 .417 .000 .250	.167 .917 .083 .000 .000	.083 .000 .500 .000	.333 .250 1.500 .000
RBW NR 17	.667 .083 2.083 .000 .000	.000 .167 1.750 .000 .000	.000 .000 .167 .000 .000	.000 .167 .500 .083 .000	.500 .667 .000 .083 .000	.000 .667 .333 .500 .083	.667 .000 .083 .167 .083	.167 2.750 1.333 .000 .083	.667 .000 .833 .000	.083 1.583 .833 .000
RBW NR 18	.000 .000 2.000 .000 .000	.000 .083 1.500 .000 .000	.000 .000 .000 .000 .000	.000 .167 .667 1.167 .000	.000 .750 .000 .000 .000	.000 .250 .333 .083 .083	.000 2.583 .083 .083 .083	.667 .000 .667 .000 .083	.250 .083 .500 .000	.167 1.500 .417 .000
RBW NR 19	.000 1.583 .167 .000 .000	.000 .000 .083 .000 .000	.000 .000 .083 .000 .000	.000 .083 .000 .000 .000	.000 .750 .000 .000 .000	.000 1.583 .333 .250 .000	.000 .583 .000 .417 .000	.167 .333 2.000 .000 .000	.000 .000 .000	.333 .083 .000 .000
RBW NR 20	.833 .000 2.833 .000 .000	1.500 .000 1.750 .000 .000	2.417 .000 1.917 .000 .167	.000 .000 .000 .583 .000	.167 .000 .000 .000 .000	.083 .583 .000 .333 .000	.000 .000 .000 1.083 .000	.167 .583 .167 .000 .000	.583 .000 .083 .000	.667 .000 .000 .000
RBW NR 21	.167 .000	.000 .000	.000 .000	.000 .000	.167 2.250	.083 .000	.000 1.583	.250 1.917	.417 .000	.000 2.167

	.000	.417	.167	.167	.333	.250	.000	.250	1.417	.000
	.000	.000	.000	.167	.083	.250	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
ROW NR 22	.000	.000	.000	.000	.000	.000	.000	.167	.000	.083
	.000	.000	.000	.333	2.250	.083	.000	.083	.083	.167
	.417	.000	1.917	.000	.000	.000	.167	.167	.167	.667
	.000	.000	.000	.167	.000	.167	.083	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
ROW NR 23	.250	.000	.000	.000	.000	.000	.000	.167	.083	.000
	.000	.000	.000	.167	1.167	.000	.000	.000	.000	.250
	.250	.250	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
ROW NR 24	1.500	.917	.000	.000	.000	.000	.000	.250	.167	1.417
	.250	.233	.167	.417	.083	.333	.333	.250	.000	.333
	.250	.167	.000	.000	.417	1.333	.250	.500	.250	.000
	.167	.167	.167	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.250	.250	.333	.000	.000
ROW NR 25	.000	.000	.000	.000	.000	.000	.000	.167	.000	1.417
	.250	.000	.000	1.167	.000	.833	.000	1.083	.167	.167
	1.750	.167	.000	.167	.000	1.167	.167	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
ROW NR 26	.750	.000	.000	.000	.000	.000	.083	.583	.083	1.000
	.000	.083	.000	.333	2.167	2.167	.333	.083	.000	.083
	.167	.083	.000	1.750	2.083	.000	.250	2.250	1.750	.000
	.000	.000	.000	.333	.083	.667	.167	.000	.000	.000
	.000	.000	.000	.000	.000	.417	.417	.000	.000	.000
ROW NR 27	.167	.000	.000	.000	.000	.000	.000	.333	1.500	1.333
	.000	.000	.000	.167	1.750	1.500	.167	.000	.000	.250
	.167	.000	.000	.000	.083	.667	.000	.083	.000	1.000
	.000	.000	.000	.417	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
ROW NR 28	.000	.000	.000	.000	.000	.000	.000	.833	1.417	.250
	.000	.000	.000	.083	1.167	.417	.083	.083	1.750	.083
	.250	.000	.000	.000	.000	.250	.917	.000	.750	.083
	.000	.000	.000	.083	.000	1.333	.000	.000	.333	.250
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
ROW NR 29	1.667	.000	.000	.000	.000	.250	.000	.167	2.083	.083
	.083	.000	.000	.167	1.500	.167	.250	.167	.000	.583
	.333	.500	.000	.083	.000	.083	.167	2.000	.000	.583
	.000	.000	.000	.167	.000	.083	.167	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
ROW NR 30	.250	.000	.000	.000	.000	.000	.000	.167	.000	.083
	.083	.000	.000	1.833	.167	1.167	.000	.000	.000	.417
	.750	2.250	.083	.000	.000	.083	.333	.083	.083	.000
	.000	.000	.000	.167	1.417	.250	.083	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
ROW NR 31	.000	.000	.000	.417	.000	.083	.000	.000	.000	.083
	.167	1.167	.000	.917	.250	.000	.000	.000	.000	.083
	.417	.000	.000	.000	.000	.000	.250	.250	.083	.000
	.000	.917	1.583	2.500	1.333	.000	.583	.417	.167	.333

	.000	.000	.000	.000	.000	.333	1.083	.000		
R9W NR 32	.167	.000	.000	.000	.083	.083	.000	.000	.000	.083
	.000	.500	.250	2.417	.667	.000	.000	.083	.000	.083
	.333	.000	.000	.000	.000	.000	.000	.000	.083	.000
	1.000	.000	.750	2.333	1.667	.000	.667	.417	.417	.083
	.000	.000	.000	.000	.000	.083	.083	.000	.000	.083
R9W NR 33	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.167	.333	.333	.000	.000	.000	.000	.000
	.250	.000	.000	.000	.000	.000	.000	.000	.083	.000
	1.917	.833	.000	2.167	.750	.000	.500	.250	.000	.000
	.000	.000	.000	.000	.000	1.083	.000	.000	.000	.000
R9W NR 34	.000	.000	.000	.000	.000	.000	.000	.000	.083	.083
	.083	1.417	.250	.917	1.000	1.667	.000	.083	.000	.083
	.167	.250	.000	.000	.000	.333	.583	.417	.250	.000
	.167	.250	.250	.000	.000	.000	.167	.167	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
R9W NR 35	.083	.000	.000	.000	.000	.000	.000	.083	.333	.000
	.250	.000	.000	1.500	.833	.083	.083	.000	.000	.333
	.583	.000	.000	.000	.000	.000	.083	.250	.000	.000
	.250	.250	.250	.167	.000	.000	.083	.083	.000	.000
	.000	.000	.000	.000	.000	.083	.083	.000	.000	.000
R9W NR 36	.000	.000	.000	.000	.000	.000	.000	.167	2.167	.083
	.167	1.000	.417	.083	.750	.833	.167	.083	1.083	.000
	.000	1.417	.000	.000	.000	.167	.250	1.083	1.083	.000
	.000	.000	.000	.333	.083	.000	.667	.167	.083	.083
	.167	.000	.083	.000	.000	1.833	1.250	1.583		
R9W NR 37	.167	.000	.000	.833	.000	.167	.000	.167	.083	.000
	.250	.083	.167	.083	.083	.167	.083	.083	.000	.083
	.167	.000	.000	.000	.000	.083	.000	.250	.333	.000
	.083	.083	.083	.333	.000	2.000	.000	2.500	1.000	.500
	.250	.000	.333	.000	.000	1.500	.917	.250		
R9W NR 38	.250	.417	.250	1.583	.750	.417	.083	.167	.333	.000
	.000	.083	.083	.083	.167	.083	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.167	.500	.000
	.250	.250	.000	.167	.000	.083	1.667	.000	.417	.667
	.500	.333	.167	2.083	.083	.000	.000	.000	.000	.000
R9W NR 39	.167	.667	1.000	.167	.167	.167	.000	.833	.167	.167
	.000	.000	.083	.167	.083	1.167	.000	.000	.000	.000
	.000	.000	.000	.167	.000	.333	.000	.333	.000	.000
	.750	.417	.167	.083	.417	.917	2.000	.417	.000	.500
	.000	.000	.083	.083	.000	.250	.250	.250		
R9W NR 40	.167	.000	.000	.167	.417	.333	.000	.167	.000	.000
	.000	.000	.083	.250	.000	.167	.000	.000	.000	.000
	.167	.000	.000	.000	.000	.000	.250	.167	.000	.000
	1.667	2.333	.250	.417	1.083	.167	1.500	1.917	.417	.000
	.083	.000	.000	.000	.000	.000	.000	.000		
R9W NR 41	.167	.000	.000	.000	.000	.000	.000	.083	.333	.000
	.000	.000	.000	.500	1.167	.000	.167	.000	.000	.083
	.000	.000	.000	.000	.000	.000	.250	.250	1.083	.000
	.000	.000	.000	.083	.000	1.333	1.667	.000	.000	.000
	.000	3.000	1.417	.000	.417	.000	.000	.167		

RBW NR 42	.667 .000 .000 .000 1.917	.750 .000 .000 .000 .000	.000 .000 .000 .000 1.333	.000 .250 .000 .000 .167	.000 .583 .000 .000 .167	.167 .000 .000 .667 .000	.000 .000 .000 .250 .000	.083 .000 .500 .000 .167	.083 .000 .000 .000 .000	.000 .000 .000 .000 .000
RBW NR 43	.083 .083 .000 .000 .750	.167 .083 .250 .000 .000	.000 .167 .000 .167 .000	.000 .000 .000 .083 .000	.167 .250 .000 .000 .000	.167 .250 .083 2.500 1.583	.167 .000 .000 .167 .833	.167 .000 .500 .000 1.500	.333 .000 .000 .000 .000	.000 .083 .000 .000 .000
RBW NR 44	.167 .250 .000 .000 1.083	.000 .000 .000 .000 .000	.000 .333 .000 .000 .667	.000 .000 .000 .000 .000	.333 .000 .000 .000 .000	.250 .000 .000 2.333 .250	.083 .000 .000 .000 .083	.167 .000 .250 .167 .000	3.000 .000 1.583 .000 .000	.000 .000 .000 .000 .000
RBW NR 45	.167 .000 .000 .000 .000	.667 .000 .000 .000 .167	.000 .000 .000 .000 .083	.000 .000 .000 .000 .333	.000 .000 .000 .000 .000	.000 .000 .000 .000 .167	.083 .000 .000 .000 .667 .000	.000 .000 .000 .000 .000 .000	.000 .000 .000 .000 .000 .000	.000 .000 .000 .000 .000 .000
RBW NR 46	.167 .000 .500 .000 .000	.000 .000 .667 .000 .000	.000 .000 .000 .000 .000	.000 .000 .000 .167 .000	.500 .583 .000 .250 .000	.000 .750 .000 .333 .000	.000 .000 .000 .083 2.750	.083 .000 .000 .000 .000	.333 .000 2.083 .000 .000	1.583 .083 .333 .000 .000
RBW NR 47	.167 .250 .167 .417 .000	.000 .000 .083 .250 .000	.000 .000 .000 .000 .000	.000 .000 .000 .333 .000	.000 .917 .000 .500 .000	.000 .917 .000 .250 .667	.000 .000 .250 .083 .000	.167 .000 .417 .000 .000	.333 .000 1.750 .000 .000	.750 .083 .000 .250 .000
RBW NR 48	.000 .000 .167 .417 .000	.000 .167 .750 .000 .000	.000 .167 .000 .000 .000	.000 .000 .000 .250 .000	.000 .000 .000 .000 .000	.000 .250 .000 .250 .417	.000 .167 .000 .000 1.917	.083 .000 .333 .000 .000	.000 .000 2.167 .000 .000	.000 .000 .000 .000 .000

List of 48 selected problemsTen major
problems

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- A OBSTACLES TO WORLD ORGANISATION
- 1 Inadequacy of the institutional organization of international society
 2 The difficulty experienced by major powers in defining their interests and responsibilities
 3 The arms race
 4 Inadequate regulation of use of the sea
- B INFRINGEMENT OF THE RIGHTS OF NATIONS
- 5 Interference by foreign powers
 6 Interference by multinational companies
 7 Non-completion of decolonization
- C INEFFECTIVENESS OF INSTITUTIONS
- 8 Inability of institutions to adapt to external change
 9 Political instability, particularly in the less-developed countries
 10 Insufficient personal involvement in political and economic life
- D DIFFICULTIES IN IMPROVING THE STANDARD OF LIVING OF RAPIDLY GROWING POPULATIONS
- 11 Disproportion between the active and inactive population
 12 Maladaptation of urban concentrations to individual and collective needs
 13 Poor use of available land
- E THE CRISIS OF ADVANCED INDUSTRIAL SOCIETIES
- 14 Physical and mental illnesses characteristic of advanced industrial civilisation
 15 Loss of the sense of personal security
 16 Obstacles to fulfilment of non-material aspirations
- F SOCIAL DISCRIMINATION
- 17 Racial discrimination
 18 Recurring threats to the existence of minorities
 19 Social discrimination based on sex
- G THE USE OF VIOLENCE
- 20 Physical violence in political and social conflict .
 21 Infringements of fundamental personal freedoms
 22 Increase in criminality and delinquency
 23 Hijacking and sabotage of aircraft
- H SHORTCOMINGS IN EDUCATION AND COMMUNICATION
- 24 Communication difficulties due to complexity and multiplicity of jargon and languages
 25 Intensification of political, economic and cultural propaganda in association with the development of mass media
 26 Insufficient education of children and adults for an active life
- I THE WEAKENING OF HUMAN MOTIVATIONS
- 27 Weakening of collective convictions (social, religious, etc.)
 28 Difficulties of social advancement
 29 Acute disparities between living conditions and aspirations
 30 Production, traffic and use of drugs
- J DEGRADATION AND DISFIGUREMENT OF THE ENVIRONMENT
- 31 Lasting damage to vital properties of water
 32 Damage (including noise) to the properties of the atmosphere
 33 Damage to vital properties of the soil
 34 Disfigurement of the environment : destruction of cultural monuments, natural beauties, etc.
 35 Attacks on man's genetic heritage
- K SHORTCOMINGS IN PRODUCTION AND TECHNOLOGY
- 36 Wastage and underemployment of human resources
 37 Fundamental waste of material and financial resources
 38 Exhaustion of non-renewable mineral and energy reserves
 39 Inadequate control of technological development
 40 Insufficient efforts to anticipate the exhaustion of energy reserves and to produce less pollutant energy
- L MONETARY INSTABILITY
- 41 Difficulty in checking inflation
 42 Crises in the international monetary system
- M OBSTACLES TO INTERNATIONAL ECONOMIC RELATIONS
- 43 Lack of capital for aid to the less-developed countries
 44 Low and fluctuating prices of exports from less-developed countries
 45 Changes in the flow of international trade due to the establishment of preferential areas
- N FAILURE TO SATISFY THE BASIC NEEDS OF THE LESS-DEVELOPED COUNTRIES
- 46 Undernutrition and malnutrition in the less-developed countries
 47 Endemic and epidemic disease in the less-developed countries
 48 Housing shortages and deficiencies in less-developed countries