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ЭКОНОМИЧЕСКАЯ КОМИССИЯ
ДЛЯ ЕВРОПЫ

UNITED NATIONS

ECONOMIC COMMISSION
FOR EUROPE

Mrs. Shoukletovich

Training and Fellowship Programme Section,
Office of Technical Co-operation, New York



TE 323/1 POLA
17 December 1973

M/R

*With the compliments
of the Technical Assistance Office
of the Economic Commission for Europe*

PERSONNEL RECORDS UNIT
ACTION
FELLOWSHIP SUB-UNIT
ROOM CH-2300 EXT. 3218
TO: *Shoukletovich*
JAN 14 1974
☐ ACTION REQUIRED
☐ ACKNOWLEDGED
☐ NO ACTION REQUIRED
INITIALS.....

TECHNICAL ASSISTANCE OFFICE
Economic Commission for Europe
UNITED NATIONS

Date of award:

20.9.73 - 12.12.73

Name and home country:

Mr. J. SOKOLOWSKI, Poland

Field of study:

Organization and operating methods of statistical
data banks and population.

Country (ies) of study:

Sweden Norway Denmark

Jan Sokolowski
EDP Centre of General Statistic
Office in Warsaw

FINAL REPORT

(from studies in Sweden, Denmark and Norway between the 20th of October and the 12th of December 1973 whilst holder of UN fellowship award)

I have studied mathematics at University of Warsaw. During this period I was mainly interested in mathematical linguistics and numerical methods. Since 1970 I have been working in the Electronic Data Processing Centre at General Statistic Office in Warsaw. At the beginning I was a programmer and I was writing programs for some EDP systems, such as foreign trade system, census 1970 etc. Later on I became interested in operating systems specially for ICL computers. At present I am responsible for implementing operating system GEORGE 3 in our centre. I have been interested also in systems designing (specially data base management systems) and file organization problems.

There are similar problems in all statistical centres. Amongst other problems are register systems such as: personal register, register of enterprises, register of buildings, register of cars etc.

At present these systems are not flexible enough. They consist of big data files stored on magnetic tapes and programs which use these files. The problem to solve is that when we want to change the structure of a file we have also to change the programs.

Another problem is to enable people who are not data processing professionals to co-operate in system design projects and enable data processing specialists to analyze the computer-oriented systems with sufficient precision.

Data base management systems are the solution of these problems.

The study in Scandinavian countries has helped me to develop my knowledge about some parts of computer science. I hope I will be able to implement this knowledge in my future work. I am going to take part in developing solutions to data base problems in Poland and perhaps in building an experimental data base upon ideas I have learned here.

The problems I was mainly interested in during my study here were theoretical approaches to Data Bases. I studied some treatments of these problems. These are:

- B. Langefors: "Theoretical Analysis of Information Systems", Lund 1970
- B. Sundgren: "An Infological Approach to Data Bases", National Central Bureau of Statistics, Sweden, 1973
- Ch. Arvas: "Data Structures: Management and Storage", National Central Bureau of Statistics, Sweden 1973
- J. Firth: "The Idea of a Data Base", National Central Bureau of Statistics, Sweden 1973
- L. Olsson: "Measures to protect privacy in statistical Database", CBS, Sweden 1973
- B. Langefors: "Concepts, Elementary Files, Data Terms", Systemering 70, Lund

During my study in SCB in Sweden I spoke to:

- Mr. Bo Sundgren about his theoretical (infological) approach to data bases
- Mr. Björn Nilsson about the ARKDABA data base
- Mr. Arno Silberman about organization of Data Base Centre in SCB in Sweden
- Mr. Harald Thorburn about the system TAB68.
- Mr. Aleksander Fisz about using data bases for statistical purposes
- Mr. Dag Bråmer and Mr. Jerk Strandberg about organization of Programming Centre of SCB in Sweden

During my study in Denmark I spoke to:

- Mr. Hugh Tucker (University of Copenhagen) about some aspects connected to data base problems
- Mr. Preben Ebsen Nørgaard (Datacentralen) about implementing IMS system to the personal register problem
- Mr. R. Stone (SCB - Copenhagen) about Minipopulation Register System

- Mr. Finn Spicker and Mrs. Herete Borehorst (Personal Register Centre) about the Central Population Register in Denmark
- Mr. Buckenburg (SCB - Copenhagen) about organisation of SCB in Copenhagen
- Mr. Jørgen Lundgård (SCB - Copenhagen) about data bases problems.

During my study in Norway I spoke to:

- Mr. Egil Habberstad (SCB - Oslo) about The Central Population Register in Norway
- Mr. Knut Eriksen (SCB - Oslo) about Registers Systems in Norway
- Mr. B.H. Lund (SCB - Oslo) about organisation of work in Operating System's Division
- Mr. Ole Førrisdahl (SCB - Oslo) about organisation of work in SCB in Oslo
- Mr. Frank Siljan (SCB - Oslo) about theoretical approaches to data base problems
- Mr. Tere Finstad (SCB - Oslo) about system's designing
- Mr. Håkon Berby (SCB - Oslo) about table generator system.

The brief descriptions of some main important problems are given below.

An Infological Approach to Data Bases (Bo Sundgren - SCB Sweden)

This theory is based upon four concepts. These are:

- objects
- properties
- object relations
- time

Examples of objects in statistical information systems are:
Persons, families, enterprises, establishments etc.

In unprecise way it can be said that property is a characteristic associated with an object

Object relation is a kind of connection between some objects.
Examples are "brother of", "owner of" etc.

Time concept is used to describe the status of a system at a particular point in time or to indicate the change of the system over time.

Properties can be split into classes. Example of property class is: marital status. Such a class is called variable. The values of this variable are married, non married etc.

Information about the state of the system is generally called a message. For example "Mr. Smith lives in Warsaw". Definition:

"Elementary message" or e-message is a tuple (O, P, t) or $((O_1, O_2, \dots, O_n), R, t)$ where O, O_1, \dots, O_n are the names of objects, P is the name of property, R is the name of relation, t the point in time.

It is intuitively believed that an arbitrary message can be constructed from e-messages. Later on we can consider data bases as a set of e-messages.

The ARKDABA data base (Björn Nilsson - SCB Sweden)

The System will provide social and demographic data about a random sample of 1/30th of the Swedish population. The objects will be the persons in the sample and their families/households.

The ARKDABA data base is built upon two general ideas. One is to provide an experimental base for future development and testing of data base oriented data processing methods. The other is to provide a system for more exhaustive use of data collected at the Statistical Central Bureau (SCB) in Sweden.

There are some basic objectives which were stated in the beginning of the project:

- flexibility
- data independence
- data protection
- man-machine communication
- real time orientation
- data structures and storage schemes.

The system consists of:

1. The Data Base Manager (DBM) which consists of subsystems:
 - a) Monitoring System which controls and aids the processing by means of the functions
 - ARKDABA Monitor
 - Information Protection
 - Communication Interface
 - Batch Specifications

- b) Support System which help users by
 - Users Guide
 - Information Catalogue
 - Documentation System
 - c) Production System which consists of
 - Optimization of Retrieval
 - Access Control and Materialization
 - Statistical Processing
2. The Data Base (DB), the DEM operates on. The DB is partitioned into:
 - a) Data Base Proper (the "real" data)
 - b) Data Base Support (workfiles, textfiles etc.)
 - c) Data Base Directory which contains all information pertaining the accessibility of data; that is name of variables in data base, user descriptions, definition of variables and relations between them, data base description (physical), catalogue of files etc.
 3. The Data Base Administrator which is responsible for the contents, definition, organization, efficiency and protection of data base.
 4. The Data Base Descriptive Language (DBDL) which is used to define the DB.
 5. The Data Base Command Language (DBCL) allows the user to make requests within the framework of the ARKDABA system.

The physical environment for the system is an IBM 360/50 OS-MVT with a large number of disc drives. The communication with the System takes place by regular telephone-lines over a distance of 200 km. One of the main objectives of the System is to provide statistical tabulations. For this purpose the table compiler TAB68 which already has been developed as a stand alone system, will be incorporated in the System.

The Central Population Register (CPR) in Denmark

Denmark has a population of approximately 5 mln. people who live in 277 municipalities. Each municipality has local self-government and one of the municipal functions is the administration of the person-registers. In this way there is today a person-register in each municipality. The person-registers' data-content consists of information about name, address, marital status, place of birth, right of citizenship and similar general person-information.

There are 6 punched-card centrals established in support of the municipal administration.

In 1968 the existing punch-cards were copied to magnetic tapes and CPR were established. CPR includes all persons who lived in Denmark since 1968. Every person is given person-number, which consists of 10 digits including birthday (the first 6 digits) and succeeding serial number. The last one is the check-digit. The person-number is assigned centrally at a new-born child's inclusion in CPR and the number remains unchanged until the death of the person.

The data-content for every single person includes general person-information needed in most public administration, and relations between members of a family. CPR is kept on 31 magnetic tapes in person-numerical order. At present it is updated once a week with approximately 50 000 alterations a week. CPR is informed of the alterations by the municipal registers.

The CPR is used by the public sector especially it passes current information of altered data to the centralized tax system, the additional pension of the labour market, the conscription authorities, the state department of statistics, the Police etc. Besides it, extracts of information are made for the solution of many concrete tasks. Such extracts are made by means of a special extract-system, which allows to limit the extract by arbitrary criteria (personal qualities, geographical criteria etc.)

Finally there is access for all public authorities to make a search in CPR for individual persons.

All administrations receivers supplies of data from CPR use the person-number as identification.

The problems that occurred in connection with the start:

- Errors in the data material that entered CPR when the register was established (one person with two person-numbers),
- mistakes in birthday (about 60 000 mistakes).

It is expected to use direct access devices and data transmission devices in the problem.

Register System at the Central Bureau of Statistics in Norway

The three basic registers in the Central Bureau of Statistics are:

- the central population register
- the central register of establishments and enterprises
- central register of buildings (planned)

All units in these registers are identified by name, address and by a permanent identification number. The registers comprise also other characteristics than identifiers.

The registers are integrated. The population register includes the identification numbers of buildings and establishments as characteristics. The register of establishments includes the identification number of a building as a characteristic.

The data in the registers is at present stored on magnetic tape.

The Central Population Register (Egil Habberstad - SCB Oslo)

The units in the population register are persons resident in Norway. All information collected about the individuals are organized in three files, kept on magnetic tapes:

- the situation file
- the new change file
- the old change file

The situation file refers to a given date and has one logical record for each person showing the most up to date information about all individuals at that given date. All changes dated later than the date of the situation file are kept in the new change file and changes dated earlier are kept in the old change file. The new change file is used

together with the situation file to produce another situation file referring to a later date. The following characteristics concerning each individual are at present available from the CPR:

- identification number
- name
- address
- postal district (code)
- municipality (code)
- type of registration (resident, deceased, emigrated, missing)
- marital status
- place of birth
- date of birth
- identification number of mother
- identification number of father
- identification number of spouse

Characteristics planned to be available in the register:

- identification number of family (family nucleus) (1973)
- identification number of building (1974)
- identification number of flat (1980)
- identification number of establishment (1975-1980) (the establishment at which a person is employed)
- occupational activity (1975-1980)
- education attainment (1975-1980)

The identification number is a number of 11 digits. The first 6 digits represent the date of birth. The next 3 digits are used to distinguish between persons with the same date of birth, between men and women and between persons born on the same date in different centuries. The last 2 digits are check-digits. The CPR is used for administrative and statistical purposes, for example:

- insurance funds
- health authorities
- police service
- military service
- taxes
- population statistics
- migration statistics

The Central Register of Enterprises and Establishments
(Knut Eriksen - SCB Oslo)

The central register of establishments and enterprises includes most industries except agriculture, forestry and fishery. Each establishment or enterprise is identified by its identification number or by name and address. The identification numbers are assigned continuously and have no built-in information. Each number consists of 6 digits plus 1 check-digit. The register of establishments includes the enterprise identification number as a link characteristic for each establishment.

The register contains about 160 000 units (that is establishments and enterprises) and is updated 2 or 3 times a year.

One record consists of 132 characters.

The register is used only for statistical reasons.

Information included in the register:

- identity number
- name/characteristic
- street address
- post office
- type of unit (enterprise, establishment etc.)
- condition (establishment with normal activity, without activity, not existing any longer)
- enterprise number (the same for all establishments within the same enterprise)
- municipality (location of establishment)
- industry (according to the Norwegian Standard Industrial classification)
- employment
- amount of sales or production
- ownership

The central register of buildings in Norway

A central register of buildings was planned to be established in connection with the 1970 census of population and housing but it is not finished yet.

Organisation of EDP work in Central Bureau of Statistics in Norway

All the EDP work in CBS in Norway is performed in the two divisions Division for system development and programming and Division for machine operations. Both divisions are placed in the Production Department.

There is no distinction in the Division for system development and programming between system work and programming work. Most of the work in the division is done in small project groups formed to do special jobs. When the job is finished, new groups are formed. More regular groups are the groups for registers and census of population. In each group they do both the system work and the programming work.

In the Division for machine operations the two groups for planning and control and for operation run the computer. The group for planning and control has the contact with the subject-matter division. This group is divided into small groups, one for each subject-matter division, which deliver their requests for system and programming work to the Division for system development and programming.

Errors in the original data are presented to the subject-matter people who correct these errors (these are errors which need reference to the questionnaires before correction). Errors which can be corrected without reference to the questionnaires are corrected by the Division for machine operations.

The job control man in the group for planning and control of computer operations checks the output according to the documentation of the program.

Operators are sent to courses given by the computer manufacturer. Job control people are recruited from the operators and given sufficient on the job training.

Programmers are sent to courses given by the governmental agency. These courses consist of 5 months theoretical education divided in 4 separate courses over a period of 2 years, but only few programmers have high (for example university) education.

Systems analysts are mainly recruited from the programmers. They are given on the job training and are sent to special courses outside the CBS.

CBS in Norway has been using computer IBM 360/40 since 1966 year.

Configuration of IBM machine:

- 128 K bytes of core store
- 6 magnetic tape decks
- 3 EDS transports, 29 mln. charact. each
- 1 card reader
- 1 line printer

The configuration is changing now to: Honeywell Bull 6060

- 192 K words (36 bits each) plus 64 K the next year
- 6 MT (266 000 charact./sek)
- 1 LP
- 1 CR
- 10 EDS transports, 100 mln. characters each

The CBS will be one of the users of this computer and will possess its own equipment connected to it (card readers, line printers, magnetic tapes).

11.12.1973

Jon Solvet Olsen

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ECONOMIC COMMISSION
FOR EUROPE

Mrs. Shoukletovich
Training and Fellowship Programme Section,
Office of Technical Co-operation, New York



RECORDS CONTROL

12 November 1973

DEC 11 1973

TE 323/1 POLA

*With the compliments
of the Technical Assistance Office
of the Economic Commission for Europe*

For your information.

PERSONNEL RECORDS UNIT
ACTION
FELLOWSHIP SUB-UNIT
ROOM CH-2300 - EXT. 3218
TO: *Shoukletovich*
DEC 10 1973
☐ ACTION COMPLETED
☐ ACKNOWLEDGED
☒ NO ACTION REQUIRED
INITIALS.....

TECHNICAL ASSISTANCE OFFICE
Economic Commission for Europe
UNITED NATIONS

Name and home country:

Mr. M.R. ZDANKIEWICZ, Poland

Field of study: Requirements referring to
production and testing materials for power
engineering.

Date of award:

2 October - 16 November 1973

Country (ies) of study:

Italy

Marek ZDANKIEWICZ, M. Sc., Eng.

Okręgowy Dozór Techniczny

K A T O W I C E

ul. Liebknechta 11

P O L A N D

FINAL REPORT

on the professional training performed in Italy in the frames of the United Nations fellowship (2 Oct. 1973 - 2 Nov. 1973.)

General subject of the training: Requirements concerning production and testing of materials used in conventional and nuclear power engineering as well as in the chemical industry.

(This report has been worked out following the instruction for TAO Fellows studying in Europe)

1. I was graduated from the Polytechnic College in Gliwice (Poland) in 1961, as engineer in mechanics with the specialisation in welding technology.

During two years after graduation I was working in the establishment dealing with repairs of power installations. In 1963 I started working in the District of the Technical Supervision in Katowice. This is the state institution dealing with problems of safe and reliable construction and operation of pressurized installations (steam and hot water boilers, unfired pressure vessels, acetylene generators, gas cylinders) and of load handling installations (cranes, lifts, gantries etc);

During my work in this office I worked first in the pressure vessel section I was employed in the section for technical acceptance and export services where I have been working till now as expert engineer.

The main activities I am engaged in on my present working post are the following:

- 1.1. Studies on materials intended for construction of the pressurized installations of different types.
- 1.2. Establishing the rules and requirements for inspection and testing of these materials.
- 1.3. Technical acceptance of such materials in the manufacturing plants.

- 1.4. Studies on the foreign codes and regulations concerning the pressurized installations, verification of design and technical acceptance of the installations that are ordered in our plants by foreign customers according to the foreign codes and regulations.
- 1.5. Cooperation with the industry in the field of qualification of newly developed materials for the use in construction of pressurized installations.

2. For the major part the high-duty boilers and unfired pressure vessels we are dealing with are operated in the plants of power and chemical industry. These two industries are being developed at a considerably high rate in Poland. Every year a lot of new installations (both of home and foreign origin) are being put into service and our organization has to meet new problems connected with the safe and reliable operation thereof.

High duty service conditions of the above installations require the right choice of materials used for their fabrication and technically justified program of material testing must be established, so as to ensure that the given installation will meet all the requirements of service conditions.

Therefore our organization should be acquainted up to date with what is being done in Poland and abroad in the field of pressure vessel materials. This permits for comparison of the relevant requirements so as to be able to decide whether our hitherto existing specifications may be kept, extended or whether our testing programs may be reduced without lowering the material quality.

Special problems are connected with production and testing of materials for construction of the nuclear pressurized installations, this being due to the specific service conditions of these latter as well as to the consequences following any possible failure of such an installation.

Nuclear pressurized installations will be under supervision of our organization in the nearest future therefore we have to be prepared to meet these problems.

Finally, export and import services as dealt with by our organization require that we should be well acquainted

with production and testing methods applied abroad for the pressure vessels. Such a knowledge is necessary in order to confront the requirements of the both contracting

parties so as to establish the optimal contract specifications.

Since all the above mentioned problems are or will be dealt with by the section I am working in I have been nominated for the United Nations fellowship so that I may study how such problems are being solved abroad.

It is expected that the information and experience gained by me abroad will help in some way in dealing with some problems that we meet in our work.

3. The duration of my scholarship was scheduled for 6 weeks. Unfortunately, because of some unexpected health troubles I was obliged to leave for Poland two weeks ahead of the previously anticipated departure date. However, my training in Italy permitted me to acquire a great deal of information on the problems I was interested in. The following are institutions I have contacted during my stay in Italy:

- 3.1. Polytechnical College in Torino.
- 3.2. Comitato Nazionale Energia Nucleare in Rome.
- 3.3. Centro Studi Nucleari at Casaccia.
- 3.4. Ente Nazionale per l'Energia Elettrica in Rome.
- 3.5. Associazione Nazionale per il Controllo della Combustione in Rome.

I have concentrated myself mainly on the problems connected with the nuclear pressure vessels. There are three nuclear power plants now under operation in Italy whereas the fourth and hitherto the greatest one is being erected. All these stations are constructed according to the foreign specifications and the major part of materials used for construction of the most responsible installations are of foreign origin.

The most interesting problems I have studied are the following:

- a) General rules for selection of materials destined for pressurized installations in nuclear power plants.
- b) Classification of the installations in the nuclear power plant loops from the standpoint of security and service parameters.
- c) Detailed technical specifications to which materials for nuclear pressure installations are made and the supplementary requirements imposed thereto by the designer and supervisory authorities.

- d) Inservice control program of the nuclear pressurized installations, methods of testing and acceptance criteria thereof.
- e) Periodical destructive testing of the irradiated specimens from the pressure vessels operating in the nuclear power plants.
- f) Role and scope of activities of the Italian Government Inspecting Authority in the field of material testing and pressure vessel fabrication and supervision.

In connection of all the above problems I have collected a considerable amount of the relevant codes, specifications, testing programs, papers etc. All these materials will be thoroughly studied on my return to Poland.

Referring to the scheduled program of my stay in Italy there are some comments I would like to make:

- (i) Since the majority of materials used in construction of the nuclear pressure vessels are not produced in Italy it was impossible to provide for a direct visit to the manufacturer of such materials. I have asked my supervisor to arrange such visit to Terni Plant that has produced some percentage of forgings for the nuclear pressure vessels, but my unexpected departure annuled these plans.
- (ii) I was very interested in visiting Breda Termomeccanica e Locomotive in Milano and Centro Sperimentale Metallurgico in Rome. According to my different interlocutors these two establishments were very interesting from the standpoint of my training. Unfortunately, the relevant applications sent by my supervisor to these institutions have been left without answer.

4. According to my opinion all information and experiences gained during my training in Italy may be applied in some way in the work of the section I am employed in. Several examples of the possibilities of such an application are listed below:

- 4.1. On ~~my~~ completion of studying of the materials I have collected our section will try to work out the draft regulations for materials intended for construction of the pressurized nuclear installations that will be subject to the technical supervision of our organization. This will be a long

term work and we shall be cooperating with the different branches of the industry. I think that studies on the materials I have collected will permit some relevant problems being solved.

The above materials in connection with the other ones we already have will also make possible to work out a draft supervisory classification of the pressurized nuclear installations that will be operated in Poland.

- 4.2. Nuclear pressure vessels require the most stringent testing conditions to be applied. Some of these tests might be applied also to the other types of high-duty pressure vessels, so as to check their high quality.
- 4.3. Some tests and acceptance criteria as used in production of nuclear pressure vessel materials might possibly be applied for research preliminary testing of newly developed materials for high-duty pressure vessels other than the nuclear ones.
- 4.4. Codes for the nuclear pressure vessels contain different methods of design and strength calculations of the pressure elements of different, sometimes untypical shape. In a majority of cases a thorough stress analysis of such elements is presented. These methods of calculation might be applied to untypical cases as being met in our practice, thereby replacing in some cases stress measurements by means of strain-gauge methods.
- 4.5. Some methods of assessment of flaws as used in the in-service inspection of the nuclear pressure vessels may be applied in the field of steam boiler drums testing.
- 4.6. Thorough studies on the Italian Pressure Vessel Code in connection with comments and interpretations I have obtained during my talks with A.N.C.C. people will prepare us to meet the problems that are likely to occur in case of Italian made pressure vessels imported to Poland and vice-versa.

The above applications are those I am able to see now.

I think that some more applications may be found on completion of studying of all materials I have received.


As I have already mentioned our organization is the only state one supervising construction and operation of pressure vessels. Practically no pressure installation may be put into operation without our inspection and acceptance.

The development of industry as well as more and more strin-

gent service conditions of the pressurized installations subject to our supervision require our being well acquainted with the world existing trends in the field of safe construction and operation of these installations, so that we may establish (and currently modify, as the need may be) our own rules ensuring full safety and reliability in this field. This is a normal way we cooperate with the industry and in my opinion the results of my training in Italy will contribute in some way to the development of this cooperation.

On conclusion of this report I would like to express my indebtedness to the United Nations Authorities for awarding me the fellowship and to Dott. Massimo Begani from I.N.I.P. for kind assistance and care in organizing my stay in Italy.

Rome, October 31, 1973.


(M. Zdankiewicz, M. Sc., Eng.)

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UNITED NATIONS

ECONOMIC COMMISSION
FOR EUROPE

Mrs. Shoukletovich
Training and Fellowship Programme Section,
Office of Technical Co-operation, New York

DEC 11 1973



7 November 1973

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of the Technical Assistance Office
of the Economic Commission for Europe*

For your information.

PERSONNEL RECORDS UNIT

ACTION

FELLOWSHIP SUB-UNIT

ROOM CH-2300 - EXT. 3218

TO

Shoukletovich

DEC 10 1973

☐ ACTION COMPLETED
☐ ACKNOWLEDGED
☐ NO ACTION REQUIRED
INITIALS.....

TECHNICAL ASSISTANCE OFFICE
Economic Commission for Europe
UNITED NATIONS

Name and home country:

Mr. W.I. TOMASZEWSKI, Poland

Field of study:

Mechanization of railway track laying and maintenance.

Country (ies) of study:

United Kingdom

Date of award:
26 April - 28 July 1973.

mgr inż. W.I. Tomaszewski
151 Al. Tytusłowicza ave
Warsaw, Poland

Final report

/i/ As a member of the mechanical engineers' staff of the Civil Engineering Department, the Research Institute of the Polish State Railways I am concerned with design and research works on track recording and on-track machinery. I am particularly interested in reliability problems of on-track machinery. The study of the above problems should be based on a proper knowledge of track condition and tolerances.

/ii/ The quantity of on-track machinery in Poland is not sufficient to obtain statistically reliable data of wear, breakdowns and failures of the machinery. The lack of the most recent machinery types makes it impossible to conclude, whether the progress in design of on-track plant involves an adequate progress in its reliability. One could not affirm, that data obtained in one country are devoided of some subjective factors. Differences in operator and fitter training may for example be significant for the reliability of a machine under operation. According to this, it is highly important to compare all the factors essential to the problem mentioned above such a comparison with the results scored in other countries makes the least expensive method of finding optimal problem solutions not only in the subject I am concerned with.

/iii/ I was given the following programme.

Thursday 26 April

Arrival. Briefing with Mrs J Jones Programme Organiser, The British Council.

Monday 30 April to Friday 1 June

London Midland Region Headquarters British Railways Board. Your training programme will be as follows: -
30 April to 11 May - Heavy Maintenance

14 May to 25 May - Introduction
application of
mechanization
30 May to 1 June - Day to day
maintenance

Monday 4 June to
Wednesday 25 July

London Midland Region
Divisional Civil Engineer's
Office Crewe

Wednesday 25 July

Travel to Derby

Thursday 26 July and
Friday 27 July

Research Department
Railway Technical Centre
Derby.

The above programme was changed as follows:

My stay with the Divisional Civil Engineer's Office was completed by a stay with the Depot in Crewe. The stay in Crewe was shortened, to enable me to spend three days /from 23th to 25th July/ with the Mechanical and Electrical Engineer's Department at Derby.

Details of the training

Heavy maintenance - Mechanical and Electrical Engineer's Department, London - Euston. Within the fortnight of my training ^{I got acquainted} of on-track plant maintenance and repairs and with the flow of information related to on-track plant operations, breakdowns and service. I also visited the Depot at Rugby and the sleepers factory in Peterborough. Furthermore I could watch some tampers under operation.

Introduction to application of mechanisation - Civil Engineer's Department, London - Euston.

During the next fortnight spent with the Civil Engineer's Department I was made acquainted with the construction of 07-16 TU and 06-16 CTM tampers and with operator training on CTM-s and TU-s. I visited a training school for fitters and another for welders.

I learned to better know the problems of track tamping, lining and consolidating as well as of track tolerances.

Day to day maintenance

I visited a depot for repairs of small plant, where I was made acquainted with tools used for track day to day maintenance.

Divisional Civil Engineer's Office, Crewe

I was made familiar with Crewe Division System of track maintenance planning as well as with the track maintenance, track recording, inspections and on-track machinery maintenance and repairs.

Chief Mechanical and Electrical Engineer's Department, Derby

My concern there were typical break downs of on track machinery and data relevant to on-track machinery failures.

Research, Derby

I visited the Soil Mechanics Section and had a view of some research work on tamping, comparison of tamping machines and a developing of a track recording coach.

/iv/ There were some items of great value I got acquainted with during my stay with the British Railways. The most important was on track machinery maintenance and repair and the mechanisation of track-maintenance. Information about on track machinery can only be obtained from the manufacturers of this equipment. These type of information is far from sufficient either for people concerned with maintenance and repairs of on-track plant or for the users of such machinery. There are practically no tests conducted by scientists to compare the machines, so that it is imposible to ~~to~~ answer some questions about the machines without visiting the countries in which the machines are being used and the experience in operating them has been gathered.

The most difficult problems are those of breakdowns of on-track machinery. The costs breakdown of an on-track machine can be apportioned to the costs of spares, those of labour and those of lost possession hours. All of these components are considerable.

In view of the quantities of machines used by civil engineers the railways are interested in all means capable to lower the costs of on-track plant operation. It is therefore important to do all the best for cutting down the costs of breakdowns since that costs are as already mentioned rather high.

Talking about modern organisation of machinery maintenance and repairs, one should consider such problems as organisation of information about the machines and their breakdowns, the organisation of maintenance and repairs. Another important problem are the spares.

Organisations of information on British Railways is not very up-to-date, but it works very well. It consists of spoken or telephone reports and written reports. There are two flows of information. One of them generated by the Civil Engineers is concerned with the work done by the machines. The breakdowns, repairs and service is included in their reports because of their affect the quantity of work.

The second flow of information comes from the workshops and Mechanical and Electrical Engineers and is concerned with breakdowns, repairs and service. If there is a mistake in any information you could find it by comparising the two flows of information. A second feature of the British system is the immediacy. Any information related to a failure is conveyed immediately to the people responsible for the repairs. So that the failed machines are repaired as quickly as possible. Although all the system is not a most modern one, the idea of immediacy and of a twofold of information proves to be feasible and should a new system be developed, those ideas would be fundamental for it.

It will be my main job after my stay in Britain will be to introduce the proper system of information about breakdowns, failures and service of on-track machinery. Knowing the British System, it would be easier for me to develop one, suitable for the F.R.P.

Organisation of repairs. - There are two groups of activities: preventive action and repairs.

Preventive action consists of the right service and readiness for repairs.

The main factor of the right service is the crew. They should be properly prepared to do their job and carry out day-by-day maintenance. A service plan is scheduled and according to this machines are inspected and where needed, repaired.

The readiness for repairs means that the technical staff of the workshops is ready to carry out repairs immediately. In Britain there are two workers on van who accompany the squadron of on-track machines when the working site lies too far off from the workshop to send them only in case of failure.

During my stay I found British workers very skillful and thoroughly trained, so that they are able to repair machines even not properly designed and constructed.

My observations of on-track machinery and some discussions about their design, construction and failures made me think, that there were some errors in design and technology on the part of the manufactures. That should not be encountered in machines designed and manufactured with a greater care. There is probably a need for the creation of an International Committee specialized in the on-track machinery. Such a Committee would solve some quality problems of the on-track machines to cover the needs of modern railways and to lower the maintenance costs of both on-track machinery and track.

A part from the information about on track plant I had the opportunity of observing some sections of British track. I found it in a very good condition. I was especially interested in modern joints, and I think the simplest and the best ones are Pandrol type. I think there are no better all over the world.

As my study in Great Britain was most usefull and extremely well organised I would like to thank Mrs Jane Jones, Mr I Mc Culloch, Mr D. Pearson, Mr D Brasil, Mr I Roscoe, Mr R Cutting, Mr K G Hadley, Mr S W Cooper, Mr I M Hanson the staff of Mechanical and Civil Engineers, Euston, Creve

and Derby On-Track Machinery Depot Crewe and all operators, fitters and workers who helped me with their knowledge and skill. I greatly appreciated my stay with them.

Ending this report I would like to express my thanks for Mr J Collondre for my fellowship.

W. Mannewick

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ДЛЯ ЕВРОПЫ

UNITED NATIONS
ECONOMIC COMMISSION
FOR EUROPE

Mrs. Shoukletovich
Training and Fellowship Programme Section,
Office of Technical Co-operation, New York



12 October 1973

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TECHNICAL ASSISTANCE OFFICE
Economic Commission for Europe
UNITED NATIONS

Name and home country:

Mr. W.J. KWIECIEN, Poland

Field of study: The skid resistance, evenness and
durability of the road pavement.

Date of award:

9 April 1973 - 9 October 1973

Country (ies) of study:

United Kingdom

WIESLAW J KWIECIEN

United Nations Fellow

Ministry of Transport

Central Office of Public Roads

POLAND

Final Report on study on

"Surface quality of Bituminous road surfacings"

in Great Britain from 9 April 1973 till 9 October 1973

ACCORDING TO THE UNITED NATIONS' INSTRUCTION MY
REPORT CONSISTS OF FOUR PARTS

1. BRIEF STATEMENT OF MY RESPONSIBILITY IN POLAND

I have been working in Central Office of Public Roads as a deputy-chief of Development Department.

Central Office of Public Roads manages the whole network of public roads ie about 280.000 km, both the state and local roads. Generally speaking the activity of Development Department has been conducted in the fields:

- collaboration with our Road Research Centre, as well as, with the Highway Institutes of Polytechnic Schools. It means, that having knowledge about the technological problems which should be resolved we provide subjects for researches to above mentioned institutions.
- utilization of the final results of these researches into engineering practice, at first on experimental road sections and later on the whole road network. Very often, the amendments of Polish standards and specifications are made at the same time or the new requirements are elaborated.
- control and supervision of 17 provincial road laboratories which take outstanding part in the road construction, both in the first stage (design) and during road works and acceptance. The quality of road building depends largely on a reliable activity of road laboratories. Moreover, these laboratories are very helpful when a utilization action takes place.

The brief description of the activity in which my department is involved, indicates that I have to be interested in the road technology as a whole, but, because my department is divided into four sections: 1. bituminous materials, 2. geotechnic (ie soils, road making above materials, subgrade, sub and road bases, as well as design of new pavements and strengthening of existing ones) 3. surface quality and mechanical properties of pavements, 4. co-operation with provincial road laboratories, I am personally responsible for Section No. 2 and 3. Therefore, the problems connected with the activity of these sections are obviously of particular interest to me.

2. BRIEF STATEMENT OF THE PROBLEMS IN MY COUNTRY
WHICH LED MY GOVERNMENT TO NOMINATE ME FOR THE
UNITED NATIONS FELLOWSHIP

Taking into consideration the climatic conditions in Poland (ie severe and snowy winters and hot summers) the best type of wearing course is asphaltic concrete. This type of mix is sufficiently dense, impervious and its stability is sufficient even for very heavy traffic and therefore the asphaltic concrete wearing course is the most common in Poland chiefly on roads carrying medium and heavier traffic. However, steadily and at a considerable rate growing traffic, as regards its volume, axle load, and increase in vehicle's speed, caused increasing demands of road users on safety and comfort of ride. We are facing at present the problem of how to improve skid-resistance and surface regularity (ie surface quality) of our pavements. Besides, the rate of road accidents in Poland is rather high, compared with other European countries where numbers of vehicles are greater.

It is evident, that the state of pavement is not the only cause of road accidents, nevertheless is very relevant especially during wet weather and then our problem number one is improvement of resistance to skidding of bituminous surfacing. Secondly, heavier and faster vehicles demand better surface regularity not only because of ride comfort which becomes more and more important but, from the dynamics point of view as well, because the oscillations of riding vehicle affect the durability of both pavement and vehicle. Finally, the increase in the durability of bituminous surfacing is a problem of great importance, especially for highway officials responsible for the allocation of money to be spent on road construction and maintenance. Roughly speaking, durability may be an antagonistic feature to skid-resistance because more open asphaltic concrete mixes and for example bituminous macadam are surfacings with better resistance to skidding but their durability is very low in Polish climate conditions and it is apparent that the question of skid-resistance must be resolved in a different way.

Another problem which appears is connected with the surface quality measurement methods on new and existing pavements.

Devices for measuring the evenness and skid-resistance we actually have in Poland represent the average European standard. It means that to examine evenness (surface regularity) we use: 3 and 4 m straight-edge, multi-wheeled profilometer and recently bump integrator mounted on the rear axle of a passenger car. The latter has the advantage of continuous and quick survey and records the dynamic and perpendicular oscillations which really occur when vehicles are riding; the trailer with blocked wheel at the speed 60 km/h is used for measuring skid resistance (coefficient of friction on wet surface). We want to compare our devices, methods of measurement and our requirements concerning surface quality with the up-to-date achievements in European countries. The last problem deals with the testing of road materials, particularly with testing of aggregates being applied to wearing courses of bituminous pavements, as well as, with determination of the requirements which should be accomplished by aggregate in order to ensure the safety of road traffic apart from its density and speed. There are many factors which determine the usefulness of aggregate for road building, but some of them are more important for aggregate which is used for wearing course, for example: resistance to polishing and abrasion, whereas these factors may be omitted when dealing with the other courses (basecourse or road base).

Briefly speaking, if we want to meet growing demands of road traffic we should improve, among others:

- surface quality of bituminous road surfacing
- methods of surface quality measurements, as well as, devices being used for this purpose
- methods of materials testing

As it is known in Poland, Great Britain is the leading European country in solving the above outlined problems, it was decided to send me, on behalf of United Nations to this country. Besides, as Transport and Road Research Laboratory is very well known road research centre it is very useful become acquainted with its activity, having at the same time, possibility to compare it with Polish Road Research Centre.

3. STATEMENT COVERING THE PROGRAMME OF OBSERVATION AND STUDY

My study in Great Britain has covered the period from 9 April 1973 till 9 October 1973 and was based upon Transport and Road Research Laboratory in Crowthorne with short visits to sites of full-scale experiments, road constructions, offices of highway authorities and one week visit to Scottish Branch of TRRL. According to the nature of my interests I have been engaged at Materials Division of TRRL, which chiefly deals with the resistance to skidding of bituminous surfacings. This question is the most important for use and I would like to describe it at the beginning and with more details.

a. Resistance to skidding of a bituminous surfacing

Great Britain's achievements in this field are outstanding but this is understood considering that researches on resistance to skidding began in 1926. The most common surfacing which provide the proper level of skid-resistance are: hot rolled asphalt with coated chippings which are applied into the hot mix during rolling, and surface dressing.

I have had a chance to become acquainted with the up-to-date results of researches connected with the method of manufacturing and storage of coated chippings before applying them to hot rolled asphalt. I have in mind the temperature required when coating, height and shape of stockpile, as well as, the binder content used for coating. Methods of laboratory tests for checking the quality of chippings by means of the appreciation of the amount of coked chippings are also very interesting especially for their reliability and simplicity.

This question is of great interest to me as we have recently tried to apply this method of antiskid treatment to asphaltic concrete surfacing, and we bought last year English spreaders for coated chippings. It is now obvious for me that our failures were caused by too high temperature while coating chippings or by too long period of storage in too high stockpiles before applying. The quality, size, shape and spreading rate of chippings have a significance as well, and are determined by British specifications and requirements very precisely. It has been very useful for me to study these problems. But, unfortunately, the asphaltic concrete is used in Great Britain very seldom, mostly as a wearing course on runways at airports, and not one experiment with application of coated chippings to asphaltic concrete surfacing has yet been made in this country. So, it has been impossible to obtain an indication about a rate of reduction of chippings content in the mix to which coated chippings are applied. It means that this problem has to be resolved by ourselves.

The technology of surface dressing is resolved in Great Britain in perfect manner. It concerns the whole process from the assessment of the degree of hardness of the existing pavement, throughout a specification of materials upto the control of materials and actual laying. The last edition of Road Note 39 "Recommendations for road surface dressing" gives the full description of all these problems and emphasizes that surface dressing applied in accordance with these recommendations should last at least five years before further treatment is required. A very interesting point for me is connected with specification of different size of chippings to offset embedment produced by traffic forces in substrates of different hardness. Although no quantitative method of assessing the degree of hardness is yet available an experienced engineer can obtain valuable information easily and comparing this with the description of five categories given in Road Note 39 bearing simultaneously in mind the volume of traffic that a road is required to carry is able to choose suitable size of chippings.

Another question deals with the possibility of applying surface dressing to roads of all types, from very lightly trafficked country roads to trunk roads and motorways carrying many thousands of vehicles a day. It sounds rather strange to me because in Poland we use surface dressing on roads carrying volume of traffic upto medium category. However, positive results being obtained in Great Britain, force us, in my opinion, to alter our views on this matter, as surface dressing apparently becomes the cheapest and quickest form of maintenance which also improves resistance to skidding of bituminous surfacing.

But when doing this in Poland, one must remember that for high standard of work to be achieved the following conditions should be accomplished:

- aggregate should be of the highest quality
- use of road tar is strongly recommended
- binder distributor and metering gritter should ensure high level of accuracy of spreading
- control of work must be very reliable
- special attention has to be paid before allowing unrestricted traffic on newly dressed lane, in order to avoid the serious risk of damage both the dressing and windscreens of vehicles caused by "flying chippings". Special treatment in such cases is necessary.

Methods of measuring skid resistance

There are two methods of measuring the coefficient of friction on wet pavements used at present in Great Britain:

- a. by trailer with blocked wheel which determines the braking force coefficient (BFC), speeds of test are normally 50 and 80 km/h and sometimes 130 km/h.
- b. by the machine which is known as SCRIM (Sideway-force Coefficient Routine Investigation Machine) which determines the sideway force coefficient (SFC) at speed of 50 and 80 km/h.

Because the latter type of machine is not well known in Poland it apparently has been useful to have a chance to obtain more details of it. The very important thing is, as the test wheel is mounted at an angle of 20° to the direction of motion of the vehicle and a sideway force which measures the skidding resistance of road surface is generated perpendicularly to the plane of the test wheel, SFC can be measured continuously. During a test SFC and speed of vehicle are sampled for 8 time periods within each 5, 10 or 20 m. length of road, and the average values are printed out on paper strip and are simultaneously punched on paper tape for processing by computer. The above mentioned advantages of SCRIM prove it's usefulness as standard equipment for measuring resistance to skidding.

I was one day the eye-witness when the full number of tests on 30 experimental sections of pavement was covered by SCRIM in half the time required by the trailer with blocked wheel. I think that it would be very helpful for us if we could buy as soon as possible at least one SCRIM, as France for example has already done.

The existing "target values" of skidding resistance recommended for roads in Great Britain are expressed in the values of SFC measured at test speed 50 and 80 km/h and although are incomparable with Polish requirements it seems that they represent the higher value of coefficient of friction. It is interesting, that these values are based upon the probability of skidding accidents which can occur at given categories of site. The proposals for new standards of skidding resistance are now in preparation, the main object of this work is to assess more precisely the minimum value of SFC required on any site. The work utilizes up-to-date results of investigation of correlation between SFC, traffic density, Polished Stone Value of aggregate, as well as, the data on the number of accidents which occurred, and at last the possibility of using SCRIM and computer techniques. It should be a further step in the improvement in antiskid quality of pavements in Great Britain.

Although the effect of microtexture in the form of the resistance to polishing of road stones is the chief requirement of a non-skid material, another factor which also must be considered is the coarse texture of surfacing - the macrotexture. The measure of macrotexture is "texture depth" commonly estimated in Great Britain by the sand path method. The macrotexture is especially very essential for high-speed roads, because resistance to skidding changes with the speed of vehicle and the rate of change (drop) depends on texture depth. It has been found that in order to maintain a good resistance to skidding at high speeds it is necessary to obtain the texture depth at least 0.65 mm and preferably more than 1 mm. The recent work has shown that on the pavement with the texture depth greater than 2 mm. BFC at speed 130 km/h may be even higher than BFC at speed 50 km/h. The problem of macrotexture has not been studied yet in Poland, nevertheless as we plan to build the network of high speed roads it is obvious that investigation on this question should be commenced as soon as possible.

I have had the opportunity to become acquainted with the full-scale experiment at High Wycombe by-pass which was started in 1967 when on 4.5 km length of carriageway 30 experimental surfacings were laid. Because there were laid four sections with asphaltic concrete I have had a chance to compare this type of surfacing with others which are common in Great Britain. The resistance to skidding was determined three times per year by measuring SFC and BFC and the texture depth was measured as well. The results obtained during recent 5 years have shown that the value of SFC and BFC for asphaltic concrete has dropped more rapidly than for other types of surfacing, both on nearside and offside lanes, despite the higher initial values. Besides, the texture depth has been the lowest for asphaltic concrete, however it gradually increased unlike on the other surfacings. The same results were obtained from the experiment which was conducted by the Scottish Branch of TRRL. These results confirm the necessity of the improvement in the technology of the asphaltic concrete surfacing.

The last question which is connected with resistance to skidding is the testing of materials and investigation on influence of the features of road making materials on resistance to skidding.

Aggregates The properties of the greatest importance in aggregate applied to wearing courses are its resistance to polishing and abrasion. Actually, methods of testing of these properties have reached in Great Britain very high level. British Standard 812 gives full and accurate description of tests, which have been lately developed in TRRL. The resistance to polishing is defined by the Polished Stone Value (PSV) and it has been found that some grit stones have the highest value of PSV, the limestones the lowest, while granites and basalts represent mean value. The relationship between Polished Stone Value, density of traffic and sideway-force-coefficient which has been recently discovered should enable road engineers to select aggregate of the appropriate PSV to achieve required level of

resistance to skidding under given traffic density. It is a very useful point for engineering practice which helps to plan and organise properly work and transport of materials. Moreover, the initial cost of work can be estimated more precisely. The more accurate forecast of future demand for different kinds of aggregates is another advantage of it.

The resistance to abrasion is defined by Aggregate Abrasion Value and this characteristic of aggregate is very important for the maintenance of macrotexture. Current work connected with the question of how other characteristics of aggregates, such as: geological group, particle size, durability, single-sizedness, chippings, affect resistance to skidding is very interesting one. as well as, the technique of "positive replica" for studying the polishing of roadstones by scanning electron microscopy. The technique allows a series of non-destructive observations to be made of roadstone in the road surface at high magnifications, and is being used in research into the mechanism of polishing of roadstones.

Simultaneously, I became acquainted with: the proper preparation of samples for the polishing and abrasion test, the actual performance of tests according to BS 812, as well as, with the construction, calibration and use of TRRL pendulum tester. It has been of great interest to me as we have actually in Poland identical equipment to carry out these tests. Moreover, by courtesy of TRRL I have been able to obtain the results of the polishing and abrasion tests performed on Polish aggregates, the samples of which were sent from Poland.

Binders - very wide investigations and full-scale-experiments have been conducted by TRRL in order to determine the influence of type and content of binder on the resistance to skidding. Because, the phenomenon of weathering of binder is simultaneously involved, the results of former researches are reflected in British specifications which excluded petroleum bitumens from being used on wearing courses of roads carrying more than 0.5 million of standard axles (according to RN 29). The pitch bitumen or equal proportions of Trinidad Lake Asphalt and petroleum bitumen should be used in such cases. But as petroleum bitumen usually has a small cost advantage over pitch-bitumen and because asphalt made with this bitumen may have better resistance to plastic deformation, the current researches are conducted by TRRL with the object of determining the conditions under which these bitumens can be used on heavily trafficked roads. Because petroleum bitumen is chiefly used in Poland the results of investigations on the relationship between the permissibility of binders and texture depth developed on the road after two years of service have been very interesting for me.

b. Surface regularity (evenness)

Surface regularity of new pavements - British requirements of surface regularity of new pavements are higher than Polish ones both with regard to the permitted number of surface irregularities and the maximum limit of permitted irregularity in mm. But methods of testing, as well as the type of devices being used for testing are very similar, the only difference is that during acceptance of work we use also multi-wheeled profilometer. Surface regularity depends largely on the quality of a finisher and whether it has proper devices to correct automatically longitudinal irregularities when spreading the mix. To equip the contractors with greater number of such finishers is the best way to improve the surface regularity.

Surface regularity of existing pavements

For measuring the riding quality of existing pavements two forms of apparatus are used in Great Britain: multi-wheeled-profilometer, which gives a graphical record of the longitudinal profile and provides an index of irregularity expressed in inches per mile, and the bump-integrator which is a single-wheeled trailer towed by a vehicle, which when operated at 20 miles/h provides another index of irregularity expressed also in inches per mile. In order to relate the indices of irregularity given by these machines with the quality of the ride expressed by passengers in motor vehicles, a large number of roads were tested by both machines and drivers were asked to express an opinion as to the quality of ride. The opinions fell into well-defined groups and the correlation was found. Report on highway maintenance which was elaborated by "Marshall committee" in 1970 gave the suggested standard of pavement when the resurfacing or reconstruction is necessary, and among others, there were the requirements for the limits of surface irregularity indicated by the bump integrator, separately for trunk and important principal roads and for other roads.

The problem of surface regularity as a whole has been resolved in Poland in identical way, as regards:

- the machines being used for checking regularity.
- the manner of finding the correlation between the results given by these machines and riding quality experienced by passengers of vehicles
- surface regularity requirements for different categories of road which are indicated by the bump integrator.

The only difference concerns the construction of the bump integrator which in Poland is mounted on the rear axle of passenger car and is connected with electronic recorder inside the car; the test speed in Poland is 60 km/h. In my opinion this machine is more modern, reliable and accurate than a English one, as is confirmed by investigation being actually concluded by TRRL in order to construct the new up-to-date bump integrator.

c. Durability of flexible pavements

The expected service life of bituminous surfacing in Great Britain is longer when compared with Polish experience and may be as follows:

Type of Surfacing	Traffic		
	Heavy	Medium	Light
	Years	Years	Years
Surface dressing	4.5	5	6
Bitumen macadam carpet	4	4.5	6
Fine cold asphalt	12	12	-
Hot rolled asphalt	20	21	-

The advantage of dense and impervious mixes can be seen very easily from this table.

Durability of pavement depends on many factors, and satisfactory service life of pavement can be achieved in engineering practice by:

- suitable strength of subgrade and pavement
- quality of materials being used for pavement construction, as well as by adequate composition of mixes
- accuracy of work
- protection of pavement construction against infiltration of water

The study connected with the durability of pavements is very complex and covers such areas as: pavement design requirement, failure criteria, traffic loads, pavement temperature, calculations of stress, strain and deflection, the effects of repeated loading on the fatigue and deformation of bound and unbound materials and soils. In recent years a substantial programme of research has been proceeding at TRRL. The current results of these researches are very interesting and allow better understanding of the behaviour of road making materials and pavements under traffic and weather. Especially valuable progress has been made in the understanding of the effects of repeated loading on fatigue cracking and loss of dynamic modulus of bituminous material, in particular rest periods between load pulses are now known to be major factor in extending the life of pavements. All these problems have been tested not only in laboratory but as well as, during pilot and full-scale experiments and it makes the results more valuable. Their introduction to pavements design practice signifies great progress from the technical and economical points of view. It has been very useful for me to become acquainted with the study of this problem and to compare the results with the Polish ones.

d. Additional problems

During my stay in Great Britain I have had an opportunity to acquaint myself with such additional problems as:

- effect of resistance to skidding on road accidents
- elimination of the splash and spray of water by vehicles travelling on wet road
- the depth of rain water on impervious road surfaces
- synthetic aggregate of high resistance to polishing
- the question of the effect of oil dropped from lubrication system of commercial vehicles on bituminous surfacing
- proposals for a maintenance rating system for roads
- current work on road pavement design
- specifications for the strengthening of existing flexible pavement
- the frost susceptibility of soils and road materials

4. MY VIEWS AS TO THE CONTRIBUTION WHICH MY
TRAINING CAN MAKE TO THE ADVANCEMENT OF MY
COUNTRY IN MY PARTICULAR FIELD OF STUDY

My training in Great Britain has been very useful and in my opinion would help to resolve such problems as:

- a. applying coated chippings to asphaltic concrete wearing courses.
- b. use of surface dressing on all categories of road
- c. elaboration of new standards of resistance to skidding which should depend on the category of road and magnitude of risk on site.
- d. improvement in the testing of aggregates and revision of aggregates classification.
- e. new methods and directions of researches on bituminous binders which should lead to the improvement of surface quality and durability of bituminous surfacings.
- f. undertake researches on problem of fatigue of road making materials and make progress in pavement design.

Moreover, it is now evident to me that our Road Research Centre should take into account progress in two very important spheres:

1. wider use of computer techniques which opens the possibility to obtain the results from a great number of statistical data, and allows to determine relationships between many factors which can effect the performance of road pavements.
2. Greater reliance on full-scale experiments which should be an inseparable part of almost any research. Being conducted for a long time they enable the comparison between the behaviour of different road materials to be made as they change their properties under condition of real traffic and weather.

ACKNOWLEDGEMENTS

I would like to thank Mrs Pollock (British Council in London) and Messrs Salt, Szatkowski, Macey, Hosking and Szafran from Transport and Road Research Laboratory, as well as, the remaining staff of Materials Division of TRRL who have done their best to make my sojourn in Great Britain the most useful and attractive for me.

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Mrs. Shoukletovich

Training and Fellowship Programme Section,
Office of Technical Co-operation, New York



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TECHNICAL ASSISTANCE OFFICE
Economic Commission for Europe
UNITED NATIONS

Name and home country:

Mr. S.W.K. PRON, Poland

Field of study:

Electronic data processing

Country (ies) of study:

Italy

Date of award:

13.2.73 - 8.9.73

Slawomir W. K. Proh

Zaklad Elektronicznej
Techniki Obliczeniowej
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F I N A L R E P O R T

on the activity performed by the author under the sponsorship
of the United Nations Technical Assistance

subject of the study: Designing of reusable management information
systems, mainly for industrial applications.

period during which

the study was made: February 13th 1973 - September 8th 1973

country of study: Italy

Rome, September 1973

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- I. Personal data,
2. Programme of the study,
3. Realization of the study:
 - 3.1. IBM System /370
 - 3.2. IBM Italia - Milano
 - 3.3. IBM Italia - Rome
 - 3.4. Istituto di Elaborazione della Informazione - Pisa
 - 3.5. University of Naples
 - 3.6. University of Bologna and University of Parma
 - 3.7. National Institute of the Agricultural Economics - Rome
 - 3.8. Nuovo Pignone - Florence
 - 3.9. Short visits,
4. The application of the information gained during the fellowship,
5. Final note.

Details:

1. The study of IBM /370 System.
2. Information systems operated by IBM ITALIA /concerning IBM ITALIA only/:
 - IBM ITALIA Information System,
 - Vimercate Plant Information System.
3. Information systems operated by IBM ITALIA Customer Bureau at Rome:
 - National Library at Florence,
 - postal-selling organization typical system,
 - Alitalia Systems.
4. The study of the IBM systems documentation standards.
5. The study of the organization of data banks:
 - IBM Information Management System IMS /370.
6. The study at the Istituto di Elaborazione della Informazione - Pisa:
 - elements of system engineering,
 - computer systems for continuous numerical control of machine tools,
 - languages for the numerical control of machine tools,
 - systems for direct digital control of processes.
7. The study of computer application in the industrial organizations:
 - Nuovo Pignone - Florence,
 - Solari - Udine.
8. The study of computer applications in agriculture:
 - National Institute of the Agriculture Economics - Rome,
 - University of Naples,
 - University of Bologna,
 - University of Parma,
 - University of Padova.

1. Personal data

The author was studying at the Technical University of Poznan, where he graduated in 1965 as a Master of Engineering. At first he took up work at the "Wiepofama"-machine tool factory in Poznan, where he remained for 4 years. The author work^{ed} in the factory design office as an electrical design engineer. He was designing and implementing digital control of machine tools and unit-construction machines^h. During this time, the author also finished a post-graduate study for 1,5 years in methods of organization and management of industrial organizations at Academy of Economy in Poznan. From 1967 he worked for the same employer but in another department, as an analyst of edp systems. There the author worked in a great team which was designing edp systems for operational planning, and was carrying out the work aimed at preparation of industrial organization for introduction of data processing. In 1969 the author changed his job and started working for ZETO Computer Centre /member organization of the Polish State Network of EDP Centres/ in Poznan, where he has been working for 4 years now with the title of " Head of designing team ". The author's present activity comprises the industrial application of the information-processing systems, and he has personal responsibility for management, coordination and supervision of the work of designing and programming team in the field of:

- analysing of needs for application of data processing in industrial organizations,
- designing and programming edp systems, mainly for industrial and commercial organizations,
- implementation of edp systems in user's organizations.

2. Programme of the study

The author's study programme was accepted by the Polish Government and presented to Technical Assistance Office, Economic Commission for Europe of the United Nations in 1971, but finally was settled after his arriving to the Italy and after discussions with specialists from a number of computer centres, when more precise programme was approved. The author suggested also to join two other subjects to the programme of study, concerned with digital control of machine tools and data processing application in agriculture. Both proposed subjects have been interesting from the point of view of development of computers application in national economy of the author's home country. All the suggestions had been supported by the INIP in Rome and accepted by the Polish authorities and UN Economic Commission for Europe, Technical Assistance Office in Geneva.

The accorded programme of study was as follows:

Objectives:

- organization and management of industrial enterprises for various industries,
- organization of industrial and regional computing centres,
- methods of analysing and designing and techniques of running automatic information systems for medium and large size serialized industrial production,
- continuous control of production processes,
- data transmission systems for application between computing centres and industrial organizations as well as between operational units,
- digital control of machine tools /with organization of data banks concerning technological processes, tools, parameters of cutting/,
- application of data processing in the field of management of big agricultural organizations.

3. Realization of the study

In the pages to follow, the author would like to display the main points studied during his fellowship. This exposition is made from the edp systems analyst's point of view.

According to J.W. Forrester "Industrial dynamics", under the term industrial organization, here is meant a structural set of interconnected processes, performed in different flows which exist in it, together with the human factor existing in the organization.

The principal flows, existing in an industrial organization are following:

- requisition flow to perform some activity,
- material-flow,
- money-flow,
- labor-flow,
- equipment-flow,

All these flows are interconnected by the:

- information-flow,

which aggregates at least three kinds of information about:

- the real state of activity performed,
- the desired state of activity,
- decisions taken in order to maintain the activity in organization in the direction of necessary change.

The information-flow does exist in the industrial organization independently from the eventually considered application of computer. After the implementation stage, the computer information system is to be considered as an integral part of the set of operations performed on the flow.

3.1. IBM System /370.

The author had studied IBM System /370 before and during his study in IBM Customer Bureau in Rome and all necessary explanations had been made by the specialists from the mentioned computer centre.

System /370 Basic structure and features.

The system transmits data between main storage and CPU in multiples of eight bits. Each eight-bit unit of data is called a byte, the basic building block of all formats in System /370. In CPU's and buffers, a ninth bit, the parity or check bit, is transmitted with each byte and carries odd parity in the byte. The parity bit cannot be affected by the program; its only purpose is to cause an interruption when a parity error is detected. In this computer, bytes may be handled separately, or they may be grouped in fields. The halfword, word, and doubleword are fields of consecutive bytes; a halfword has two bytes, a word has four bytes, a doubleword has eight bytes. These fields make up the basic fixed-length data formats. Data formats are either fixed length or variable-length. During processing, the field's length is either implied by the operations to be performed or it is stated explicitly as part of the instruction. In System /370 data /whether numeric, alphabetic, or alphanumeric/ is processed in multiples of an eight-bit byte.

Main storage provide the system with directly-addressable fast-access storage of data. Both data and programs must be loaded into main storage before they can be processed. Main storage capacities offer a wide latitude in choosing the amount of storage required. The capacities vary from 96K /98304/ bytes to 4096K /4194304/ bytes, depending on the system model. Available models have a choice of several storage capacities, with each model's maximum capacity several times its minimum. Storage protection, made up of the store and fetch protection features, prevents the unauthorized changing or use of contents of main storage. Protection is achieved by dividing main storage into 2048-byte

blocks and by associating a five-bit storage key with each block. The storage cycle time is 2.07 microseconds or less, the exact value depends on the system model.

The addressing arrangement uses a 24-bit binary address, which gives System /370 the capability of addressing as many as 16,777,216 bytes of storage. This set of main-storage addresses includes some low-address locations reserved for special purposes.

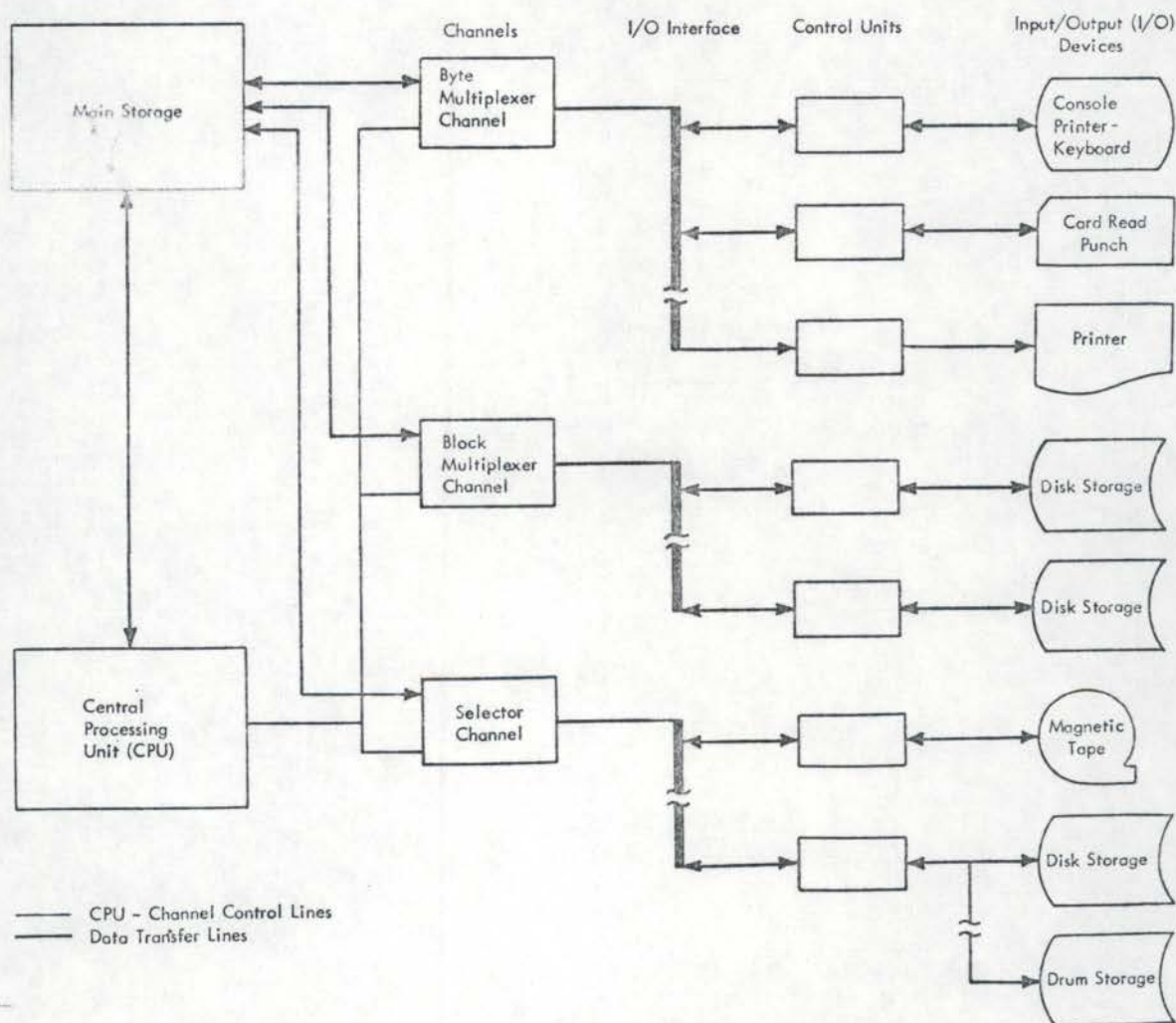


Figure 1. Organization of a Representative System /370 Model.

The central processing unit/CPU/ is the controlling center of system. It provides facilities for:

- addressing main storage,
- fetching and storing data,
- arithmetic and logic processing of data,
- executing instructions in a desired sequence,
- initiating communication between main storage and input/output devices.

Three prominent types of registers are provided by the CPU; general, floating-point, and control.

The 16 registers and 4 floating-point registers are accessible to the programmer and are capable to receiving data, holding it, permitting it to be operated on and transferring it.

The arithmetic and logic operations fall into four classes:

- decimal arithmetic - used principally for commercial applications,
- fixed-point arithmetic - used to perform arithmetic operations on both data and storage addresses
- logic operations.

The control panel, usually mounted on the CPU, provides the operator with manual control of the system. It gives the operator the ability to reset the system, to store and display information, and to initial program operation.

An input/output operation transfer data between main storage and an I/O device. An I/O operation is initiated by a program instruction that generates a command to a channel. A control unit receives the command via the I/O interface, decodes it, and starts the I/O device. Channels are the direct controllers of I/O devices and control units. They provide System /360 with the ability to read, write, and compute, all at the same time, by the relieving the CPU of the task of communicating directly with the I/O devices.

Channels may be standalone units, complete with the necessary logical and storage capabilities, or they may time-share CPU facilities, and be physically integrated with the CPU. The type available to any system model depends on the system model itself. Functionally, the channel data path is divided into subchannels. To a programmer, each subchannel is a separate channel, and can be programmed as such. System/370 has three types of channels:

- byte multiplexer channel - which separate the operations of high speed devices from those of low-speed devices,
- selector channel - which transmit data to or from a single I/O device at any time. They can handle both high- and lower-speed I/O devices,
- block multiplexer channel - which has advantages of both byte multiplexer and selector channels in that they can concurrently operate many high-speed I/O devices on a single data path.

I/O devices fall into a number of categories, some of which overlap. They are used in and for:

- auxiliary storage,
- machine and manual /keyed/ input, both local and remote,
- teleprocessing,
- reading /or output/ of external documents and displays,
- process control,
- data acquisition.

Many I/O devices function with an external document, such as a punched card or a reel of magnetic tape. Others handle only electrical signals, such as those in process-control and data acquisition systems.

The interruption system uses program status words /PSW's/ to hold status and control information as in System /360. Additionally, System /370 uses control registers to regulate the interruption system. After the interruption has been serviced, the CPU is restored by the program to the status it had before the interruption.

Operating system.

An operating system is a collection of programs that provides for the preparation and execution of the user's problem programs /jobs/. IBM-supplied operating systems are designed to match the needs of the equipment configuration and the customer's job requirements. All operating systems are either tape-resident or direct-access-resident, and consist of two basic parts:

- control program,
- processing /or problem/ programs.

The control program is the framework of an operating system;

It has three distinct functions:

- job management - provides the facilities to read, interpret, initiate, and terminate jobs submitted for processing. It also provides the facilities for the operator to communicate with the system,
- task management - is core of an operating system. Because it performs the supervisory functions associated with the execution of a task, it is often called the supervisor. The functions provided generally include interruption handling, resource allocation fetching of non-resident routines, time supervision, and transient-error recovery,
- data management - provides the functions of record blocking and deblocking, space allocation on direct access devices, processing of labels, and the transfer of data between main storage and external devices, all by means of various access methods. These functions allow data set /sometimes called data files/, and their processing the utmost independence from the I/O environment. The access methods, which are well-defined and consistent, handle data set according to their basic organization: sequential, indexed sequential, direct, partitioned etc. Some access methods provide automatic buffering facilities.

A processing program is defined as any program that is not a control program. Processing programs are kept on tape or direct access devices; as collections of data sets known as libraries, and fall in three general categories:

Language Translators for Assembler, FORTRAN, COBOL, PL/1, etc.

Service Programs such as utilities and sort/merge.

User-Written Problem Programs that become part of the operating system library and are retrievable by name alone.

The IBM-supplied operating systems for the System/370 are:

- System /360 Disk Operating System /DOS/ - which is 2311, 2314 or 3330 disk resident on a system with the minimum recommended storage of 32K bytes. DOS provides a control program, five language translators /Assembler, RPG, FORTRAN, COBOL, PL/1/, utilities, sort/merge programs, and special-purpose library maintenance programs. DOS also provides a multiprogramming facility which allows several programs to be run concurrently.

- System /360 Operating System /OS/ - which is the most sophisticated and most powerful of the IBM operating systems. At least 128K bytes are required; the storage size must be estimated for each system according to the OS facilities actually needed. OS is resident on direct access devices having a data rate that the using model of System/370 is capable to accepting. OS offers two control programs:

- multiprogramming with the Fixed Number of Task /MFT/,
- multiprogramming with the Variable Number of Task /MVT/.

MFT reduces the problem of CPU wait-time by supervising the execution of more than one job at a time. Each job is executed in its own area of main storage. The size of each of these areas, or partitions, is established when the system is generated, but may be changed by the operator. MFT is especially useful to users who must process a wide variety of jobs that require a corresponding variety of computing system resources. The system's capability of providing partitions as small as 8K bytes is a distinct advantage to the user with many small jobs.

MVT also supervise execution of more than one job step at a time, but, in addition, allocates main storage dynamically to each job. This configuration supports the large job as well as the customer who has many small jobs. Dynamic storage areas, called regions, can be as small/as 12K bytes for MVT.

Teleprocessing.

System /370 was designed so that it could serve as the data processing complex within a larger teleprocessing system. Experience with real-time and teleprocessing systems indicates two major differences between teleprocessing systems and the more familiar batch processing systems: batch processing input is scheduled, whereas teleprocessing input is unscheduled; batch processing is usually serial, whereas teleprocessing is random. System/370 incorporates the ability to service these two teleprocessing characteristics.

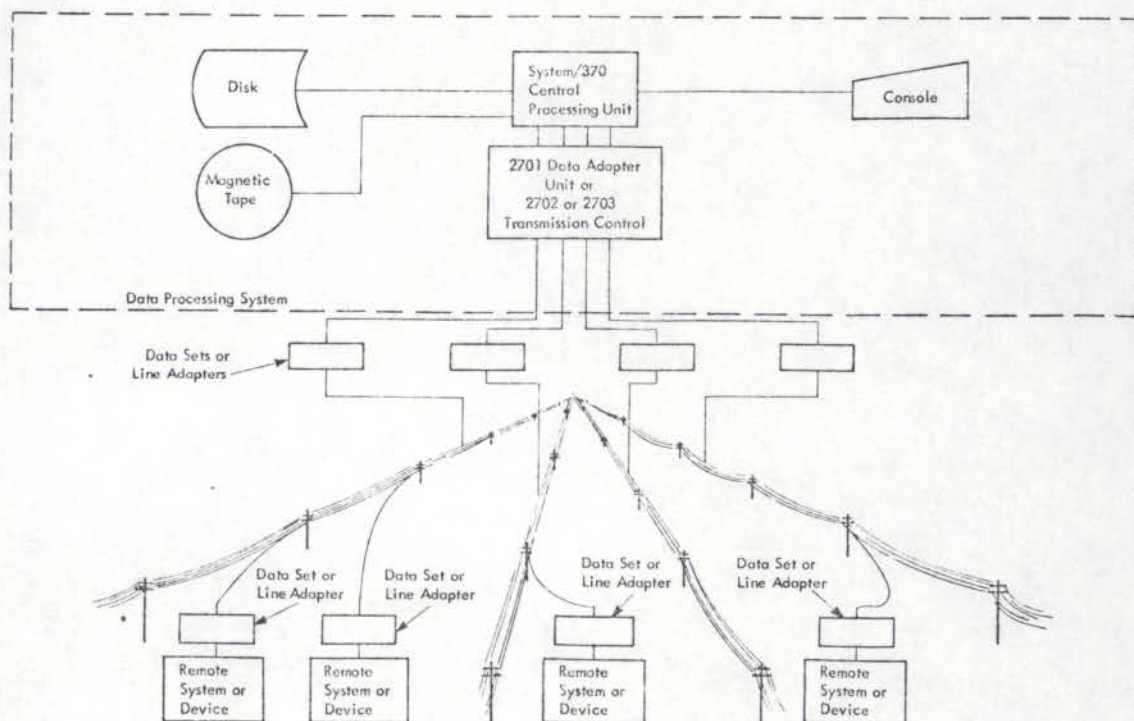


Figure 2. System /370 as a Teleprocessing System.

A communication line /Also called a communications channel or circuit/ is a path for electric transmission between two or more terminals. Basically, teleprocessing equipment can operate over three types of circuits, which names describe only directional capability:

- simplex circuit - can carry data only in one direction,
- half-duplex circuits can carry data in two directions but in only one direction at a time,
- duplex circuits can carry data in two directions at the same time.

A network can consist of any combination of these circuits according to application requirements.

Information can be transmitted over the various types of communication lines by the three different modes of transmission:

- asynchronous transmission /also called serial start/stop/ requires the use of start and stop bits to designate the beginning and ending of characters.
- synchronous transmission eliminates the need for start and stop bits; a special pattern of bits is sent periodically to keep the transmitter and receiver operating in unison. The bit pattern is generated automatically and sent as required by the system.
- parallel transmission allows all bits of character to be transmitted simultaneously by providing a separate path for each bit in the code structure.

Most often a user obtains his communications lines from a communication common carrier. The common carrier leases him a private line for his exclusive use or connects him with the common-carrier /dial up/ network available to the public. A user can also purchase and maintain his own communications facilities, but these must be purchased from suppliers other than common carriers.

3.2. IBM ITALIA - Milano

The author's study in IBM ITALIA in Milano were consisted of three parts:

- the study of organization of IBM ITALIA and Vimercate Plant,
- the study of Head-Quarters Information System,
- the study of advanced systems approached in production in Vimercate Plant.

During discussions, the representatives of IBM ITALIA Head-Quarters suggested also a certain number of visits with discussions to IBM installations, such as:

- Fiat Presse - Torino,
- Alitalia - Rome,
- Bank of Italy - Rome,
- National Council for Nuclear Energy - Rome,
- Euratom - Varese.

IBM is a multinational organization, operating on a world-wide scale, producer of central processing units, input-output devices, peripheral equipment and data transmission terminals. IBM Corporation operates in 118 countries all over the world.

IBM ITALIA as a branch of IBM WORLD TRADE operates in Italy:

- 11 Data Centres,
- over 50 Sales Locations,
- 3 Scientific Centres:
 - Bari- Computer in Education,
 - Teaching of the Information Science,
 - Pisa- Econometrics,
 - Environmental Sciences /Arno River/,
 - Teaching of the Information Science,
 - Computer Science,
 - Statistic linguistics,
 - Venice- Environmental Science /Lagoon problems/.

3.3. IBM ITALIA _ Rome

The author also had opportunity to study organization, methods of work and prepared systems at IBM Data Processing Service Centre - Rome. The IBM DPSC-Rome has been divided into

- commercial service department
 - office for commercial problems /2 sections/,
 - office for scientific problems /1 section/,
- computing centre,

and is working mainly for government. There is also interest in payroll problems, billing, selling analysis and general ledger.

The staff of each commercial section consists of:

- operator-programmer /makes programs/,
- operator-programmer specialist /makes more advanced programs/,
- associated systems engineer /helps the systems engineer make the analyse more detailed and write specification of programs/,
- systems engineer /coordinates work of 3-5 people's team/,
- assistant systems engineering adviser /works in the staff of chief of office/.

There are two great data banks, which have been designed by the IBM DPSC at Rome - for Biblioteca Nazionale Centrale di Firenze and for the postal-selling organization. The first system comprises the following parts:

- preparation of the catalogue,
- preparation of the list of new books in the decimal subject number and in the alphabetic order for printing of the bulletins of news,
- preparation of the MT with above-named information, which are sent to others libraries all over the world for exchange,
- allocation of the books in the library, according to the subject, number of the book, language etc, /single description for each volume/.

The second system concerning booking, postages, billing, sales analyse,

general ledger and stock control for a great post-selling magazine, and consists of:

- order control,
- stock control,
- Bill printing,
- invoice control,
- bulletin printing.

There are also produced records for accounting, control of payment, and for statistic systems.

Each stock-item has a separate code, which consists of 9 digits:

- | | |
|--|-------------|
| - class of goods | - 1 digit, |
| - group of goods | - 1 digit, |
| - information about available manners of selling | - 2 digits, |
| - composition of the set /model/ | - 2 digits, |
| - range of cost | - 1 digit, |
| - sequential number of item | - 2 digits. |

Each customer can buy articles from I class only, or is obliged to send more calls.

Customer code consists of II digits /plus 2 control digits/ and base on postal code.

It was possible to the author to study the organization of data banks which have been operated in the IBM Installation Centre at Rome, such as Bank of Sicilia System and Bank of Rome System.

Both above mentioned systems consist of:

- IBM Information Management System IMS/360,
- Operating System,
- application programs.

All application programs have a contact with Data Banks and TP facilities as well as with Operating System through IMS.

The main IMS features are elimination of redundant data, reduction of data and program maintenance and outline data maintenance.

The other customer systems, the author was acquainted with, were Alitalia Company Systems.

At present the Alitalia Company Data Processing Centre operating the following computers:

- IBM 360/65 - for passenger reservation system and cargo system,
- IBM 360/65 - as a back up system for the first one,
- IBM 360/65 - for the O.S. programs,
- IBM 370/155 - for maintenance of engineering of the aircrafts.

The last system seems to be most interesting as an example of organization of the great data bank and because can be easily transformed for industrial organization requirements.

The mentioned system consists of:

- stock management /50 terminals "on line" through 14 hours daily, during the night-time updating only/,
- routable parts control /future-workshop planning/,
- engineering changes plan,
- location control for stock,
- liability program.

There are two structures of Data Base, one for handling of stock, and second for about 5000 routable parts. All records are interconnected by the pointers, each of them has 4 bytes.

Typical documentation for EDP Systems /IBM standards/.

The different centres are using their own standards, but usually there are some typical forms for all.

I. Title page

- project name and number,
- computer model destination,
- program languages,
- client contract,
- frequency of program use,
- brief abstract,
- author.

2. Problem description

- Problem statement /complete description with history, purpose and value/,
- technical write ups and diagrams,
- basic formulae,
- definitions of symbols and terminology,
- restrictions and limitations,
- list of references.

3. User's guide

- description of using of the programs,
- input cards description /sample cards layout, data input/,
- output /description of information, sample output forms/,
- estimation of computer run times,
- table of errors and recommended courses of action,
- complete list of outputs with a brief description, how the program affects these variations,
- list of related programs,
- possibility of extension.

4. Programmer's guide

- overall logic flow diagrams, including interaction of data set,
- if overlay, show the tree structure,
- map listing,
- list of definitions of all variables in common,
- description of flow sheet of routines and subroutines,
- description "off line" devices and sample diagrams.

5. Operator's guide

- job flow on computer,
- input with detail data card, tape and disk files,
- operation
 - normal instruction descriptions,
 - list of possible troubles with recommended courses of action,
- output instructions.

3.4. Istituto di Elaborazione della Informazione - Pisa.

The research fields of the Institute are:

- numerical analysis and applied mathematics,
- programming languages,
- systems for information processing,
- bio-engineering,
- processing of non-numerical information.

There is also interest in applied research and development in the field of information processing and of automata.

The personel of IEI /about 80 permanent staff, 20 temporary appointments/ is divided into Research Section and Service Section.

For its work, the IEI uses a computer HP/2116/B with 8 terminals, and a small computer PDP8 /for image processing/, and has access to the computing facilities of a separate organization in Pisa, the Centro Nazionale Universitario di Calcolo Elettronico /CNUCE/, where the following IBM computers are available:

IBM 360/67, 360/20, 7090, 1800, 1130.

The scientific activity of IEI embraced:

- numerical analysis:
 - solution of nono-linear systems,
 - integration of equations in fluid dynamics,
- numerical computation for physical chemistry problems,
- computer aided design in engineering; investigation in applied mechanics and applied physics,
- simulation of chemistry plants,
- investigation on the foundation of programming languages,
- languages for the numerical control of machine tools,
- optimalization problems for the State Railways and other public agencies,
- various programming problems,

- bioelectronics:

- systems for computer processing of bioelectric data,
- recording system for myoelectric activity,
- artificial stimulation.
- synthesis of combinational networks,
- computer aided design of digital systems. Topics in switching theory,
- systems for continuous numerical control of machine tools,
- systems for direct digital control of processes,
- switching circuits and fixed storage memories,
- investigations on information flow in nervous nets,
- computer processing of images,
- computer aided collection of clinical data,
- computer aided instruction.

During his stay at IEI, the author's interest were:

- elements of system engineering;
- computer systems for continuous numerical control of machine tools,
- languages for the numerical control of machine tools,
- systems for direct digital control of processes.

Numerical control of machine tools.

The first numerically controlled machine tool was demonstrated at MIT in 1952. During 1953, MIT began to develop the part programming system known as APT/Automatically Programmed Tools/for the US Air Force. In the short period since 1956 the development has assumed international proportions. Over 33 languages have been developed and the techniques have been extended in all directions. Language processors have been prepared for dozens of different computers, and over 50 post-processors have been prepared to fit these to various controls and tools.

An example of numeric control of machine tool - computer design of cams for driving an automatic screw machine /Olivetti-Ivrea/.

The consistency of input data is controlled by the program, which also tries to correct the errors detected. The program is divided into the four following phases:

- reads input data, verifying their consistency and divides them according to the slides they refer to,
- for each sleeve, classifies the commands according to the three fundamental groups and calculates the parameters which define the different zones of the cam profile corresponding to each group,
- computes the coordinates of enough point of the cam profile, on the roller center path and on the cutter path to be able to draw them with the desired precision by the linear interpolation,
- prints out results, makes a drawing of the cam profiles and punched the paper tape for driving the milling machine.

Three types of movement have been provided for:

- active movements- covering all codes concerning working strokes /except thread and unscrew/ and all operations performed with the toolslide at rest /measure, open chuck, feed bar etc/,
- service movements- covering all codes concerning positioning movements like fast forward and backward strokes, tool head rotation and tool disengagement operations,
- thread commands- which include only the three thread commands: thread, reverse motion, unscrew.

Each command is further divided by the program into a fixed sequence of movements corresponding to elementary zones of the cam profile. To describe all possible operations three elementary zones are needed:

- linear - corresponding to a motion of the toolslide with constant speed,
- fast rise - corresponding to a forward motion of the toolslide

at the maximum speed compatible with inertia forces and pressure angles,

- fast returned - corresponding to a backward motion of the tool-slide at the maximum speed for which the contact between the wiper roller and the cam is still assured.

The other elementary zones have also been introduced to calculate the cam profile and the roll center path between adjacent zones:

- parabolic - corresponding to the motion of the toolslide with a speed lineary varying with angle, is inserted between every pair of linear zones to join them without discontinuity in the speed,
- external rotation - corresponding to points, where cam profile has a discontinuity in the first derivative, the cam profile reduces to one point and roll center path to a circle of radius equal to the roll radius,
- internal rotation - corresponding to points, where the roll center path has a discontinuity in the first derivative, the roll center path reduces to one point and the cam profile to a circle of radius equal to the roll radius.

The input data in computer designed cams is of four types:

- general geometric data, which defines the essential dimensions of the cam mechanism to be constructed, namely:
 - type of coupling between driving cam and follower; rocking lever with roller, translating rod with roller,
 - distance of cam centre to the lever; length of the lever; roller diameter; cam initial dimension,
 - ancillary data such as possible stock allowance, tool diameter.
- the laws of motion of the follower are defined by a set of cards, one for each required motion. Each card defines the angle of rotation of the cam, to which the motion described in the card refers, the travel of the follower; other kinematic data /velocity, acceleration/ and non-kinematic data /radius of curvature of the cam/. The kinematic problem contained in this set of cards is automatically

solved by the computer, which process the shape of the cam and defines it as a series of lines, segments, circles, spirals etc /geometric types that can be interpolated by the electronic control system of the machine tool/.

- machining data, such as "setpoint" and feed back rate of the cutter,
- sequence of operation including, besides machining of cam profile, rapid horizontal and vertical traverse of the tool and execution of other operation, such as marking, drilling, milling etc.

The author also got acquainted with the NEL 2, L Processor by Numerical Control Division, National Engineering Laboratory, East Kilbride, which can be used to assist in preparation of control tape, and with milling machine AUT 40A/460 CNZ "Olivetti", which has been controlled by punched tape.

The System 360 AD-APT language and processor.

The IBM ADP-APT system is composed of a language and a processor. The AD-APT language is used to describe the part as shown on an engineering drawing. This description takes form of a sequence of statements defining the part geometry, required machining operations, and auxiliary functions. These statements, written on coding sheets, become the part programmer's manuscript/or "part program"/, which is used as a source document from which the statements are punched into cards/in either BCD or EBCDIC/; The AD-APT processor converts the statements into an intermediate format and performs the required calculations. By means of a user-supplied postprocessor program, the intermediate data is then converted to instructions that can be read by the machine tool controller.

An AD-APT part program consists of statements and data in the language recognized by the AD-APT processor. Using this information, the processor, in conjunction with a postprocessor, performs the required calculations to produce machine-readable instructions for the numerically controlled machine tool.

The AD-APT processor is a collection of computer programs which process the AD-APT part program and calculate the required cutter path. The processor is composed of four major parts:

- section 0 - /control section/. This section performs all input data and output functions and performs supervisory tasks /as in the transfer of control to each of the other major sections/.
- section 1 - /input translator/. This section validates the part program statements and translates them into a numerical format for subsequent processing by other sections. All geometric definitions are reduced to their canonical forms, and mathematical computations are performed in this phase of processing.
- section 2 - /arithmetic element/. This phase calculates the required cutter-center path. Calculations are made to determine the offset which are required to allow for the cutter shape and size to develop approximations for curve sections within the required tolerances.
- section 3 - /editor/. This section of processor performs the calculations for transformation of cutter coordinates and lists the the output files as requested by the part program.
- section 4 - /postprocessor/. This phase calculates cutter motions and feed rates as required by the particular machine tool-controller combination. The postprocessor also interprets machine tool function commands.

The input to the AD-APT processor is a part program consisting of a collection of AD-APT statements set forth in an ordered fashion. AD-APT statements are used in order to:

- define scalars and geometric entities,
- describe a cutter path,
- describe auxiliary machine tool functions,
- define machining parameters.

This part program statements are punched in 80 column cards.

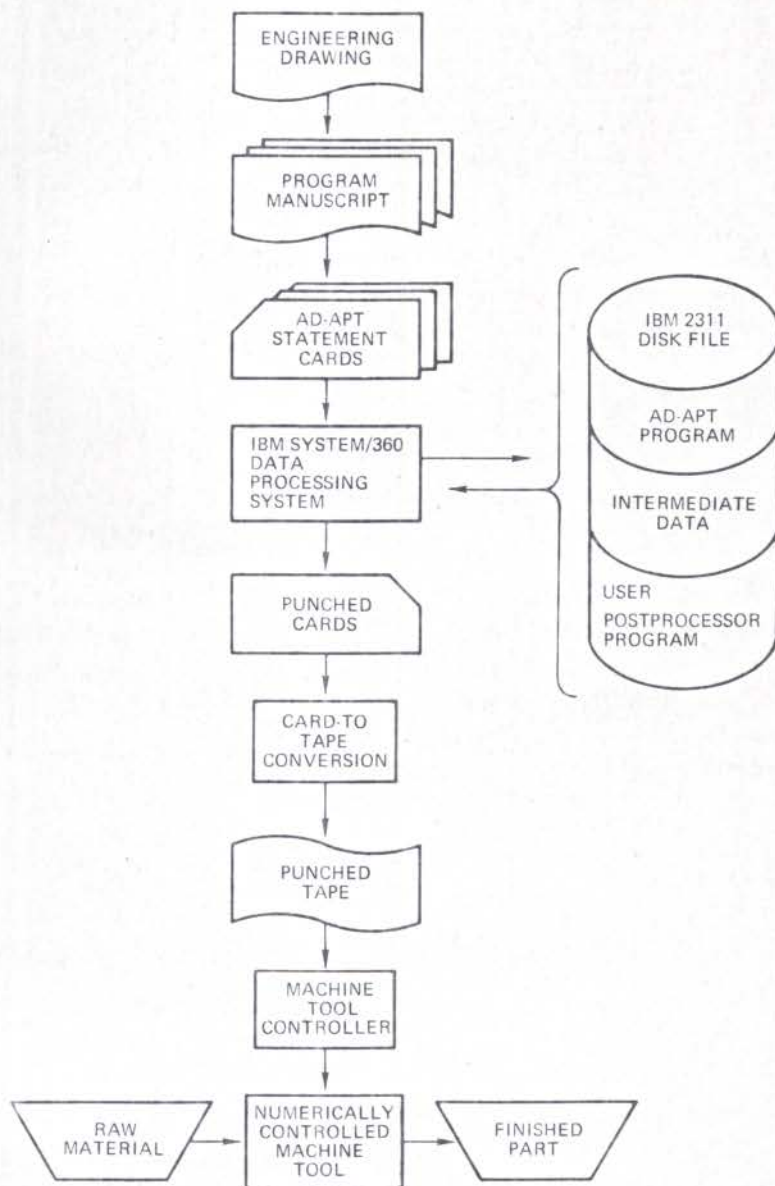


Figure 1. AD-APT system flowchart

During study at IEI, the author visited also Centro per l'Automatica "Enrico Piaggio" - Università di Pisa, where the author's interest were:

- adaptive control of metal cutting process for milling operations,
- "off-line" optimization of parameters of cutting.

In the test installation for a research on adaptive control, a time-shared IBM 1800 computer operates as adaptive controller for a numerically controlled machining centre. The simulation studies are developed in order to test the convergence and stability of the control loop. In the installation are used a special instrumentation for measure of bending and torque of the cutter, which data are necessary for optimization of spindle speed and feed rate during all the path of cutting. The analog inputs are connected, through a multiplexer, to the A/D Converter Unit, which converts voltage or current signals to digital values. The computer can also receive binary informations represented by contact closures or changes of voltage levels. The analog voltage outputs, coming from D/A Converter Unit, are available with the option of driver amplifiers, to provide low output impedance to match a wide variety of loads.

The digital outputs are in form of contact closures, pulse trains and digital values of 16 bits.

Two different simulation procedures have been considered:

- simulation of the performance of the closed loop by using the Continuous System Modeling Program for IBM 1130 computer;
- simulation of cutting process and of machine tool dynamic by an analog computer, which is closed in loop with process computer.

The first mode allows to check and compare the optimization strategies, the last is useful in order to test the control routines of the process computer and the A/D and D/A instrumentation.

3.5. University of Naples, Institute of Agricultural Economics Portici.

During the author's study at the University of Naples, he got acquainted with works, which ~~was~~ carried out by the Institute of Agricultural Economics at Portici in cooperation with Council for Advanced Training and Research in Agriculture, Ministry of Agriculture and Council for Development of the South. The Institute main works have been aimed at the methodology of agricultural extension and development in Italy, specially in the south regions of country. The staff of the Institute has been working on preparation of two projects - one for management of small farms, the second one for medium and large-size farms.

During his stay at the University, the author's interest were:

- methods of application of economic rules in agriculture organization,
- methods of evaluation of farm efficiency,
- methods of comparison of different farms with similar natural resources,
- simply accounting system for small farms, which had been tested on IBM II30 computer;
- input = yearly information about resources, performed activities and expenses /for the 1st of October/,
- group analyse,
- output = information for the farmers about changes, to be necessary as well as analyse of unit costs /fixed and changed/,

There were also provided further activities such as:

- help in planning, by using linear programming, for representative farms,
- organization of experimental telephone network for information requirement purposes,
- simply accounting system - from the financial point of view - for big farms.

3.6. University of Bologna, Faculty of Agriculture.

University of Parma, Faculty of Economy and Commerce.

University of Bologna, Faculty of Agriculture Computer Centre has been equipped with IBM II30 system and has been working both for educational

and research purposes. The research activity has been sponsored and supervised by the National Research Council /CNR/. At present, the research activity besides, there are operated an information system for about 600 farms /70.000 HA/. The input and elaboration frequency varies from 1 month to 3 months and depends on size of the farm. After about 10 days the following information, as a system output, are sent to the farmers:

- list of input information /daily/,
- performed activities and their costs, according to crops, machines, labor /a kind of simple general ledger/,
- production costs:
 - ingredients /unit costs/ for each final product,
 - total cost,
- costs differences among similar farms of group and differences analyse
- medium /average/ production costs of the groups of similar farms.

For the very small farms, from which detailed information are not available, output information is more simple and concerning general data about farm structure and performed activities only.

Above mentioned output information are interesting for farm owners mainly from the point of view of estimation of efficiency of their farms and as a help to decide on necessary changes, to increase the activity profit. The yearly charge paid by the farmers depends on the farm greatness and amount lit 700/ha.

The same activities are carried out at the University of Parma.

The main fields of interesting there are also cost accounting as well as comparison of production costs and efficiency of similar farms.

3.7. National Institute of the Agricultural Economics /INEA/ - Rome.

The National Institute of the Agricultural Economics Computer Centre has been working for the National Council for Research and has been equipped with IBM 360/5 system /16K, 4MT, 1 disk/ and during 1974 a new IBM 370 family system will be delivered to the Centre. Now, because

of the great number of input information, and shortage of technical facilities, main part of data have been calculated at the University of Rome Computer Centre. The system which has been operated by INEA is not destined for statistical purposes, but some summary information are sent to the European Common Economy Headquarters /Agricultural Division/ at Brussels /Belgium/. In the INEA Information System input information are delivered from about 4500 farms all over the country, which are considered to be representative for whole Italian agriculture, and there is planned to increase this number up to 12.000 within nearest 2-3 years.

During filling in data forms, the farmers are helped by the technical assistants /about 350 people, not working for INEA only/ who also transfer ready forms from farms into "compatibility offices" /12 offices/ in which information are checked and completed and all necessary codes are put on the delivered forms. There are used special input information forms:-

- for start inventorying - yearly information,
- for financial data /diary of spends and incomes/- collected each month for a number of farms only,
- for human labor/hours per day for each activity and each employee/- monthly information,
- for machines exploitation - some farms only.

Month after month above mentioned information are collected and updated and at the end of the year /practically during October or November/ data are processed and following output information are sent to the farmers:

- list of undertaken activities,
- list of all costs and incomes,
- balance:
 - total income netto,
 - direct costs of each productive activity,
 - non-divided costs.

3.8. "Nuovo Pignone" Industria Meccaniche e Fonderia - Florence

Nuovo Pignone - medium range mechanical plant and iron-foundry, produces various metallurgical fittings, such as pumps, tanks, fuel distributors, gas-meters etc.

The factory computer centre has been equipped with IBM 360/50 System, both for calculations /20%/ as well as for accounting, jobs and industrial management /80%/.

During his stay at the factory, the author's interest were:

- stock control- quantity control, average prices, movement of the items, emission of the bills of materials for raw-materials and products, emission of the purchasing requests and checking certificates /by procurity dep./, orders statistic, raport on expected but non-arrived materials from vendors.
- job management- planning of machines operations /15 days in advance/, planning of working-cycles and work of shifts, application of the PERT network, job cards emission, job orders realization control.
- costs accounting /bases on the job cards/- direct costs of production accounting /materials, jobs, general expenses, extend costs, unexpected costs/, comparison of expected costs /according with the contracts/ with real costs.
- payroll- plus list of social charges, over-hours list, total work-hours of the plant, emission of the clock-cards for employees, some summary information for tax and insurance purposes.
- general ledger accounting- daily records of incomes and expenses, check budget, invoices realization control, production costs.

3.9. Short visits

a/ "Solari and C." Industrie Orologerie Speciali e Apparecchi Elettromeccanici - Udine

The Solari plant is a medium range precision mechanics factory specialised in production of large watches and balances for industrial application as well as production of electrical measu-

re instruments:

The Solari information systems concern with such problems as:

- stock control,
- costs accounting and general ledger,
- personal evidence and payroll.

Input information are collected usually daily. Data are calculated with various frequency /mainly monthly/, and besides output information, summary data are memorized for statistical and control purposes.

b/ Agenzia Regionale Dati - Milan

The subjects of the author's interest were computer applications in agriculture. The author was interested in computer using both for planning and control of the agriculture activities, as well as for evidency and statistic of the activities performed. The Agenzia activities have been concerning mainly with production costs accounting and costs differences analyse for similar /or comparable/ farms. There are also interest in the comparison of activity results of the farms with similar natural resources. Input information are available from a number of farms from the north regions of Italy, which farms are considered to be representative. Output information are destined for farms owners only but summary information are sent to the authorities.

c/ University of Padova, Faculty of Agriculture

The University of Padova activities concerning computer application in the agriculture, specially for evidency and accounting purposes. There have been also attempts to solve other agriculture problems, such as cattle feeding and programming of field activities, but there haven't been on the working stage yet. The input information are delivered from few representative farms only. In the future, the system will be enlarged for a greater number of farms.

4. The application of the information gained during the fellowship.

The author considers the study performed during his stay in Italy as particularly useful in his further work in home country. This is due mainly to the study of the methodology of problems solving and to the study of the organization of systems which are run in different industrial, commercial and agricultural organizations. The author's meaning is, that the study during the fellowship has provided the unified approach, which seems to be very useful in the analysis and synthesis performed for the application of information-processing computer systems in different organizations. The information about Italian achievements at the field of computer application for solving agricultural problems, will be very useful to prepare the agriculture EDP system concept for Poland.

After his coming back to the home country, the author desires to publish the detailed report for each stage of his study in Italy, and to participate in the seminars on this subject as well as in the meetings with Polish systems engineers.

5. Final note.

The author would like to express his gratitude to:

United Nations Economic Commission for Europe

Technical Assistance Office

Geneve, Switzerland.

Istituto Nazionale per l'Incremento della Produttività

Rome, Italy.

International Business Machines Corporation - Italia

Milan, Italy.

Istituto di Elaborazione della Informazione

Pisa, Italy.

Krajowe Biuro Informatyki

Warsaw, Poland.

Zjednoczenie Informatyki

Warsaw, Poland.

and particularly to:

Dr A.Lusignoli	- INIP, Rome,
Dr M.Begani	- INIP, Rome,
Dr C.Baggio	- IBM Italia, Milan,
Mr L.Tarlarini	- IBM Italia, Milan,
Mr C.Turinetto	- IBM Italia, Vercate,
Prof.G.Capriz	- IEI, Pisa,
Dr J.Kardasz	- IEI, Pisa,

for organization of his study and for help during his study in Italy.

Stawomir Hoen

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Mrs. Shoukletovich

Training and Fellowship Programme Section,
Office of Technical Co-operation, New York



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of the Technical Assistance Office
of the Economic Commission for Europe*

TECHNICAL ASSISTANCE OFFICE
Economic Commission for Europe
UNITED NATIONS

Date of award:
19.6.73 - 15.9.73

Name and home country:

Mr. B. SZCZEPANSKI, Poland

Field of study: Modern designs and exploitation of
high-parameters steam boilers in power plant
systems.

Country (ies) of study:

United Kingdom

UNITED NATIONS FELLOWSHIP IN THE UNITED KINGDOM

FINAL REPORT AT THE CONCLUSION OF MY PROGRAMME
STUDY IN THE UNITED KINGDOM

1 Fellowship has been granted by the Bureau of Technical Assistance Operations, a unit within the Department of Economic and Social Affairs of the United Nations Secretariat, under the authority of various resolutions of the United Nations General Assembly, in period from 31 May to 24 August 1973.

The place chosen for my studies in the United Kingdom was the South of Scotland Electricity Board Power Station at Cockenzie.

I arrived in the United Kingdom on 19 June 1973. My arrival was delayed due to certain formalities in the issue of visas and, as a result of this, my study period in the United Kingdom was extended to 15 September 1973.

2 Personal Responsibility in my home Country.

Management, administrative as well as economic and technical, of the Department of Steam Boilers Equipment Construction.

3 Problem in my home Country which led my Government to nominate me for a United Nations Fellowship.

3.1 Modern designs and exploitation of steam boilers and auxiliary installation.

3.2 Organisation and technology of steam boiler renovation.

3.3 Technology of production in prefabrication plants:-

- (a) organisation of work.
- (b) extent of prefabrication.

3.4 Assembly of steam boilers and equipment in Power Stations:-

- (a) acquaintance with technology.
- (b) regulating measuring works.

3.5 Questions connected with the normalisation and classification in boiler works.

4 Progress of my observations.

My observations took place in design and exploitation of high parameter steam boilers in power plant systems at the South of Scotland Electricity Board Power Station at Cockenzie. This Power Station is of the latest design in construction, installation of units, organisation of work and exploitation. The Station is one of the largest in Scotland and has an installed capacity of 1200 megawatts.

There are four identical high-capacity units, each consisting of a single boiler and 300 megawatt turbo-generator. The units are separate except for the necessary interconnections between the electrical outputs for feeding into the Grid System.

Electricity is fed into the Grid at 275kV.

Some 136000 m³ an hour of chlorinated seawater are passed through the steam condensers for cooling purposes.

At full output the station consumes some 12000 t of coal daily.

Almost/

Almost all of the 2800 tons of ash and dust that accrue daily when the station is at full output is used to reclaim land from the sea.

There are 22,000 tons of structural steelwork in the main building, which is approximately 244m long by 137m wide and about 61m high. Each of the two brick-lined concrete chimneys is 149m in height, with an external diameter of 13.233m at the base to 8.2m at the top.

Each of the single-furnace radiant boilers produces a total of 930 t of steam per hour. The temperature and pressure of the steam leaving the superheater section of the boiler are 568°C and 169 bar respectively. After expansion in the high-pressure cylinder of the turbine, the steam is reheated to its original temperature.

Each of the four 300 megawatt units is monitored by a data logging set which is a small special-purpose computer consisting basically of a central processor, magnetic-drum memory and ancillary input, output and operating equipment.

In the six year period since the commissioning of the first unit, problems in construction, operation and maintenance have been investigated and remedied and I have learned of these faults and the remedial measures taken.

During my period at Cockenzie Power Station, major overhauls have taken place, although a constant check on plant takes place in order that modifications to improve the performance of plant may take place.

According to my training programme prepared by the British Council and the South of Scotland Electricity Board, I have become acquainted with the organisation of Cockenzie Power Station, and in particular with:-

Operations Department: Plant Efficiency, Monitoring and Control
Maintenance Department: Plant Maintenance and Major Overhaul
Technical Resource and Laboratory
Planning Department and Stores

During the period of my stay, certain maintenance work has been carried out by various highly skilled companies. I had the opportunity to make contact with these companies and learned the organisation and methods of work and technology, extent of prefabrication, spare parts and organisation of work in various other steam Power Stations.

I also received an offer to visit companies who provide services at Cockenzie Power Station and who during my stay had not been present at Cockenzie. These included:-

The Central Maintenance Team, South of Scotland Electricity Board
The Metallurgy Laboratory of Stress Analysis and Structural Design, South of Scotland Electricity Board
Parsons Peebles, Electrical Engineers

Cockenzie Power Station provided me with technical information with particular reference to my field of study and arranged for me to meet with experts in this field.

I received an allowance to purchase technical books and publications necessary for my study programme and obtained the following:-

- (a) Steam, its Generation and Use - Babcock & Wilcox
- (b) Modern Power Station Practice, Operations and Efficiency

5 Statement covering the programme of observation and study devised by the United Nations and the host Government

I believe that the programme prepared by the British Council and the South of Scotland Electricity Board fully covered the recommendation of my Government and I am grateful for the opportunity given to carry out this programme.

6 Value of training as applied to my field of study and its application in my home Country

6.1 Higher professional efficiency as a result of familiarisation with the fields of modern designs and exploitation of high parameter steam boilers.

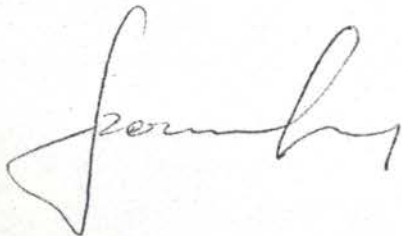
6.2 Applying the information obtained in the application of modern technology in maintenance and assembly of steam boilers in power stations.

6.3 Applying the information obtained to the production organisation as well as the effective application of tools and machinery.

7 During my stay in the United Kingdom I encountered friendship and help from the people who organised my programme, the people with whom I worked and with those I met casually.

In conclusion, I would like to express my sincere thanks to the employees of the British Council and the South of Scotland Electricity Board, and in particular to those at Cockenzie Power Station for their friendship and co-operation during my period of study there.

My studies at the South of Scotland Electricity Board's Cockenzie Power Station were completed on 7 September 1973. I leave for London on 8 September and return home to Poland on 15 September.



Bohdan Szezepanski
United Nations Fellow in United Kingdom

7 September 1973

BS/AJ