

INTERDISCIPLINARY DISASTER RESEARCH: MEXICAN EXPERIENCE

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ABSTRACT

The paper exposes a brief history and some results of the Interdisciplinary Disaster Research (IDR), the field that has been developed since 1976 in the Engineering Institute of the Mexican National Autonomous University as a response to the alarming tendency of the increase of disasters and to the necessity that surged to understand this phenomenon as well as to find the means for its control in order to alleviate the national problems in this matter.

To develop the new field, an ambitious program has been realized based on the Systems Approach, that contemplated, on one hand, the priority to elaborate the conceptual framework in order to form a cognitive and methodological bases necessary to identify the problems and to develop the methods for their solution. On the other hand, it considered the urgency to prepare and to integrate the personnel, in order to assure certain critical mass indispensable to carry out the studies, as well as to implement and diffuse their results. The realization of about 30 projects dedicated to improve the safety and safeguard of a vast range of systems such as the human settlements, productive areas, strategic services, environment and civil works has contributed to the IDR maturation.

Among the main results the design of the Protection and Re-establishment System for Mexico-City in the face of disasters as well as the University Security and Safeguard System could be distinguished by their importance in so far as they have resulted crucial for the establishment and operation of the National Civil Protection System and the development of the organizational structure of the Mexican - Japanese Center for Seismic Disasters Prevention, actually National Center of Disasters Prevention.

1. INTRODUCTION

Due to the complexity of disasters, the need of their study and, moreover, of their control in order to prevent and attend the consequent emergency situations are demanding a close collaboration between the specialists from distinct fields of knowledge and human practice such as scientists, engineers, managers, lawyers, economists and sociologists, just to mention some of them.

However, the solution of disaster problems is frequently impeded by a generalized lack of communication and, therefore, of understanding between the different actors whose efforts are isolated due to their distinct backgrounds and to the diversity of the used terminology.

In order to permit the information exchange between them as well as to guide the relevant studies and to assure the compatibility of the obtained results, it became imperative to have a general conceptual framework and an appropriate methodological basis.

Moreover, in spite of the important achievements obtained by the diverse scientific areas and engineering branches, there have been revealed, in the course of the last decades, certain restrictions of the traditional disciplines inasmuch as they are not appropriate for the consideration of the interrelations between destructive phenomena that frequently are studied by distinct fields. In consequence, as it happened in Jamaica, the hurricane flew off the buildings light roofs that were designed perfectly but according to the seismic engineering code requirements. Likewise, in general the monodisciplinary approach does not contemplate the complex interrelations between the components of the exposed system where disaster is materialized and where the failure of one of them produces a failure of another one, complicating consequently the risk reduction of the whole system. Furthermore, the monodisciplinary approach is missing to take into account the interrelations between the adverse consequences when they are studied by distinct fields of knowledge.

On the other hand, the strategy of a profound specialization of the monodisciplinary approach, that constitutes the basis of its power and has assured its achievements, is often focused on the technical problems so far as they could be resolved by available methods. However, this preference had its cost insofar as it leads to the omission of socioeconomic and political aspects that are decisive for the definition of disaster concepts as well as for the elaboration of a rational basis to coordinate and integrate the efforts of the diverse scientific and engineering fields, prejudicing the society's ability to withstand and combat the disasters.

Thus the use of a monodisciplinary approach has had certain repercussions such as getting partial results and overshadowing the necessity of looking for complete solutions.

In turn, the appearance and development of some new fields such as Operations Research, Management Science and Systems Engineering have shown the fertility of the new substantially interdisciplinary approaches that are establishing their own object of studies and are developing their specific research means in order to analyze the structure and behavior of complex objects and phenomena, and to explain and predict their functioning as well as to control them [1].

This concern to face up disasters problems, in the complete and interdisciplinary form, was obtaining a widening recognition of the academic community and had succeeded to constitute one of the main goals of the International Decade of Natural Disasters Reduction established by the UN on the eve of nineties due to the need to assure the society safety and safeguard. This attitude produced a new field of studies, denominated Interdisciplinary Disasters Research (IDR), dedicated to identify and solve the related problems through the elaboration of its own conceptual framework and methodological basis. Its development and maturation have being reached by the realization of diverse research projects during the last 20 years and constituted a very own effort of the Mexican academic community. That is why it has been considered interesting to present a brief description of the IDR history and its main results.

2. THE INTERDISCIPLINARY DISASTERS RESEARCH DEVELOPMENT

In order to improve the capacity for obtaining the integral answer to the problems that had been surging due to the tendency of disasters growth in their frequency, extension and severity, a general program had been conceived at the end of the seventies, in the Engineering Institute of the Mexican National Autonomous University. It explicitly contemplated as a priority the task of the development of a new interdisciplinary field through the definition, organization, realization and coordination of the necessary activities by providing the strategies, policies and action alternatives in order to identify and resolve the urgent problems of safety and safeguard in face of disasters. Among its policies there were standing out such as:

- Realization of the studies according their priority defined by the importance and urgency to face the corresponding problem.

- Diversification of the types of problems to resolve by research projects in order to obtain a better understanding of the disaster phenomenon as well as its control.

- Preference for the sponsored projects to assure the availability of resources as well as the feasibility of the information gathering and the consequent implementation of obtained results.

- Development of the methodological and basic studies as an requirement for finding the efficient applied solutions.

-Equilibrium of the growth of the IDR diverse areas and specially the Disasters Engineering and Management considering the insufficiency of the isolated technical solutions that do not contemplate the relevant aspects of organization and planning.

-Employment of computing and information sciences as the most appropriate supporting means for the prevention and attention of emergency situations.

- Encouragement of the human resources formation as well as of the academic community and the society participation in the IDR development and specially in the use of its results.

Likewise, the following strategies were determined:

-To identify the related problems and urgent necessities of the diverse sectors and strata of the Mexican society as well as to carry out the research to obtain their complete solutions.

-To provide the necessary advising support for disaster management.

-To prepare the qualified specialists in order to extend and deepen the studies as well as to implement their results.

-To gather the corresponding bibliography as well as to disseminate and diffuse the information and results of studies.

-To promote the exchange and collaboration with other institutions and centers of disasters studies in Mexico and abroad.

These policies and strategies have permitted to define and organize, as time went, some areas of studies as well as to orient and realize a multitude of research projects, whose descriptions and results are presented in the following sections.

3. AREAS OF STUDIES

The magnitude and complexity of the disaster problems related with the different political-administrative levels (municipal, state and federal) as well as with the public, private and social sectors of Mexico constituted an great challenge for the IDR. To get a clear idea about the extent and specificity of these problems, it has been chosen, according the mentioned

above policy of diversification of the objects of study, to select different real systems as a focal object such as a city, a thermoelectric generation plant, a campus, an aqueduct, a dam. This as well as the sponsorship obtained from the Federal District Government (1980-1982) and the Federal Electricity Commission (1983-1984) were crucial as the obtained results permitted to get the recognition of the IDR as a field of cognitive activity that studies, in an interdisciplinary form under the Systems Approach, the disaster phenomenon in order to describe, understand, forecast and control it. Its main objective consists in identifying and solving the safety and safeguard problems of the population, human settlements, strategic services, productive areas, environment and civil works exposed to the natural and men-made hazards, through the elaboration of methodologies of risk estimation and reduction as well as by the design of the Disasters Control Systems supported by the plans and programs of action and by the necessary technology. Its development and maturation have been obtained by the following studies:

-Methodological studies that are looking for the conceptual framework to form a general basis in order to carry out the interdisciplinary research as well as to coordinate and integrate the efforts of diverse discipline through the creation and use of the universal concepts and terms as well as of the compatible methods and techniques.

-Fundamental studies, empirical and theoretical, aimed to investigate the disasters phenomenology and the mechanisms of their production as well as the laws and regularities that govern their diverse aspects.

-Applied studies, that are oriented to identify and solve the concrete problems suffered by the society and particularly by its diverse subsistence systems -considering the environment as a one of them-, due to their vulnerability and to their exposition to destructive phenomena.

-Disasters Theory that integrates the results of the methodological and fundamental studies in order to support the applied ones being based on the research of the scientific theories structure and on the Systems Approach.

-Disaster Engineering that constitutes a basis for research, design, construction, maintenance and operation of reliable technical processes and civil works facing destructive phenomena as well as for facilitating the disasters studies and control.

-Disaster Management that forms a foundation to assure the analysis and design of the organizations as well as their management processes in order to study and control disasters.

The specific research lines have been dedicated to:

- Elaborate the risk estimation and reduction procedures and techniques as well as methods to determine the emergency attention means and activities including the posterior recovery.

- Estimate the latent risks of exposed systems as well as to determine the measures of hazards prevention and mitigation of the destructive phenomena impacts according to the cost/benefit analysis for concrete systems.

- Design the organizational structures and to elaborate plans for their operation as well as to establish the necessary procedures to support management.

- Study the use of expert systems and other computational means in order to assure the analysis of the spatial location of risks and the optimization of the resources employment.

- Elaborate different assisting means such as a Decision Making Support System, a Glossary of IDR Terms and bibliographical summaries.

4. MAIN RESULTS

Certain achievements have been obtained through the realization of a multitude of projects, among which there are standing out the following results:

- The formation and consolidation of the research field with its own conceptual framework and methodological basis that permits to study the disaster phenomenon and look for the solution of the safety and safeguard problems [2].

- The development of the Protection and Re-establishment System for Mexico City in front of disasters that contemplated the design of its organizational structure as well as the elaboration of the plans and procedures of its establishment and operation [3].

- The determination of the prevention and rescue measures in case of the fault of the cooling pool dike at the thermoelectric plant Rio Escondido, State of Coahuila, and their integration in action programs as well as the design of the organization necessary for their execution [4].

-The planning of the disasters prevention, mitigation and attention projects in case of earthquakes in the area of Mexicali - San Diego, and in case of hurricanes in the area of Matamoros - Brownsville, in the framework of the Bilateral Agreement between Mexico and USA on Cooperation in Cases of Disasters [5].

-The determination of the safety and safeguard organization and planning for the South-East System of Aqueducts in Mexico City [6].

-The definition of the optimal velocity for the dams closing under the flood risk [7].

-The study of the response to the Volcano Chichonal eruption and its consequences [8].

-The study of the damage estimations in case of the 1985 earthquakes in Mexico City [9].

-The development of the Security and Safeguard System for the University City in order to solve the problems related with criminal acts, lacking surveillance, handling of dangerous substances, destructive phenomena, etc. [10].

-The collaboration in the design, establishment and operation of the National Civil Protection System [11].

-The design of the University Program of Disasters Studies in order to coordinate the university activities of research, teaching and popularization activities related with the civil protection (actually the Risk Prevention and Industrial Monitoring [12]) as well as the elaboration of the organizational structure of the Mexican - Japanese Center of Seismic Disasters Prevention (actually the National Disaster Prevention Center) with its research, training and popularization programs [13].

-The development of the General Risks Reduction and Rehabilitation Program and design of the Safety and Safeguard Organization as well as the elaboration of the Information Support System to improve the functional reliability of the Cutzamala Water Supply System [14].

It is important to mention that the personnel that collaborated directly in the area of IDR or indirectly through the development of related topics has carried out 4 bachelor's thesis, 7 of master's degree and 1 doctoral one (at the moment, they are developing 6 bachelor's thesis, 1

master's and 2 doctorate's); at the same time there have been elaborated around 175 documents and internal reports, besides 110 publications and 12 thesis.

Naturally due to the general approach the products obtained during the IDR development have been applied, also, to other fields such as transportation, organizations and management to mention some of them. In turn, with due interpretation, the results in these fields have contributed to the solution of some of the IDR specific problems.

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