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About 25 years of the National Instrument and Measuring Technique Centre of the Hungarian Academy of Sciences

Dr. GYULA STOKUM
C.Sc (engineering), Director

30 years ago the Presidium of the Hungarian Academy of Sciences, in its resolution (1) declared its decision according to which the solution of such tasks as the provision of means creating a practical background of the scientific work, the solution of the problems of measuring technique should be centralized. (This resolution is considered as the first written document aimed at the establishment of our Centre.) Fundamentally, these tasks were the following:

- The operation of equipment in central laboratories which are available for any research worker (e.g. the Electron Microscope Laboratory situated at the time in the Faculty of Natural Sciences of the University „Eötvös Loránd”).
- Periodical hiring of smaller instruments, first of all for research laboratories of the Academy.
- Assistance to costumers who are not experts in measuring technique, by the way of consulting service.

Through many years these questions got an increasing importance. This is proved by the fact that in 1957 the department acting in the frame of the Instrument and Measuring Technique Institute of the Hungarian Academy of Sciences was organized to an independent institution, i.e. to the National Instrument and Measuring Technique Centre of the Academy of Sciences. This happened just 25 years ago. On these pages we should like to give you an overall view about the development in these 25 years. The following articles will offer a brief survey of some special fields of our activity.

First of all, for sake of completeness it is advisable to present you, however, the development of the Centre as a whole.

Establishment of the Centre (1957–1966)

When the Centre was established, it settled down in premises available at Martinelli-square. From the very beginning two main fields of activity of the Centre were the hiring of instruments and the consulting activity. Its independence opened up greater chances for a more comprehensive and higher quality work but also involved the necessity of independent economy and the demand of harmonizing its services suitably with the research works of the Academy.

It has to be emphasized that the first ten years were – as a matter of fact – the period of seeking the ways and means. It can be said that the Centre in its kind is the first one all over the world, consequently, it could not rely on previous experiences either in evaluation of results or in solving the problems and in selection of the ideas for development, but only on the assistance of its superior organ, and partners and on the sense of vocation and diligence of its staff.

The initial conception of the activity practically borne the character of a research institute. The tradition of the predecessor institute on one part, and the close co-operation with the partner-research institutes on the other, diverted the character of activity to this direction. The Centre tried to display its activity as a measuring technique department for its all partner-institutes and institutions, which demanded a very flexible adjustment to the most unexpected requirements. At the same time this afforded an opportunity for the Centre to collect valuable experiences about the demands arising during the research-development work, about the possibilities of their fulfilment. Such cases were, e.g. when temperature distribution had to be measured by collecting 100 pcs of multi-channel recorders, or when a control of demands of research workers had to be encouraged at the initial steps of the application of laser technique. The high-speed recording, repair, service-activity, research filming, the foundation of the National Instrument Register, introduction of vibration measurements all meant a separate phase of development of this way and means-seeking work.

In this initial stage the Centre developed rather rapidly. From 10 persons in the 57-ies its number has increased to 61 persons by the 66-ies, with further 36 outside research workers. In 1966 the stock of the instruments on hire exceeded the value of 110 million forints; the collection of the technical library regularly consisted of 60 journals of capitalist, 13 of socialist and 18 of home origin.

In the first 10 years the Centre proved its usefulness and the conception of the Academy which established it. It established excellent partner-relationships, one can say, it won the first battle. It should be, however, clearly revealed that by its all results the initial conception coped already at the beginning with serious problems, first of all with the following ones:

1. *Efforts to meet any and all demands.* This followed inevitably from the fact that – due to its character – the Centre acted among others as a department of its partners and on the other hand it got manifold and a great number of commissions through its outside collaborators.
2. *„Prime cost character” of the Centre.* At the very beginning this highly promoted the spreading of the use of the Centre, at the same time the custom of „lasting hiring” cut the investment costs of the partners – to the detriments of others – and gave a preference to them: in case of purchasing the instrument higher assets had to be paid, than the hire fee of instruments hired from the Centre.
3. *Lack of infrastructure for main activities.* The main fact was: problems of the own repair workshop (much loss of time brought about the sending abroad of the instruments for repair or guarantee repair, being for the most part imported ones), insufficient place and auxiliary staff (storage of instruments, placing of service laboratory, extension of library, etc.).
4. *Limited possibilities of development.* The above described problems of the conceptions derived from the conception itself. A viable conception of a research institute demands to centralize the activity to a restricted professional field, to given research aims. In this case the personal and material concentration can be realized successfully and the economic preconditions of the work can be created. At the Centre this professional field was, however, quite expansive including any aim of research while its resources and possibilities were limited. Therefore in the later stage of way-seeking a conception of development even could not have been formed as the low rate of development of the staff and means devoted to all purposes proportionally would not have been enough even for the maintaining of the existing level and the maintaining of the character of a research institute did not allow selection among the great number of requirements.

From the middle of the sixties the contradictions of the situation became evident, and the ending of the way-seeking emerged as a necessary and timely problem. The essence of the new conception: *The*

Centre should have the character of a service and not of a research institution. By the new conception we could overcome the main contradictions:

- The Centre envisaged the constant and high-level fulfilment of the determined demands (to be met favourably centrally) instead of meeting all demands of the partners.
- The fees of the services increased so covering self-support, maintenance of the instrument park and development. This afforded the opportunity to prefer short-time hiring instead of the practice of „lasting hiring”.
- The restriction of the number and kinds of the main activities made it possible to develop the infrastructure necessary for the efficiency of the activities to suitably extend an on required level.
- The development enabled demands and available resources to be harmonized.

Owing to the new conception the new phase of development started.

Initial steps of present development of the Centre (1967–1976)

In the practical realization of the service conception the rational principle of progressivity was fully adopted. While previously the structure of the Centre was distributed functionally (See Fig. 1) the new structure was distributed to main service activities.

Out of these main activities the field of *consulting activities* demanded the least structural change. Up to this time this also had been an independent organization. Inside its activity, however, the main points had changed. As compared to the preceding years the proportion and absolute quantity of detailed consulting work in solving measurement problems of research workers decreased, as this – in certain cases – could have required an active participation in the research work itself. There increased, however, the importance of the consulting work concerning investment and procurement (so-called „background information”). In this new distribution the direct measuring problems had regressed and shifted over resp. These tasks were taken over by the education institutes, faculties, laboratories and experts, further research development institutes, enterprises and their experts resp. Parallel with them and with their co-operation, however, the maintenance of an other such service at the previous level became anachronistic.

The National Instrument Register, set up at the initiation of the Central Planning Office (basis of procurement, hiring, consulting work) began a remarkable development, has become more up-to-date since 1976. On basis of the order of the secretary-general of the Academy of Sciences the National Instrument Register was organized on basis thereof.

The regular publishing of the *Instrument and Measuring Technique News* is also worth mentioning, having an important role in the propagation of information of public interest.

In this period *instrument hiring* became an independent main activity. Here – as an essential and important structural alteration – we can mention takeover of the coordination of activities being in close connection with hiring (storage, transport, measuring, repair) from the Technical Provisional Department with its respective sections. The new department was in a position to manage – within its own framework – the means of its own instrument park and of that mobilized through cooperative hiring.

In this period – especially at the beginning – a firm basis of realization of the new conception was the Instrument Hiring Department. The new service oriented conception brought about the greatest change in the field of *measurement-service activity*. All the material testing, the colorimetry and the spectroscopic laboratories stopped their activity, in the first half of 1967 only two laboratories existed out of the six ones having operated yet in the first half of 1966 in the framework of the Instrument Hiring, Service Department. The new Measurement-Service Department dealt, however, with repair, too, taking over the service activity (Reichert) which formerly had been carried on there. The Research Filming Laboratory with its professionally closed field (the Laser-laboratory already separated before 1967) steadily developed during the whole period, preparing the realizing of the conception of the National Research Filming Centre. Alto-

gether, in this ten-year period the chief activity of the Centre – the measurement-service – has advanced and has been concentrated to a great extent.

- a) *Measuring Technique and Instrument Development.* In the framework of this activity the Centre undertook elaboration of measuring methods, conducting of measurements, construction of special instrument and equipment – or optional combination of all these – though within the limits of the service activity but fundamentally by research work and realization of routine service (e.g. vibration measurement), on the basis of outside orders and commissions.
- b) *Research-filming.* The Research Filming Department and the National Research Filming Centre acting within its framework granted – on its professional field – the services detailed in subpoint a) and lended methodical and practical assistance in introduction and application of the latest methods and means of research-filming technique, in propagation of its use. Over and above this, they nursed and developed our international relations, by harmonizing the purposes. The social recognition of their work is proved by the fact that the head of the Research Filming Department has been for several years Deputy Secretary-General of the Optical-Acoustical and Film Technical Society of Technical and Natural Science Association.
- c) *Brand-service activity.* By improving further its former successful repair and service activity (first of all for sake of maintenance of good running order of the own instrument stock) by systematical and resolute work the Centre set up one of the biggest brand-service centre of imported instruments in the country. In 1977 the Centre represented already 13 foreign firms; having organized consignment stores, repair times were cut substantially. The scope of repaired and serviced instruments was extended. All these contributed to the more effective operation of the home instrument stock to a very remarkable extent.

**Establishment, stabilization of preconditions
of the new conception, formation of the country-wide
character of the activity**

Precondition of the above outlined development was the fundamental improvement of the infra-structural background. The first, initial step in this course was the rearrangement of internal forces and resources. The main objective was to concentrate the staff- hitherto scattered into most different sections. In this respect a decisive change was the moving of the Centre – after 17 years – from the old outgrown premises on Martinelli square to the present central premises situated on Lenin street. In the new place the Instrument Hiring Department, the Consulting Activity, the economic sections and the maintenance workshop could be satisfactorily accommodated. Owing to the old and new place the required pace of development of instrument service could be eventually reached. So could be secured – for approximately 6–8 years – the advance of the Centre and its activity in spite of the separate accommodation of the Research Filming and Investment Department.

Realization of preconditions of development, the exerted planned and successful work allowed for the Centre to take part in the national instrument and measuring technique activity more and more effectively. Over and above the foundation of Secretariate of the Instrumentation Committee of the Academy of Sciences in the framework of the Centre – the Committee of Science Politics recognized the potentialities inherent in the activities of the Centre and trusted the Centre to fulfil important tasks.

In its resolutions it dealt with the promotion of better economy of instruments, modernization of the National Instrument Register, the 10-year development program and the construction of a new central service house. The main point of the 10-year development was to bring the main activities of the Centre into harmony with national demands, and to realize them from national sources. In 1976 the Committee of Science Politics adopted a resolution for the foundation of the National Research Equipment Committee –

to be an instrument measuring technique, consulting, advisory corporate body. According to this resolution the director of the Centre became Secretary of this organ and the Secretariate of it was put up in the framework of the Centre in Summer, 1977.

Recent phase of development of the Centre (1977–1982)

The first ten years of the new, service conception brought the expected results; it secured the proportional development both of the Centre itself and of its main individual fields of activity separately. By the end of the second decade the unfortunate contradictions existing at the first 10 years' end could be eliminated. In the years having passed since that time nothing stood in the way of the full realization of a service conception.

At present the Centre is an integrated, complex institution of measuring technique, able to fulfil the nationwide tasks – mentioned in my introduction – on a high level. The basis of integration is the ever increasing, high-level meeting of the national demands of instrument economy by our services, repair and improvement.

Out of the recent phase of development in chronological order we would highlight the following events:

- 1977* On the basis of the respective resolution of the Committee of Science Politics the Instrument Hiring Department prepared itself for the increase of the service instrument stock. The Service Instrument Committee has begun its activity. On the basis of the commission they also begun the small-scale processing of „brought” measurement data. Upon foreign commission a dielectric strength testing instrument was constructed. On the basis of a brand-service contract, the repair of instruments of the firms Opton and Gould Advance was also started. The construction of the new recording room in the Research Filming Department was also ended. In May the Research Film' 77 preview was organized in cooperation with the Optico-Acoustical and Film Technical Association by the participation of 13 foreign countries. Started its activity the Archive of Films for High Level Education and Research, there was continued the organization of the National Instrument Register processed by computers. The Instrument and Measuring Technique News issues were expanded by Russian and English publications. On the basis of the resolution of the Committee of Science Politics there was established the Secretariate of National Research Equipment Committee and on the basis of Secretary General's resolution (Hungarian Academy of Sciences) commenced its activity the Secretariate of Instrument Committee of the Academy of Sciences. Still some remarkable work had been carried on in connection with the detailed designs of the new premises of the Centre and the rules of its activity.
- 1978* The list of the „Loan instruments 1978” was edited. On the basis of a special commission we conducted the dynamical test of the Margaret Bridge in Budapest. In the Research Film Department a light-sounding device was put into service. The test operation of the National Instrument Register processed by computers started. The modernization of the instrument prospectus collection – unique in the country – was also started.
- 1979* The JEOL electron-microscope service was established and the practical work commenced. The stock of the Archive of Films for High Level Education and Research acting in the National Research Film Centre has grown considerably richer, by the increasing of the stock of the Scientific Research Film Service in Paris and by obtaining several, prize-winning films of the 8th Budapest Technical Film Festival. With the intervention of the State-Owned Computer Service started the large-scale operation of the computerized National Instrument Register. The Secretariate of National Research Equipment Committee assisted to organize the instruments files and elaborated various aspects for this. For the preparation of investment of instruments the Secretariate of the Instrument Committee of the Hungarian Academy of Sciences gave a detailed information to 50 academic research spots.

1980 The catalogue titled „List of instruments on hire 1980” was edited. On the basis of the commission of the Ministry of Transport and Communication we tested the dynamic change of state of 15 provincial and capital bridges. In the Cardio- and Blood-Vessel Surgery Institute of the Medical University „Ssemelweiss” we contributed to the research work by research films shot about infarcted territories of the human heart. There was edited „Film catalogue 80” specifying films can be loaned. A second terminal was put into work connected to the data stock of the National Instrument Register in order to directly help consulting work. On the basis of the resolution of the Commission of Science Politics a separate work team of the National Research Instrument Committee was founded in order to promote the more effective so called cooperative loaning activity in the framework of the Centre. The Instrument Committee of the Hungarian Academy of Sciences examined the questions of material-, spare part- and service supply of instrument operating in the field of the Academy. The Service Representation Department fulfilling rather increased tasks moved to the building destined to solve temporarily its rooming problems.

1981 The Centre participated in the Budapest International Spring Fair with much success, showing its sphere of services. We elaborated an acoustical and correlation signal analyses method for fault localization of heat transmission lines. We carried out the dynamic pressure test of a water transmission line between Pécs and Mohács along a track of 40 km. By 1st July, 1981 the Acoustic Research Laboratory joins to the Centre, where it deals with research, development and designing. The Instrument and Measuring Technique News are sent regularly already to more than 1000 addresses. With the consent of the Commission of Science Politics, in cooperation with the National Research Equipment Commission the Centre prepared measures for the increase of the so-called cooperative hiring, the drawing up of the National Instrument Service Register and the National Free Instrument Capacity Register. The Secretariate of the National Research Equipment Commission also participated in the preparation of two further proposals (improving of material, spare part and service supply of instruments, examination of the necessity of the Instrument Committees of the Ministries). The Secretariates of the Committees and the Consulting Department got under common direction which resulted in better co-ordination and more effective participation of the Centre in the national target. The construction of the Centre building was commenced.

1982 By organizational measures we widened the possibilities of measurement-service, instrument development and research work. Registrations for the National Free Instrument Capacity Register were started. The Centre participated also with great success in the Budapest International Fair of 1982, and in the 9th Festival of Technical and Model Design Films. The Centre building is being constructed further. Summarizing the development of the recent years we can come to the conclusion that the starting of the construction of the Centre premises, the internal reorganizations serve the preparation of a new more perfect phase. Development of our main activities can be characterized by the fact that in 1981 we hired almost 3/4 of our instrument stock worth 265 million forints. By our measurement and service activity we fulfilled abt. 1500 commissions, our film technical services were granted on 200 occasions and in 1981 we gave professional advices to our partners more than 350 occasions. Our instruments, service activities, measurement, instrument development, research work, background information are demanded, utilized by almost all branches of industry and other institutions. Our work is closely connected to the instrument and measuring technique activity exerted in the framework of the national-wide conceptions of the Ministries, the National Research Equipment Committee and the Committee of Science Politics, and through this to the promotion of the research-development work upon which nowadays a great stress is laid.

Staff of the Centre

Up to now, on the occasion of the anniversaries our review have borne always and „impersonal” character. It should be emphasized however, that the successfulness of our 25-year activity cannot be treated separately from the efficient work and efforts of our staff. From those, who are working with us even today, those, who left us – due to other commissions, reorganization, retirement and those from whom we had to part for ever.

However important the above mentioned results are, as a matter of fact they are partial ones only. As main result promoting all the above mentioned success should be considered the bringing into existence of the Centre staff. Both by decades of work, education of own people, creating better labour conditions, by their continuous improvement, by securing professional and political extension training, study of languages, relaxation, culture, sporting possibilities, likewise by the thorough selection and backing of the quick and successful adapting of our new colleagues we endeavoured to promote good fulfilling of this great task. The management of the Centre has cooperated always in harmony with the social organs, with the party organization, trade union, and KISZ (Young Communist League). The Centre always has assisted its workers in developing the knowledge and skill in obtaining new knowledge and to actively lend a help – by this knowledge – in the professional, economic and research work of their colleagues and of all those who turned to the Centre for advice.

In order to illustrate all the foregoing, I refer to the data of the year 1981: The distribution of persons participating in various courses and training was the following:

- language course – 54 persons
- service training – 55 persons
- courses of engineer extension training – 4 persons of Budapest Technical University
- secondary (technician) and lower (skilled worker) education – 13 persons
- manager training – 1 person
- ideological lectures – 23 persons
- higher political training – 11 persons
- state education (primary and secondary school) – 6 persons

Our workers took an active part in the publication and social works. Some characteristic data:

- 17 monographical issues were published
- 19 lectures were held in home, and international programs
- a great number of our workers took an active part in the activities of the Society of Instrument Technique and Automation Science, Society of Optic-Acoustic and Film Technique, Society of Organization, Management and Science, Scientific Society of Information.
- Our workers also took part in preparation and publishing of home and foreign publications (books, journals, conference volumes, etc.)

Many workers took the opportunity of the preferential rest possibilities granted by the Academy, trade union and the Centre (in Mátra and at Lake Balaton). In no one case took part our colleagues in our common programs together with their families (professional and political lectures, processions, common excursions, cultural and sporting events.)

Our future tasks

Following this brief introduction of the development of our Centre and our Staff, last but not least we have to mention that consequent and constant help lended by our superintending organs – by the Academy, other organs (acting in the National Research Equipment Committee) by party- and governmental organs – among these – by the Committee of Science Politics – recognizing and admitting the difficulties of

our work and development. In another respect, in other fields a valuable and indispensable assistance has been rendered by those several thousands of specialists whom we have cooperated and cooperate at present.

All this help – for which, seizing this opportunity we express our thanks – remains, even in the future, an important, indispensable factor in the continuation of our successful service work contributing to the successful activity of the whole people's economy. Our future tasks are:

- more effective operation of the Centre's and the country's instrument stock (by narrowing the non-desired wide assortment, by improving the material, spare part, auxiliary material supply and service, organization of better utilization of instruments, by coordination of procurement and sorting out activities on basis of uniform principles);
- to meet the demands for instrument hiring more perfectly (by suitable development of the stock of the Centre, by availability of special instruments in form of cooperative hiring and/or measurement service, by country-wide registration of the free instrument capacity, etc.) instead of purchasing.
- modernization, development of research filming, existing instruments.

All these are tasks aimed at innovation for the fulfilment of which the Centre has bound itself during the last 25 years and the fulfilment of which demands heavy efforts by the unfavourable economic circumstances all the more, as the importance of these tasks has considerably increased, precisely in order to obviate the non-desired consequences of the unfavourable economic conditions.

These duties can be fully tackled during a long period only, naturally by the creation of cooperation of the above-mentioned public organs and many-many thousands of technical and economic specialists acting in research, development, control, qualification, production. Although the tasks themselves are long-term ones, even a part of them devolved to our Centre in each year is so great which required from each of our colleagues more effective work and serious responsibility. Among these I would not mention more than the efforts to overcome the financial, foreign exchange, organization, construction, investment, coordination and other problems arising during building up of the new service house, development of instrument stock to required level, moving-in to the new Centre house. Summing up the experiences of the last period I have every reason to trust that our staff will fulfil the increased demand with much success, by making use of the available potentialities as far as possible.

About the instrument hiring activity

JÓZSEF KISS

Head of Instrument Hiring Department

We describe here the development of instrument hiring in our country – established at the first in the world – as well as its advantages in the economy of enterprises, economic investments and in the more rapid availability of the instruments. Outlining the perspectives of the qualitative and quantitative increase of this service, we mention here, as a very important factor, that it is possible to increase the proportion of the so called „cooperation” hire – first of all in case of instruments to be used in a special, relatively restricted field. In case of general purpose instruments, however, to be used in several professional fields, according to 25-year experience and to an already decided 10-year development program, the increase of instrument stock to be hired centrally can cover the measuring demands quickly and economically.

1. Aim of instrument hiring

During the past decades the demand for measurements in the field of high-level education, research and development was increased and proportionally to that also grew the volume of necessary instruments. The financial facilities of the national economy do not make possible direct fulfilment of instrument purchasing requirements. Durable use gives reason for the investment, but it frequently occurs, that expensive measuring instruments are purchased for only a short use.

It has been a recurring problem for years, that while in certain cases we can speak about the insufficient level of the instrument supply of above fields, the nation-wide and ministry's level survey show that the costs of instrument utilization and supply have a low efficiency. This „strange” duality calls the attention to the *instrument hire*, as to one of the possibilities for increasing efficiency of instrument economy.

1.1. When is it useful to hire instruments?

- a) It is useful to hire instruments, if they are required for a short period only. For this purpose hiring is the most rational method from point of view of both the institute in question and the national economy. Sometimes, such partial tasks are to be solved in a certain research work, for which the necessary measuring equipment is missing. In such cases it is not economical to buy the equipment, since it is not required for any other measurement.
- b) Sometimes, parallel control measurements are necessary and economical to buy the instruments.
- c) In other cases, the institute is going to buy new ins-

truments, however, it knows these only from catalogs or descriptions. It is doubtful from the point of view of applicability, how the instrument in question can be connected and adapted to the system. It can be decided only in possession of the instrument. It is useful and economical to test the parameters in question by hired instruments.

- d) Finally, it occurs sometimes, that some of the instruments breaks down and therefore another one is needed for replacement while repairing the defective device. In such cases a hire-device solves the problem. These are the main cases, which can be solved economically and flexibly by a well organized instrument hiring service.

2. Rentability of instrument hire

If, instead of buying instruments required for only a short period, the institute borrows the instrument from a central source, the demands of nearly 10 customers can be covered by one instrument during 6–8 years. [7] Otherwise, these instruments ought to have been bought ten-times separately which would have involved tenfold costs. Of course, this is to be interpreted averagely. To illustrate the above solutions numerically, if this central institute has an instrument stock of 500 million forints, which is equivalent to an investment of 5 milliard forints during 6–8 years considering the above solutions (the institute should invest this amount, if it bought instruments, instead of hiring) then the institutes using the loan-stock have to pay only a hiring charge of abt. 500 million forints instead of 5 milliard forints investment cost (not calculating the costs of operation, which are the same in both cases). As per our above example, 4,5 milliard forints investment can be

saved in the national economy. This is considerable all the more, as in this way the imports from capitalist countries can be saved.

2.1. Maintenance, repair and calibration costs

In our country there is no possibility to have calibrations carried out systematically or periodically with the competent organ. This is reasoned by the fact, that calibration reduces the use-value of the instrument and may cause considerable damage (wastes, time loss) due to measurement faults.

Nevertheless, the main problem is if the instrument breaks down. It is especially difficult to repair foreign instruments in cases, if the manufacturer of the damaged instrument has no service centre in our country. Depending on the elaborateness and type of the instrument, character of damage and on the service circumstances, the loss due to fault can last from some weeks to even a year. This circumstance reduces the effectiveness of utilization of the instrument – besides the repair costs incurred – and its relative maintenance costs will also increased.

However, not belonging strictly to the above costs, the costs connected to the purchase of consumables e.g. electrodes of electro-chemical instruments, those of recording papers, ink pens, special lamps, batteries etc. are to be mentioned. These costs cannot be saved in any way, it is not the same whether the materials can be bought against forints or against foreign currencies, – (taking into consideration that these materials cannot be purchased in our country – since in the latter case, 3–6 months or much time is to be calculated and suitable storage possibility and currencies are to be provided for.)

2.2. Maintenance costs of instruments

Hereunder the yearly maintenance costs of an average instrument are analysed. Considering the fact, that the estimation is carried out on a percentage basis, the value of the instrument will not be defined.

The amortization costs of the instrument are divided to 8 years, which is a good average.

- a) Yearly depreciation, i.e. the eighth part of the countervalue of the instrument on basis of the above: 12,5%.
- b) Contribution to fixed assets, yearly: 5%
- c) Maintenance, repair, calibration costs: 8%.

Accordingly the yearly unchanged maintenance cost: 25,5%.

This ratio may vary between 20–60% depending on the instrument type, the character of the customer and

the maintenance repair demands. This number itself is not an answer to the question, whether it is worth hiring or buying the instrument. Therefore the utilization factor mentioned above should be correlated. It is obvious, that the higher the maintenance cost and the lower the utilization factor are, the more worth hiring the instrument. One can determine such a critical hire charge which is equivalent to the maintenance cost. In case of higher hiring fee is it worth buying, and of lower hiring charge is it worth hiring. [4]

This can be explained by following formula:

$$K_k = \frac{F}{H} \frac{100}{12} \%$$

where

K_k = critical monthly hiring charge in percentage of the value of the instrument,

F = yearly unchanged maintenance cost in the above equation,

H = utilization factor in percentage of yearly average utilization.

On basis of the above formula, considering 3.5% utilization of an average instrument:

$$K_k = \frac{25.5}{35} \frac{100}{12} = 6\%$$

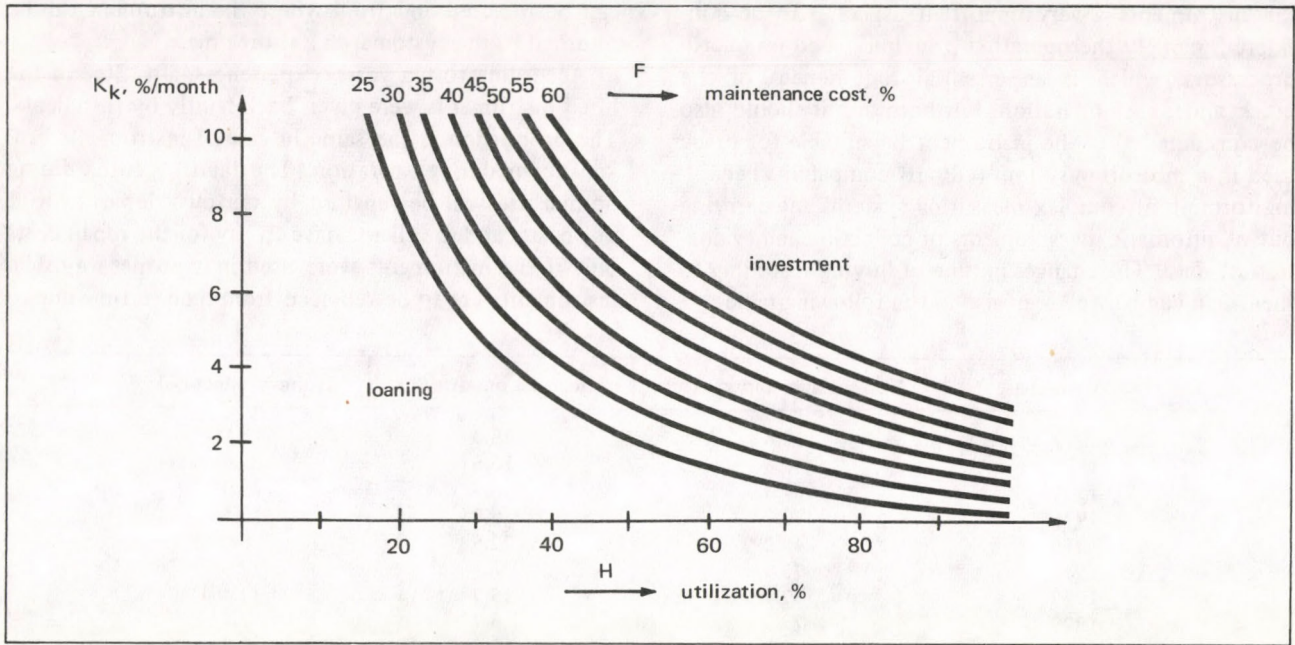
Consequently, by a 6% hiring charge it is worth hiring and above it – buying.

The correlation can be better seen on a diagram (see figure No.1) i.e. above the given maintenance cost curve is it worth buying and under it – hiring. Of course, in most cases there are instruments required by the institutes for their research development work which on an average is 80% of the required instrument stock, however, in case of min. 20% the short and occasional use reasons the hiring by all means.

There is, however, a further – numerically hardly explainable – advantage of hire. This is the shortening of the access time. In case of suitable hire instrument park, the required instrument will be available within a short time as compared to the time of usual purchases. The staff employed for the maintenance of the concentrated instrument park can even increase this factor by professional maintenance and quick repairs of smaller faults. The proverb says „who gives quickly, that gives twice” and this means that the above advantage may double the use-value of the instrument park.

3. Home basis of instrument hiring

The leaders of the Hungarian Academy of Sciences have realized in time that the development of national economy requires an instrument basis providing for the suffi-



Rentability of hiring and purchase depending on hiring fee. [4]

cient measuring equipment supply of the research-workers i.e. for economical utilization and continuous operation by concentrated investment and by safe repairing-maintenance background. Therefore was organized the loaning service of instruments in Hungary – at first in the world – in 1952.

At the end of the sixties there were established various instrument hiring systems and institutes in West Europe on basis of several years' experiences of the USA and they are spreading now all over the world. Recently, the Hungarian periodical „Weekly World Economy” has published a very interesting article on the development of instruments hiring in the Soviet Union. [5]

In 1976 – after having sized up the national economy's possibilities originating from the Centre's services – „The Committee of Political Sciences” has accepted the 10-year development program concerning the Measuring Technique Centre. Thus the basis of domestic instrument hiring can be considerably extended.

During the past 25 years the hire-instrument stock of the Centre developed dynamically both from the point of view of quantity and value.

- in 1957 a hardly more than 1500 instruments were hired in a value of 8 million forints
- in 1981 this stock amounted to 4500 pieces, in a value of 265 million forints.

The increase in value was more rapid than that in quantity, which means that nowadays more complex and up-to-date instruments are hired. The development of the last 10 years can be well seen here below showing the increase of instrument stock:

Year	Value (million Forints)
1972	106.80
1973	112.20
1974	128.46
1975	145.93
1976	155.60
1977	175.69
1978	213.57
1979	242.45
1980	254.90
1981	264.90

In further stage of development, the stock should reach 400 million forints value, till the end of the VI. Five Year Plan. The hire-instrument stock of the Centre, considering the requirements of the up-to-date measuring technique, has changed structurally too, during the past 10 years.

When selecting the new instruments, the following aspects are to be taken into account:

- requirements of our clients,
- suitability of instruments for hiring (fixed or large instruments are not suitable)
- existence and efficiency of the domestic service representations
- sphere of market demands
- modern construction,
- applicability and measuring principle,
- price and expected delivery time.

When evaluating the construction and applicability of

the instruments a very important aspect is to be considered, namely the operation principle based on micro-processors, which is an essential requirement of the quick and exact operation. Furthermore, it should also be considered that the instrument be suitable for or be used in a measuring system (GP-IB compability) enabling forming of complex measuring systems and carrying out of automatic measurements or collection and evaluation of data. The changes in time of buying according to the origin can be well seen also in the following table:

Year of purchase	Non-socialist imports (%)	Socialist imports (%)	Home product (%)
1972	52.8	28.4	18.7
1973	46.4	16.6	37.0
1974	64.3	6.7	29.0
1975	80.7	5.8	13.5
1976	48.2	22.5	29.0
1977	73.9	9.2	17.0
1978	67.4	15.2	17.4
1979	73.9	8.7	17.4
1980	79.7	10.5	9.8
1981	79.3	11.9	8.8

The structure of the purchases shows that there is a possibility for reaching an ideal non-socialist instrument proportion.

On basis of the experiences of the past ten years, the grade of utilization of hired instruments still exceeds the optimal level of 70%, contrary to that of the individual investments reaching generally 10%. The proportion of hired instruments as compared to the whole stock:

Year	Proportion of hired instruments (%)
1972	82.5
1973	84.0
1974	84.3
1975	83.5
1976	84.1
1977	87.0
1978	82.5
1979	76.0
1980	73.8
1981	76.4

Our outs – besides the increasing instrument stock – emphasize the necessity of further development since it would be advisable to increase the store stock of instruments to be hired partly for meeting the requirements within a reasonable time and partly for increasing the control time as a result of increase of the complexity of instruments.

During use, it may occur that the customer gives back the instrument in a faulty state. The Instrument Hiring Department has its own laboratory, where the defects

can be repaired and from where the instrument can be returned to the customer in a short time.

According to ten years' experiences, abt. 20% of the hired instruments were given back faultly by the clients. The proportion is the same in case of instruments broken down during operation. The faults occurred during normal use will be repaired by our own department at our costs, and the clients have to pay for the repair costs only if the instruments were used in improper way. The instruments are to be replaced from time to time due to

their physical wear and tear and to their moral termination. As a result of workmanlike use and careful maintenance, the rate of yearly scrapping is only some percentages of the full stock.

The variation of hiring is especially worth mentioning when the unused and mobilizable instruments of certain institutes will be hired by other institutes for so-called cooperation hiring purposes. This means advantages for all parties concerned. For the hirer – because he receives great part of the hiring charge if the instrument in his institute would be otherwise in „idle run” and for the hirer – because he can get the instrument without any investment, against a comparatively low forint sum within a short time and for a period required by him. Gross value of instruments taken into cooperation hiring:

1976	1.76
1977	2.23
1978	2.87
1979	1.88
1980	1.77
1981	1.70 million forints.

Considering the above mentioned and the *very small* volume of cooperation hiring as compared to possibilities, further efforts are necessary on behalf of instrument owners and their supervision organs to considerably increase the present turnover.

The *hiring conditions* had to be also improved. The *hiring charge* should encourage the clients to hire only those instruments which are necessary for a short time. The Instrument and Measuring Technique Centre established the tariff system exactly with the considera-

tion of this fact. It is possible to hire the instruments on basis of weekly or monthly tariffs. If an institute requires an instrument of a value of 100.000 forints, the hiring charge for a month is 3.000 forints and for a week 1.000 forints. In case of instruments hired for more than six months, the charge can be increased by 50% and for more than 12 months – by 100%.

4. Problems of instrument hire

4.1. The *outer* problems of hiring service can be summarized on basis of public opinion research as follows:

- a) The hiring charge is not favourable for those who try to compensate really necessary investments by hiring instruments for a longer period. Consequently, hiring service is effective in case of hiring for a short period, therefore the hiring charge is calculated accordingly.
- b) The details of hiring activity is not known entirely all over the country. The primary reason of the above is that we could not propagate our activities enabling the institutes to get acquainted with us, because our instrument stock could not have met the wide-spread requirements. Our development reached the phase, when we can meet wider requirements, especially if the suitable circulation speed can be ensured as a consequence of the „encouraging tariff”.
- c) The assortment of hired instruments is not wide-range enough. When establishing the hire instrument park, our main goal was first of all the purchase of instruments for carrying out electronic general purpose measurements – and at the same time of those used for electric measurement of non-electric quantities. Accordingly, our instrument park includes mainly electronic instruments (oscilloscopes, digital multimeters, signal generators, etc.). In the next step of development – in case of demand – there will be a possibility of buy and hire analytical instruments in a greater volume.
- d) The instrument park contains instruments mainly from non-socialist countries, because such instruments are hired for a short time which cannot be purchase economically inside the country or from Comecon countries. In other socialist countries these instruments are purchased also from capitalist sources. Accordingly, smaller part of instruments is hired from the socialist countries. Partly, because the institutes themselves also dispose of such general purpose instruments which can be obtained from socialist relation and partly because series of instruments available in the socialist countries had been developed so that the possibilities of procurement of some special instruments from the capitalist countries – within the limits of economicalness – was kept in view.

4.2. Some inner problems of hiring:

The determined development direction can be taken if the additional investments will be realized securing the outer conditions of our activity as follows:

- a) setting up the service building ensuring the technical level for establishing the suitable background-laboratory and stores serving for the treatment of the instruments.
- b) increase of staff dealing with hiring in the pace of growth of demands
- c) advertisement, publicity, information extension for the purpose of developing the possibilities in accordance with importance of the instrument hiring in the national economy.
- d) it is necessary to sum up better the increasing instrument park and to carry out the administration work concerning the hiring more quickly and exactly, as well as to analyse the turnover data for the determination of tendencies and furthermore to introduce computerized file and data processing methods instead of manual ones.

Summary

Summing up the above facts it can be said that the loaned instrument stock is suitably utilized.

The task and the purpose of instrument hiring is to meet the clients' interests well and quickly according to the expectations of the national economy on basis of the development program. The home experiences, the existing results and expected development of instrument loaning are reasoning the more effective economy in the future, contributing thus to the balance of the national economy by means of the moderate but considerable possibilities of it.

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About 25 years of our services

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The article outlines the development of the service activity of the Instruments and Measuring Technique Centre of the Hungarian Academy of Sciences and its main characteristics. It gives a brief summary on the personal and objective conditions necessary for the service activity. It outlines the future tasks in the field of future service works.

Most excellently constructed, most thoroughly designed instruments can get wrong, therefore their operation demands their regular maintenance and repair. This is especially important at instruments of foreign origin if the user is forced to call upon – in a circumstantial way – the foreign manufacturer in lack of a local service network. A protracting, lengthy repair work – resulting in the lack of the instrument – may frequently involve considerable damages, either undetermined or even determined numerically. Both to avoid this disadvantage and to release service troubles of the Hungarian instrument users, the Centre took remarkable steps by organizing the service supply.

Development, characteristic data of the service activity

In the framework of the Instrument and Measuring Technique Centre there was carried on already in the first years a service activity which fulfilled, first of all own demands: it made repair and examination of the instruments on the hire. As a further development of this initiation, in 1968 we acted already as service representation of four foreign firms in form of a nation-wide organization. Later on the number of our service contracts was increased. On the basis of the following table we can follow with attention the dynamic development of the service activity.

	1974	1976	1978	1980	1982
No. of consumers' service contracts	6	12	14	20	25

In 1982 our activity extends to the repair and maintenance of instruments of 40 firms in the framework of 25 service contracts. These firms are as given below:

Beckman Instruments Prozess-Geräte GmbH

Biccotest Instruments Ltd.*

Brabender GmbH

Comark Electronics Ltd.*

Data-Check Corporation*

Data-Scan Ltd.*

Finnigan MAT

G.P. Instrumentation (Grubb Parsons)*

Hewlett-Packard GmbH

Hone Instruments Ltd.*

Hottinger-Baldwin Messtechnik**

International Sensor Technology Inc.*

Jeol GmbH.

Keithley Instruments GmbH***

Labtest****

LKB Instrument GmbH

AB Lorentzen and Wettre

Marconi Instruments Ltd.

Moore Industries Ltd.*

Moore Products Ltd.*

MTS Systems GmbH

Neotronics Ltd.*

Opton Feintechnik GmbH

Perkin Elmer GmbH

Philips N.V.

Philips GmbH

Racal Communications Ltd.*

Racal Dana Instruments Ltd.*

Radiometer A/S

RE-Instruments

Redland Automation Ltd.*

(Agar Instrumentation Division)

C. Reichert Optische Werke AG
 Spectra-Physics and Laser Analytics Inc.*
 Spectra-Physics Laserplan Corp.
 Ströhlein Labortechnik GmbH****
 Tekelec Airtonic
 Varian AG
 Westinghouse Electric Ltd.
 (Computer and Instruments Division)

*In representation of Blandford Systems Ltd.

**In representation of Kosimex Ex- and Import GmbH.

***In representation of Universal Elektronik Import GmbH

****In representation of EPCO GmbH

In knowledge of the products of the above enlisted firms we can say that our service activity covers a rather wide professional field.

Over and above the „classic” electronic instruments (analogue, digital, etc.) our service activity comprises chemical-laboratory, biochemical, medico-analytical, optical, electron-optical, precision-mechanical, computer-technical instruments and complex laboratory and industrial equipments constructed of their combination. In the course of the years naturally not only the number of our service contracts has decreased, but – parallel with this – has grown the quantity of works fulfilled by us.

To display this growth we summarized the number of service work fulfilled in some years of the period between 1974 and 1980:

Fulfilled tasks	1974	1976	1978	1980
Servicing, Repair	314	788	1108	1335
Repair under guarantee	94	238	364	288
Maintenance	226	251	356	1494

Circle of our consumers is very diversified. Among our clients we can mention e.g. various research institutes of the Hungarian Academy of Sciences, instrument-users in the most different professional fields of hospitals, clinics, other public health institutions, industrial research centres, enterprises, agriculture, etc.

We concluded our customers' service contracts in the cooperation with the Import Customers' Service Department of the Foreign Trade Company „Metrimpex”. The good relations with the Customers' Service Department established during many years' of successful cooperation lends a very considerable help in the fulfilment of our service tasks.

Above we spoke about the customers' service activity displayed only in Hungary. A number of our Service contracts concluded with foreign firms makes possible to perform service work on the so-called „third-market”, too. This means that – on behalf of our foreign partners,

producers of the instruments – our specialists may carry on service work not only in the country but also abroad. In the framework of such contracts we undertook repair and commissioning works in the Soviet Union, Yugoslavia, CSSR and Poland. Among future plans of certain firms figures the extension of commissions to the countries of Middle and Far-East. Over and above the foreign exchange income of the commissions in „third countries” this fact proves that our foreign clients are satisfied with the professional skill and work of our specialists.

Preconditions of the service activity

In order to get better acquainted with the service activity, it is worth to sum up briefly its preconditions without aiming at completeness of the facts.

The main groups of these preconditions are: personal resp. technical conditions. The first one: versatile, skilled specialists. A high-level theoretical knowledge not only in the field of electronics but also in other professionals as e.g. precision mechanics, optics, vacuum technics, etc.

We should emphasize the ability of application which is a precondition of a successful elimination of the defects – by surveying proper use of the instruments. Besides the theoretical training and logical thinking ability, the good practical sense, manual skill are also required; without these neither fault detection nor repair can be imagined.

As meeting the service demands of foreign firms it is absolutely necessary for our colleagues to have an adequate knowledge of one or more foreign languages.

In many cases repair and maintenance of the instruments are made in very different territories of the country. Transport of special tools, components materials, testing instruments, quick and flexible settlement of claims require use of cars. The most economical is if the servicing specialist drives the car himself. In such cases the car driving – possibly at some hundred kilometers distance – and besides this the performance of repair work requiring special attention, concentration lasting sometimes some hours, mean a very serious physical burden to the specialist.

It follows from the aforesaid, that one can become a perfect, completely skilled servicing engineer or technician – even in case of suitable basic capabilities – only as a result of many years' purposeful work and this level can be maintained only by continuous, steady extension training.

For acquisition of basic knowledge required at the repair of certain instruments, for refreshing of information connected to new products on the market our colleagues regularly participate in the service courses

organized by foreign firms. They exchange their experiences and – in remarkable cases – they even publish them. Switching over to the technical preconditions we should deal – in the first line – with the question of material supply: without material there is no effective repair activity.

On basis of our consumers' service contracts greatest part of material supply can be secured through consignment stores. In case of certain repairs, however, special instrument components may become necessary. Therefore it is not an exaggeration to state that the success of service representation work of a firm is fundamentally based on the time of delivery of spare parts supplied by it.

Managing of stores naturally involves a lot of administrative work. Large quantities of materials in the consignment stores, registration of stock, demand of updating for its control reasoned the introduction of computers. In 1983 the processing of data of the stores will be carried out already by means of computers.

It is an essential demand to provide for tools, testing and measuring instruments of suitable quality, including high-accuracy calibration means to examine features of the repaired instruments. We have already mentioned that the quick repairs at the site is absolutely necessary to use a car. Operation of the service car park, preserving its good technical state by regular repairs and maintenance are also very important viewpoints.

Last but not least: without a precise, quick, well-organized administrative work a service activity without complaints cannot be imagined.

Something about our future tasks

By our hitherto activity, in our own field we contributed to the solution of consumers' service provision of the valuable instrument park to be found in our country.

For the future we set ourselves the task to preserve the quality of our service activity, moreover to increase its level. According to our estimations made on the basis

of the demands of the domestic instrument users and the foreign firms it seems to be a very real requirements for the quantitative extension of this activity.

The extent and the scheduling of meeting demands of such a character are naturally determined by the economical and territorial possibilities of the Instrument and Measuring Technique Centre. Maximally exploiting these possibilities, we shall endeavour, also in the coming years, to fully meet the requirements of our clients, to lend a many-sided help in their work.

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About Measuring Technique and Instrument Development Services

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At the Centre, the Instrument Technique Department deals with above services. This article outlines advantages of this activity and deals separately with the measuring technique, the connecting computerized data processing and with the instrument development services.

Even in 1952 there was a central measuring service at the Hungarian Academy of Sciences (electronmicroscope laboratory) within the framework of the predecessor institute of the Centre. It was obvious, that even mere hiring of instruments does not mean solving of measuring problems for the experts in case of more complicated measuring tasks.

The services indicated in the headline organically supplement the instrument hiring activity of the Centre in case, if measuring technique problems cannot be solved by hiring only (by forwarding of the adequate instrument to the client) due to lack of skill, routine, capacity and due to technical and/or economical factors. The many-sided practice of our experts specialized for handling special and elaborate instrument and measuring systems is a unique possibility for solving individual measuring tasks effectively. Our clients avail of this opportunity. This is proved by the activity of our Measuring Technique and Instrument Development Department and by the work of the Acoustic Research Laboratory which is described in a separate article. [1]

1. About our measuring technique services

Our Measuring Technique Department carries out measuring tasks for other institutes or enterprises either itself, or participates in it at an extent desired by the clients, relying on its own instrument park of 14 million forints, sometimes on the hire instrument park of the Centre and on other cooperation possibilities.

By an instrumentation exceeding the technical level prevailing in the country and by well-skilled experts we can meet requirements of those enterprises and insti-

tutes, that have neither sufficient instruments in the field of technical development, research and designing nor have well-experienced experts. Our two decades' activity proves that we meet real demands of the national economy. We are prepared, first of all, for carrying out measurements of non-electric quantities electrically. Besides this we can undertake measurements of electric factors, too, owing to universal nature of our instruments.

We are ready to co-operate with other departments of our Centre. The development direction of our measuring methods and instrument park is determined by the increasing volume of our tasks, data collecting and signal analysing tasks and by the demands to apply measuring technique and an up-to-date computer system. Due to the demands of various professional fields, composition of our instrument park should be „universal”.

A great part of our commissions is plant- and field-scale, i.e. not laboratory-measurements. In these cases, suitable preparation of local works and constructive cooperation of our clients are indispensable for the good results of our work – of course besides the authenticity and „environment-resistance” of the instruments.

Our measuring technique possibilities, features of our fields

Our activity comprises the following fields. *Measurement of mechanical quantities.* Strain, force, pressure, torque, movement and other factors reacting upon these can be measured by strain gauge, inductive conversion methods and by carrier-frequency and DC measuring amplifiers. We can carry out static measurements by scanning method on 100 measuring places and dynamic

measurement – on 20 measuring places. We can store signals obtained locally by analogue or digital data recording and by registration of time response for laboratory evaluation.

Power-engineering measurements. Temperature rise and dispersion are registered with thermo-elements and resistance thermometers by analogue registration and digital data recording on max. 100 measuring places. Special thermometers of low heat inertia are prepared. We join with the thermovision service of the Research Film Department in the field of power-engineering. [2]

Acoustic noise- and vibration measurements. We can carry out noise level measurement within the range of 2 Hz...200 kHz by condenser microphones, measuring amplifiers, magnetic tape analogue recording for signal analysis, simultaneously with several measuring places. We also have statistic distribution analyser, by which we can produce various statistic features of the noise level by analogue or digital print-out in case of short or long-term measurements. Typical tasks are factory- or residence noise level measurements for qualifying tests, noise reduction designing and for other research-analysing work.

We can carry out vibration measurements by acceleration sensors, charge amplifiers and integrators in the range of 0,03 Hz...200 kHz with recording and analysing facilities for evaluation as per standards, for machine diagnostic tests and for other research-analysing work. The acoustic emission measuring methods are being elaborated. Calculator-based signal analyses and data processing are our well-proved services at noise and vibration measurements.

The activity of the Centre was extended considerably by joining the Acoustic Research Laboratory in 1981. [3] The division of labour has been developed commonly so that local and routine measurements are in the highlight. There are certain works which are carried out commonly. The division of labour has been developed depending on the researching, designing and measuring character of the tasks and considering our instrument parks and skill.

Electric measurements. Besides the tasks mentioned above, voltage, current power and other electric factors are also to be measured. Requirements can be met by means of amplifiers, signal recorders and data collecting facilities. For magnetic recording 1, 2, 4, 7 and 14-channel and for traditional recording 1, 2 and 8-channel devices are available.

The fields of our measuring technique services and our possibilities provided by the technical level of our instruments are summed up in a table. The so-called „quantity limits” are indicated in this table. Of course, we can undertake other tasks, too, for which the instru-

ments can be hired through our Centre and we can rely on our cooperation possibilities with other departments.

Elaboration of measuring methods. It often occurs, that the available instruments are not suitable for measuring or analysing purposes. Therefore, new methods are to be found. We can rely on our measuring practice, facilities of our instrument park, literature sources and on our own ideas in solving these measuring problems. In this field we have to join in the development activity. In some cases, special-purpose instruments or special measuring transformers have been developed on basis of elaboration of a measuring method or just the result of development work enabled carrying out of measurements.

The measurements are generally not finished by demobilization. The following period requires more time, when the laboratory signal processing, depending on obtained basic data and on consumption purpose, the application of numerical processes, the graphic and tabular illustration and the qualification as per standards all take place. The calculator aided signal processing and computation technique groups are involved here in this phase. The measurements, results and consequences are laid down in protocols and/or expertises.

For illustrating the above and our work, we give you hereunder in headwords a list of our important works carried out during the last years:

- measuring the noise level of steel casting arc furnaces [4]
- motor power and current measurement [5]
- analysing the vibrations affecting accuracy of gravity-meter [6]
- vibration load measuring of manual pneumatic tools [7]
- dynamic test of bridges [8], [9]
- bending resistance test of leathers [10]
- measuring the factories' noise level [11]
- measuring the traffic noise level [12]
- damping factor measurements of vibrations [13]
- temperature dispersion measurements by thermo-elements of low heat inertia [14]
- determination of failure points of long-distance thermal transmission lines [15]
- torque measurement on rotating shaft by contactless signal processing
- technological test of machines for the rubber industry [16].

Our ideas concerning development of the measuring technique. New measuring processes, instrument facilities are to be realized to fulfil tasks for the national economy and new demands are to be met in every field of the national economy. This should be considered in developing the level of our services.

A new measuring technology is supposed – besides

the rejecting of old instruments (physically and morally out-of-date ones) – to meet new requirements and to increase volume of commissions. The digital storage and automatic control are to be solved locally, for the application of computation technique. Our services are to be based on a uniform system from the point of view of data collection, data transmission and computation technique.

We have to follow with attention the development of measuring transmitters. Extension of measuring ranges, increase of measuring accuracy, new measurements of physical phenomena (e.g. acoustic emission) are required. These are to be developed effectively in the future.

3. About processing of measured data by computers

The data processing and computer technique activity was based on the HP 9830 type calculator purchased in 1975. [17] The measured data recorded in analogue or digital form are analysed in laboratories in terms of frequency or time and are processed by up-to-date computation technique methods. This service is connected first of all to our own measurements, however, it can be an individual activity, too, which will be available for our clients, too, from data carriers joined to the system. The present data collecting and processing system established within the framework of multi-stage investment program consists of two configurations:

1. Computation technique units with measuring network control (function of controller, too),
 2. Measuring system containing special-purpose processors, enabling real-time processing of network to be controlled by calculators and of measured data.
- The two systems can be used either separately or jointly. The method of use depends on the task, pretension, instrument demand and on practical economic aspects.

An independent software staff has been established to carry out many-sided tasks, by involving experts having been well-experienced in the field of measuring technique tasks for years. One of the initial difficulties of our work was that stage by stage increase of the measuring network to be established in several steps due to financial scheduling, involved the whole measuring technique software purposefully. And since there is no so-called „general” measuring technique or mathematical algorithm, we have to prepare all software necessary for the fulfilment of wide-range measuring technique tasks.

During our work, the program controlled data collecting and service of so-called GPIB bus-system has been established at first in our country, which was proposed by Hewlett-Packard for standardization internationally and accepted later on (IEEE 488 and ANSI MC I.I. standards).

Our service forms and characteristics

The aim of the service is to promote measuring technique work of the Centre, the exact, real-time digital data collecting and the multi-purpose processing of these.

The advantages of solution based on the digital system technique over the traditional measuring data collecting are evident, therefore it is not necessary to prove them, but some aspects are to be taken into account:

- „subjective” failure, of the measurements has been eliminated,
- measuring accuracy has been considerably improved,
- a great number of samplings increased statistic authenticity,
- digital processing may not be comparable to the hitherto one, it resulted in a new solution of system technics and task fulfilment,
- time required for the processing has been considerably reduced, thus the service volume could be increased and the quality indices have been considerable improved,
- manpower requirement for the preparation of numerical tables, industrial drawings and functions has been reduced by a great extent with application of mechanical devices, digital drafting machines and line printers, and provides for constant aesthetic quality,
- magnetic discs enabled the storage of numerical measuring data. Thus we can undertake fulfilment of such nation-wide tasks, when for the determination of waste-changes of various construction elements (bridges) of several milliard forint countervalue, it was indispensable to have an access to previous measuring data in form of a data bank, to be able to actualize these by computers.

For completing our services – not only as a part of the measuring technique activity – we are ready to carry out directly processing, evaluation work. The results of our clients having analogue instrument background for measurements – which are recorded by magnetic type signal storing facility – can be processed with us. Thus the purchase of expensive special instruments mainly by imports from capitalist countries can be avoided at clients, where such tasks presented themselves only on an ad-hoc basis.

We help our clients in solving their tasks with up-to-date devices, putting at their disposal own measuring technique software already prepared. We are ready to write special programs initiated by our clients within a short time-limit. In case of commission work, clients may be present at the processing of their measured results. Thus, they will have an opportunity to require solution of a measuring technique task in the most optimal

way from utilizing the possibility of their own activity provided for them during these processes.

This service form is very popular. A lot of experts make use of it regularly, even in fields, where considerable computation technique supply and utilization culture are available. Just because our clients can solve evaluation problems in a more up-to-date way and more economically by our means competitive even on world level.

Besides the forms mentioned above, so-called „opened-shop” service form is required to a great extent. In this case clients may use the whole system solely with rental character, in this way most sufficient data processing methods can be selected by them for solving the tasks by the available whole software assistance and experience.

About our further work

Computerized data collecting and processing will be required even in the future, too.

A great part of our instrument stock is in the forefront of the world. Our digital measuring system will remain up-to-date and will have a high precision even in the following years, there will be no problem in this field. Of course, further special-purpose instruments are to be purchased, by which we can undertake more exact or precise data collecting tasks. E.g. special correlation analyses, analyses including two-channel fine frequency disintegrated Fast-Fourier transformation, special transient tests, high-speed data collecting, spectrum analyses.

It seems to be fitting to promote compatibility of digital signal recording data turnover between the clients and the service institute. According to international experiences, purchase of digital recording facilities conforming to ECMA-34 standard seems to be the most practical for digital recording and storage of signals and the conception concerning digital signal storage is being developed.

Precondition of high-speed signal collecting and processing is to apply a more rapid computer system. This is included in our middle-term development plan. Thus, there will be a new opportunity for a more rational fulfilment of problem-oriented data processing commissions and for further increase or development of the service.

3. Our instrument development services

The instrument development, i.e. special purpose instrument development has been an important part of measuring technique and especially of new measuring processes. Of course, a lot of instruments are being developed on basis of which individual tasks could be carried

out and which cannot be manufactured at factories or research institutes due to their character and low quantity to be made.

The following list will prove that our work enhances a wide field of activity. The professional background of it is ensured by involving the best experts as consultants or co-workers. The tasks to be fulfilled require much skill and experience. The application of „typical” solutions of most developed analogue and digital technique means considerable relief, however, it demands a constant improvement of the workers' skill and its keeping at constant level. This applies especially to microprocessor technique to be applied in a more and more wide field.

In the future we are going to utilize advantages granted by this technique better and for this purpose we started a considerable internal development. Within this we have to develop a universal microprocessor developing system — supporting or development activity in all respects — based on our existing calculators.

Further considerable task of the instrument development work is to have several special-purpose instruments — within the measuring technique conception — which cannot be purchased either in the country or abroad.

For illustrating the wide range activity, we give you hereunder some special-purpose instruments having been developed since 1970 in headwords, and we refer to some transducers which could not be easily developed, notwithstanding the fact that they seem trifling matters:

- Semi-automatic special-purpose instrument suitable for measuring coercitive force and remanence of permanent magnetic materials (Magnettest A.). [18]
- Sensor and special-purpose instrument for detecting ferromagnetic „impurities” in copper.
- System for controlling paper speed and stretch of the emulsion pouring units in the photopaper production [19], [20].
- 16-channel measuring amplifier, heat- and pressure-sensors for measuring temperature and pressure inside extrusion pulleys and pulley blocks of the plastics technology [21], [22], [23].
- Special instrument for measuring asphalt thickness
- Transmitters, pressure- and moment sensors and signal processing electronics for measuring working parameters of welding machines.
- Sensors and measuring systems for measuring mechanical tension in gap walls.
- Interface device for data processing between the Instron tensile test machine and the EMG 666 mini-computer.
- 8-channel amplifier for multipoint measurement of mechanical tension in driving rods of high-power tyre-vulcanizing machines.
- Sensors and instruments for measuring detonation

- speed of explosives [25].
- Special-purpose instrument for testing the electric breakdown of condenser-paper [26].
 - Microprocessor controlled special device for measuring specific resistance of soil.
 - Special-purpose instrument for measuring rheological conditions of synthetic materials, temperature controlling electronic tool, heat- and pressure sensors.
 - Electronic measuring system for contactless detection of moment and speed of mandrels, with special power supply.
 - Pressure sensor for dynamic analysis of detonation wave-propagation in space.
 - Reconstruction of heater, heater console and regulating system of high temperature X-ray chamber. Heat sensor, electronic temperature-reference- and measuring system.
 - Line- or quartz synchronised, six digit, 10 ms resolution, count-presetting stop-watch.
 - Temperature reference, special temperature-probe for analysing the photooxidation characters of synthetic materials.
 - Combined heat- and pressure probe for synthetic tools; contactless axle moment and rpm sensor; special low heat response, tape shaped sensor; overload protected push- and pull sensor.

It is obvious from the above, our department keeps steps either with the alterations of the home demands or with the technical development in the field of traditional measuring technique and instrument development; this attitude determines our future plans, development aims. The Acoustic Research Laboratory has been involved in the activity of our department since 1981, the work of which is outlined in a separate article.

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About the work of the Acoustic Research Laboratory

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Head of the Acoustic Research Laboratory

The Acoustic Research Laboratory is the latest organization of the Instrument and Measuring Technique Centre of the Academy of Sciences. We make you acquainted with its history and with its first years' activity within the framework of the Centre. The acoustic research development, designing, measuring technique service – first of all the exact sound field measurements in the „big laboratories” – belong to the services of the Centre.

The Acoustic Research Laboratory acts as a department belonging to the Instrument Technique Section of the Centre, its staff consists of 12 members (5 physicists, 2 engineers and their assistants). Its peculiarity is that special acoustic measuring places under the title „big laboratories”, (anechoic room, reverberation room, audio-monitoring room, tank for water-borne sound measurement and low frequency acoustic impedance tube) are here as a unit [1] and furthermore there are precision acoustic measurement possibilities and a wide range interest in acoustic problems. At present, there is no other similar comprehensive acoustic laboratory in the country. This is due to the previous basic role of the Acoustic Research Laboratory of the Academy of Sciences developed during its 30-year activity until its re-organization in 1981.

History of the Acoustic Research Laboratory

1st July 1950 the Hungarian Academy of Sciences founded a small group within the framework of the Physical Institute of „Eötvös Loránd” University which acted from 1951 as the Acoustic and Ultrasound Research Group of the new Central Physical Research Institute with 12 permanent and 4 assigned workers.

After the liberation there were principal, objective, traditional and personal reasons for starting the home acoustic research. These were: teaching and practicing the acoustic science in the country; continuing the ultrasound researches; scientific foundation of antinoise activity; utilization of some existing acoustic measuring instruments and ultrasound radiating apparatuses; and furthermore saving the small-size anechoic-room disassembled that time at the Technical University of Bu-

dapest; and last but not least continuation of the activity of the Nobel-prize winner *György Békéssy*. Thus the tasks were worked out accordingly:

- a) general acoustic tests,
- b) radiation and intensity-measurement,
- c) researching the effects of ultrasounds,
- d) designing and elaboration of the apparatuses.

During the first 3 years the research group reached several results, which are even nowadays cited in the domestic and foreign professional literature (readability tests, ultrasound zone lens, improving the acoustics of the Erkel Theatre, successful industrial and biological ultrasound processes). During this period began the education of acoustics in the country.

The Academy directed great part of the research group to other sections of the Central Physical Research Institute in 1954, directing some people and works to the Post Experimental Institute reserving their original tasks. The transfer of research activity to the Post has not come up to the expectations. Therefore on the basis of a new resolution of the Technical Department of the Academy, the research group belonged again to the Academy from the middle of 1958. The domestic acoustic research belonged to the telecommunication section of the Technical University of Budapest up to the end of 1975. During this period the scientific purposes were modified in such a way that the ultrasound research was displaced gradually to the field of architectural room acoustics and electro-acoustics and of those of human being and environment.

During this period a lot of architectural acoustic designs were drawn up, the laboratory rendered assistance in solving the practical problems by holding several industrial consultations. By education on two universities (the laboratory was at the Eötvös Loránd University, however it belonged organizationally to the Technical

University) and by Academy-level education (scholars, aspirants etc.) the research group contributed considerably to the foundation of the Hungarian acoustic expert staff.

The international recognition of the research work is characterized by the fact that during the first 25 years altogether 200 scientific dissertations and lectures in foreign languages were held on the work of the research group.

The resolution of the Presidium of the Academy in 1973 stated that the domestic acoustic research work is successful and it is to be developed. Following this, the Acoustic Research Laboratory became independent from 1976 and the research possibilities were developed quickly and to a great extent within the framework of the Natural Science Research Laboratories of the Hungarian Academy of Sciences. The main task was the research of certain fields of the acoustics enabling us to get acquainted better with the physical and biological effects of sounds and vibrations and thus helping the human communication and the acoustic connection between the human being and the machines and reducing its effects to the human being. We have already described in details the results reached during the last 5 years. [1]

The present role and work of the Acoustic Research Laboratory in the field of research-development

Upon the suggestion of the Natural Science Section of the Academy, the Acoustic Research Laboratory got to the organization of the Instrument and Measuring Technique Centre of the Hungarian Academy of Sciences from the 2nd half-year of 1981. By this, the material, and intellectual capital accumulated hitherto became available widely, during the acoustic research-development.

The new idea widened and modified the scope of activity of the laboratory. Instead of the previous 2-3 subjects a wide scope of the acoustics is to be embraced (Figure No.1). Besides the research work, development, measuring technique, designing, specialits' tasks are frequent, requiring more a comprehensive review and efficiency as compared to previous one. For illustrating this, we mention hereunder the various fields of activity of the laboratory, besides the special tasks indicated in the „intensity-frequency range” on figure No.1:

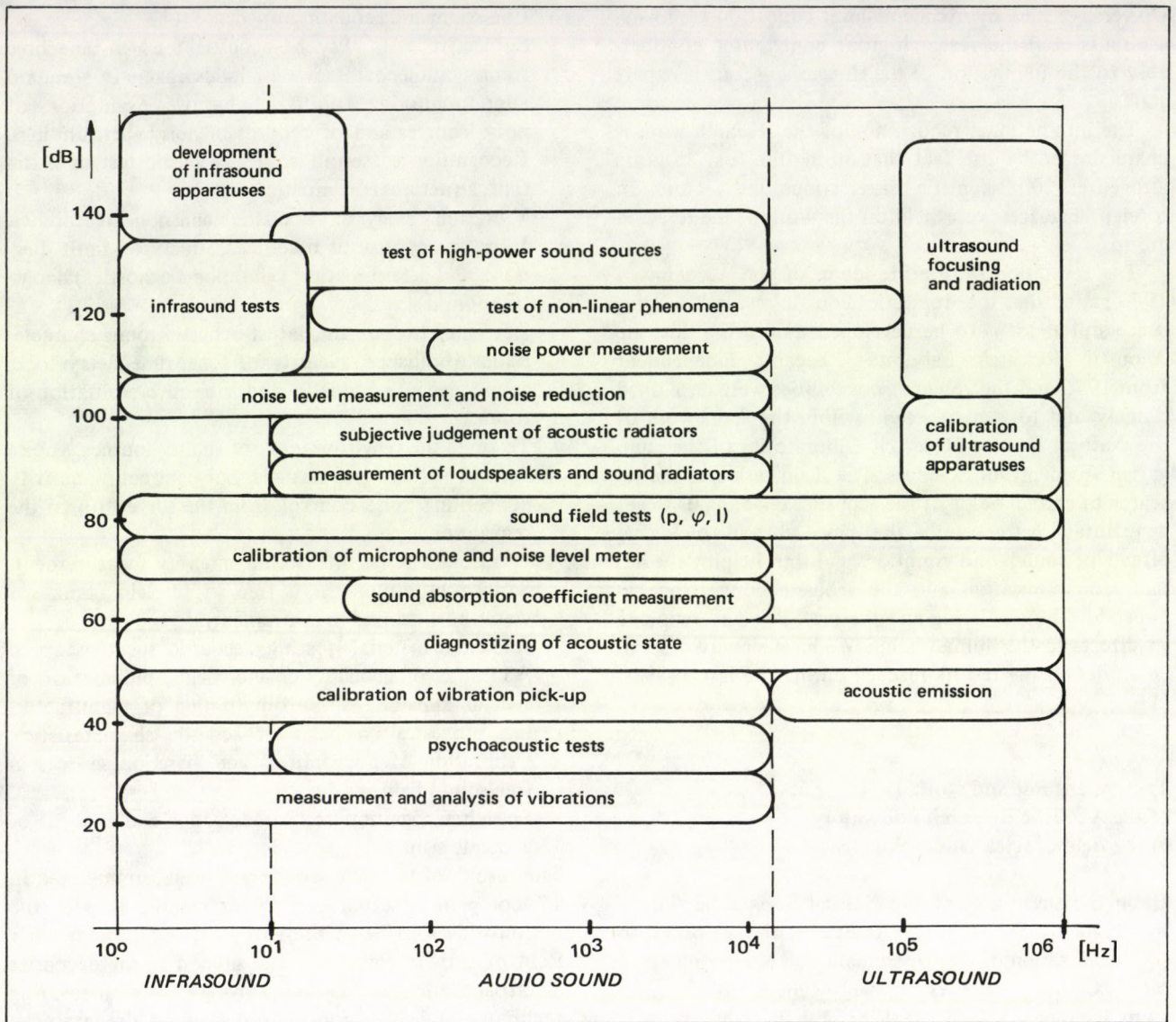
- Infrasound tests.
- Big laboratory services in sound-frequency range in anechoic and reverberation rooms. Electro-acoustic measurements, development. Measurement of features of the sound field (sound pressure, phase).
- Noise- and sound source measurement
- Measurement of sound absorption factor in reverbera-

tion room and acoustic impedance tube

- Subjective tests. Psycho-acoustic tests in anechoic rooms. Subjective views of loudspeakers in standard audio-monitoring rooms. Subjective evaluation of noise sources and of records of noisy surroundings.
- Recognition of sound source, acoustic test of materials, structures (diagnostics).
- Vibration analysis, acoustic emission researches. Vibration control of machines, structures, fault diagnosis and determination (vibration-diagnostics) acoustic room tests.
- Determination of the latest acoustic room characteristics (brilliance, clarity of tone, time delay lock, sound decay). Acoustic and subjective evaluation of rooms.
- Testing the environment of noise sources, noise control surveys and designs. Sub-contracting activity concerning noise control from the survey up to the realization.
- Ultrasound tests, ultrasound intensity measurement. Service ultrasound in a free sound field (tank for water-borne sound measurement).
- Acoustic material testing, acoustic spectroscopies.
- All kinds of acoustic developments, preparation of special apparatuses, automatization of manufacturing processes on basis of acoustic characteristics.
- Calibration of microphones and vibration sensors in free sound-field.
- Speech recognition tests, recognition and analysis of acoustic signals.

The results of the first service year were summarized in 17 complete research and other reports. Besides the nation-wide K-14 environment protection program, our field of activity comprised the support of the domestic electroacoustic industry and solving a lot of measuring technique and noise control tasks. Out of the latest we should like to emphasize the co-operation contract concluded with the National Measuring Technique Office, within the framework of which the free sound-field calibration of microphones and noise level meters is carried out. This activity is very important from the aspects of legal regulation of the environment protection. We actively cooperate with the Measuring Technique Department (local noise level measurements) and with the Construction Cooperative of Tatabánya (realization). We undertake noise designing work in the above division of work. Till now there were concluded several years' commission agreements with 5 hungarian institutes.

Our work gives possibility in the future, to participate in professional conferences and to publish scientific issues. [2-15] Due to this, there is a keen domestic and foreign interest in the work of our laboratory. This interest is represented by the offered co-operation (CNRS France, PTB GFR, Inst. De. Sci Phonetiques Groningen Holland, IPPT PAN Polish Academy of Sciences) and by the common work carried out with foreign experts.



The laboratory is the inland base institution of this profession. The extended possibilities within the new circumstances, the fruitful cooperation with the Instrument Technique Section of the Measuring and Instrument Technique Centre of the Academy of Sciences [16] contribute to this fact and increase it. Our common results reached in the very beginning and the above mentioned favourable prospects prove all this.

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About 20 years of our research film activity

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One of the special and up-to-date branches of the film technique is: research filming. This article gives an overall view about 20 years of the National Research Film Centre brought into being in the framework of the Centre. It describes development questions, gives information about film shooting and infratechnical work, lays stress on some typical tasks which can be solved by the research film technique. It draws a picture about the results of the Archive of Films for High Level Education and Research reached hitherto. It touches upon the role of the Centre in home and international programs and summarizes our international relations.

There are such phenomena and processes where – for the recognition and analyses of the relations – a visual observation following the occurrence in time and space is indispensable. Certain phenomena are, however inaccessible for the eye – in consequence of its capabilities. Our eyes are unable to follow the motion of „too small” or „too large” objects, the „too quick” or „too low” processes and phenomena. In these occasions the special film technique makes the invisible visible, forming a perceptible picture. [7], [15]

In our country the practical application of such a special film technique in the research-development work looks back upon several decades. [19], [28] In the framework of the Centre, more than 20 years ago the development of planned research film park was begun under the direction of *Dr. Sándor Dékány*, university professor. [10], [11]

In the beginning we only hired film technical appliances, but it has become soon evident that this solution was not always economical. The operation of the devices required specialists, special raw materials and – the development of the films – adequate circumstances. These tasks can be solved effectively only if – instead of hiring – we lend a help in the works performed in certain professional fields in form of special film technical services. [6], [21]

By means of the initial, pure equipment and accessories we could fulfil only some commissions yearly, but in 1972 our instrument stock reached already 12 million forints and the number of our staff was 12 persons. The increasing demand proved that it was worth to go on this way. In the beginning the support of the National Office of Technical Development then the Academy has made possible from year to year to purchase further instruments. In 1982 the value of our instrument park already reached 20 million forints and our staff has increased to

17 persons. The growth of the volume of our commissions is shown by the following table very well:

Year	1962	1967	1972	1981
Number of commissions	18	107	330	667

Since 1965 – by a gradual development – we are fulfilling the tasks of the National Research Film Centre, too. Yearly we get into contact with several hundreds of research institutes, university institutions and are also able to help the most different companies by special film technical services. We undertake to make exposures at normal speed, time acceleration, low-, medium- and high deceleration, pulse exposures, exposures with Schlierentechnique, microscopic and band exposures, using the most up-to-date equipments (20). In the course of years we were the first among the Comecon countries to develop a well instrumented basis with a wide field of activity, capable to undertake services for scientific training, industrial developing and for education, not implementable in any other way. We also consider the processing of information recorded on films to be of high importance. Instrumental evaluations eliminate the many error possibilities of subjective evaluation methods; at present we already have an up-to-date analyzer suitable to be connected onto computers and capable of digital display. [8]

Although in these lines it is quite impossible to draw up a summary about all subjects in their integrity we dealt with during the last 20 years, it is advisable, however, to present briefly some characteristic examples which would give prospective ideas in connection with more perfect utilization of research filming possibilities. – *Behaviour of liquid drops* in surroundings of solid surfaces can be very well studied on slow, near exposures. The formation of capillary waves during se-

- paration of liquid bridges in tertiary oil exploration or in typographical tests can be followed and evaluated very well. [25]
- *Railway reconstruction works* demand installation of safe, easy-to-assemble overhead electrical lines. At the section-insulators the observation of phenomena occurring during a split second may produce very valuable data for designers. The high-speed shots – if necessary 10.000 exposures/s – and the evaluation of coordinates of crabs per picture by analyzer, by computer processing give visual and numerical data about a behaviour during dynamic load. [9]
 - From operational safety viewpoints behaviour of the mechanical parts of *very small-size elements of automatics* is not negligible. For development engineers each measurement document is very important which can result in better constructional solutions. Extraordinarily rapid arc effects can be followed on research films by 400-times deceleration, thoroughly observing deteriorating side-effects. [12]
 - Process of *welding* cannot be observed even through welding glasses as our eyes are not able to follow the rapid process of arcs and drop separation. A 200-times deceleration can already separate the most characteristic motions. During a research-development work we can adopt different test circumstances (e.g. protective gases) under which visual comparison can be made. [2]
 - One of the characteristic examples of *product development activity* can be demonstrated by model-designing tests of autobuses. Experiments made on the built-up models lended help to bus designers. The fume- and dust processing devices placed on the models show the stream situations along and behind the body elements under working conditions. When analyzing high-speed exposures the effect of each structural element could be recognized. [9]
 - *Testing of crystalline synthetic products* is a good example of joint application of microscopic and time acceleration film technique. By a microscope installed with polar filters and heated stage e.g. the structural changes of polypropylene crystal can be fixed. Connection of physical structural and thermic alterations of crystallization lended help in the developing of different synthetic material grades manufactured in great volumes on a world scale. [9]
 - At the applications of *irrigation equipment* the soil solidifying effect of water jet is not negligible. Diameter of water drops, their speed, angle of arrive onto soil, etc. all influence the effect on the soil structure. Night, dark background, slow-motion exposures made at counterlight enable to observe the behaviour of each drop. By an analyzer dislocation, changes of the drops can be followed step by step. The large quantity of data can be processed by computer. [1], [3], [4]
 - *Analyzes of sportsmen' movements* can lead to the further increase of their achievements. Besides the small-scale deceleration frequently applied in telecasts, a very detailed recording of technique of swordsmen, jumpers, etc. sometimes may require a 20–30-times deceleration. Decelerated film [9] is an up-to-date observation means of biomechanics.
 - *Labour organization tasks*, preparation of straight-line production can be met successfully on possession of data collected very thoroughly. One phase of work is recorded from time to time by one shot. Projecting each shot at normal speed, period and course of motions and work phases can be precisely followed and measured. By „sampling” filming method labour organizers can get important data about utilization factor of the equipment, length of idle time, possible impeding factors of auxiliary equipment, etc. This method is also suitable to check labour rates. [5]
- The above examples taken at random reflect very well those „routine-like” tasks which can be solved nowadays by research-film technique. In addition to these independent, special film technical measurements and analysis such rows of exposure can be well used also in *educational, technical information, documentary- and popular scientific films*. [9] Instead of periphrases and trick shots – or in combination of these – decelerated demonstration of the phenomena may bring about a very good effect on original pictures. During recent years we have availed ourselves of the opportunity also in this field. We assumed the preparation of 8–15 educational and documentary films yearly, so – added to research films – 40 to 60 films were shot by us yearly.
- To complete the stock of our special film technical appliances in 1971 we started to purchase means of *Infrared Technique* and to widen circle of such kind of measurements. By means of our AGA Thermovision System equipment we make recordings of temperature distribution in a range of -20°C and $+2000^{\circ}\text{C}$. On the display of the equipment the different temperature points of objects appear in different colours. Isotherms – points of identical temperatures – are shown in same colours. Thus we prepare photographed, coloured heat maps, fulfilling 35–55 such commissions in a year. [22–24]
- In 1973 we put up an independent sound-studio which has been modernized since that time systematically. The magnetic and light sounding technique of 16 mm films is applied not only in our own films, but we lend a help to other film studios, too. Nowadays we can rank among our regular clients the Hungarian Television and the Hungarian Film Making Company. In 1982 we entered in a cooperation activity abroad with the intervention of the Hungarian Film Laboratory. In our studio is operating the most up-to-date 16 mm light-sounding equipment in the country. [16]
- The Archive of Films for High Level Education and*

Research was established in 1976. [18] Now we lend a help in biological and technical education by loaning of 1000 films. By purchasing 622 films of the Encyclopedia Cinematographica (EC), 210 films of the Scientific Research Film Service in Paris with the support of the State Office of Technical Development, the Ministry of Culture, the National Centre for Education Technology and the Hungarian Academy of Sciences, further adding our own films and the prize-winning, gifted films of the Technical Film Festivals, we established one of the largest scientific films archive of the country. By regular hiring at a symbolic fee per films and days, the Archive has a yearly turnover exceeding 150.000 forints. In 1980 we issued our first catalogue of 550 pages containing professional information about 777 films with a summary of their contents too [29], completed in 1982 by another issue on 123 pages introducing further 147 films. [30] Our Research Film Centre lays a great stress on the promotion of the home and international exchange of technical experience.

The central, social base of the *home research filming activity* is the Optico-Acoustical and Film Technical Association acting in the framework of the Federation of Technical and Scientific Societies. With the cooperation of this Association – besides lectures and shows – an exhibition of research filming means was organized in the House of Technique already in 1964 and since 1969 – National Research Film Days have been held 2–4 yearly. On the last „Research Film Days’ 81” 49 foreign and domestic lectures were held.

In 1972 the 3-day Budapest show of the greatest scientific film centre of the GFR, that of the Scientific Film Institute Göttingen was arranged where 97 research films concerning technics, biology and folklore were presented. The show met nationwide interest, primarily with respect to high-level education. As a result of the above, we succeeded in purchasing several hundreds of films of the Encyclopaedia Cinematographica (EC). In the activity of the International EC 578 specialists of Scientific film-making from 36 countries – among 18 to whom Nobel Prizes were awarded – participate, thus it represents an unreplaceable documentary value. [31] Complete or partial archives of it exist in 14 countries. Among the Comecon countries it was Hungary, where the first socialist EC archives were founded. Numerous technical films shot by us were also adapted by the EC.

Since 1973 we have been co-organizers and since 1976 independent organizers of the International Budapest „Technical Film Festivals” held in each third year on the initiative of the Optico-Acoustical and Film Technical Association. 100 to 150 home and international films were judged by an international jury in general for a week. This public show gave valuable information first of all to the domestic specialists, but the shows were regularly visited also by specialists from abroad. In 1982 was organized the 9th Technical and Mo-

del Design Film Festival on the initiative of the Ministry of Industries, Ministry of Housing and Public Construction, Ministry of Transport and Communication, Industrial Model Design and Publicity Centre of the Hungarian Chamber of Commerce, Industrial Model Design Council of the National Office of Technical Development.

To enlarge professional knowledge and information of the Hungarian specialists and research workers, the Centre issues suitable *written documentation*, too. The Instrument and Measuring Technique Centre in its issues, in the journal „Picture and Sound Technique” [13], in the „Audio-Visual Issues” [16] gives a continuous home information on the Research filming activity. In 1965 was published in Hungarian language the book of W.G. Hyzer titled „Engineering and Scientific high-speed film shooting” contributing to the home propagation of the research filming technique with much information. [15] In 1973 was edited the handbook „Technical photography and filming” describing the means and methods of special photo- and film technique. Among the authors we can also find the workers of the Centre. [10] In 1982 we prepared a summary for the handbook of Short-film production under the title: *Research Film in service of Industry and Science*”. [20]

Besides those achieved at home, our activity rejoices in having step by step developed international relations and successes, too. As soon as in 1963 contacts were already entered with the Research Film Section of the International Science Film Association (AICS–ISFA) organizing international congresses yearly at different respective places. In this organization having been functioning for 35 years now our intern and extern co-operators presented numerous lectures illustrated with films prepared by them. In 1974 Hungary undertook the organization of the AICS Congress in Miskolc [21] in the framework of which the organizational work to be done for the Research Film Section was completely performed by us. The successes achieved by us were honoured by the fact that the presidency of this section is being permanently filled in by the professional head of our department or research films as the representative of Hungary. [32] Our international relations, however, are not limited to this organization. There exist permanent contacts with the International High-Speed Photography Congress [14], [26], [27], the Centres of the universities in Padova, Milan, Utrecht, Eindhoven, with the International Colloquium of Educational-Research Films Brno, the film Centres in Warsaw, Katowice and Moscow, with the research film experts of the Microbiological Institute of the German Academy of Sciences in Jena, with the National Committee of Technical Development in Sofia, with the Scientific Research Film Service in Paris.

* * *

From this brief outline of the 20-year research filming activity displayed in the framework of the Centre it can be established that the initiation aimed at the introduction of this modern method of measuring technique reached the goal; by a step-by-step development it rendered very valuable help in the national research filming activity even till now. Our future aim is to proceed with this work by the help of several hundreds of our partners, national organs, with the cooperation of which we could reach our hitherto good results outlined above.

We should emphasize the enormous intellectual property accumulated during many years: the propagation of this up-to-date technique in Hungary on such a high level. In order to raise this level even more higher we are at disposal of the domestic and international research and development work, education with our film-making, sound-, infrared technical means and film hiring services.

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On services on the Technical Secretariate

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This article displays „by the eye of consumers” the consulting possibilities, sources of the instrument Centre, emphasizing at the same time the relationship of this activity to the national tasks, to the activity of the National Research Equipment Committee and the Instrument Committee of the Hungarian Academy of Sciences. It gives a short description of the Prospectus Collection, the National Instrument Register, the National Instrument Service Register and the National Free Instrument Capacity Register.

The free of charge consulting activity has been incorporated in the activity of the Centre from the very beginning [1] all the more it has been carried out at the legal predecessor, formerly. Without going thoroughly into the details, we can mention two, fundamentally different periods, as far as the contents of services are concerned:

- During the period of „research institute conception” the consulting work concerning the summary of factual measurements, the application of instruments and of hired instruments has prevailed (this period was ended in 1967) and the Consulting Department has worked and has been constructed accordingly. [2–4]
- When the „service conception” has been developed (after the above period) the information, especially that preparing certain decisions has come into prominence. [15]

This change has fully met the requirements of our inland instrument users and of the national economy. Just following these requirements and the gradually developing possibilities of the realization have reached the instrument consulting services the level of today. We outline hereunder our today's possibilities.

1. Possibilities of our consulting work

a) *Consulting activity in investments.* The Consulting Department can lend a help for the purchase of new instruments in several respects

- *from the Prospectus Collection* the prospectus of the required or any other instruments can be picked out enabling us to get acquainted better with the possibilities

- The data of the *National Instrument Register* (in case of instruments worth more than 100.000 forints) inform us on the availability in the country of instruments to be purchased or of the competitive ones; in the affirmative the Register shows the town where the instruments work furthermore it shows the user of the instruments and the person who can give more detailed information on the experiences gained hitherto, providing for possible testing of the instruments.
- The data of the *National Free Instrument Capacity Register* – by the help of instruments available in the hire instrument park of the Centre or to be offered for cooperation hiring – indicate the possibilities by which the measuring problems may possibly be solved not by investment.
- From the data of the *National Instrument Service Register* we can get information on the availability of service facilities in the country for the operation of the instrument to be purchased.
- Upon request, we can give short information (in case of more valuable instruments – so called „background information”) where same or similar instruments do work in the country; to what extent is the chosen instrument suitable for the given task, and whether there is a service facility for the instrument.

b) *Consulting activity on measuring technique.* It comprises the problem, what kind of instruments is useful to carry out the given measurement. We can give information – on basis of National Free Instrument Capacity Register (in case of located instruments) what are measuring facilities from the hire instrument park of the Centre and where is an opportunity to carry out such measurements (in case of instruments in a value exceed-

ing 100.000 forints) on basis of data of National Instrument Register. Further information can be obtained on the problem, who can give detailed information in a special measuring field.

c) *Consultancy of operation.* Here are also several possibilities.

- in case of instrument breakdown, the *National Instrument Service Register* informs us on the service facilities
- in case of located instruments, after the notification, the data of the instruments will be registered in the *National Free Instrument Capacity Register* and anyone interested in these instruments will be sent to the operator thus promoting the better utilization of the instruments. (Better utilization of not located instruments is promoted by the Instrument Hiring Department through so called „*cooperation hiring*“.
- Concerning the supplement of instruments (improvement) the data of *Prospectus Collection* give adequate information or possibly other users of instruments, who are enlisted in the *National Instrument Register*.

d) *Consultancy for inter-departmental cooperation.* The so called inter-departmental instrument committee established by the National Research Equipment Committee and by its experts, its inter-departmental work committees and by the ministries and authorities being interested in the measuring technique also can lend help for solving certain problems in this field. Their secretariates have regular relations with each other, with some institutes and experts, employing some experts as constant consultants.

The purchase of instruments above 100–500.000 forints value requires the decision of the inter-departmental committee, while above 5 million forints the National Research Equipment Committee decides on the purchase of such instruments. The Secretariate of the National Research Equipment Committee acts within the framework of the Centre and can promote the solving of problems by inter-departmental cooperation, involving the committee secretariates. The Consulting Department and the Secretariate of the National Research Equipment Committee cooperate closely in this respect, too.

2. Sources of the Consulting Work

The intellectual capital of the Consulting Department collected for years means the main source of the consulting work, the most important fact of which is whom to ask or where to look for, when we want to know something. First of all the Computer Department, in cooperation with the Consulting Department and the Committee Secretariates, (Secretariate of the National Re-

search Equipment Committee and of the Instrument Committee of the Hungarian Academy of Sciences) their members and the outside consultants can be mentioned here, but we can likewise recon with the skill and help of other experts of the Centre.

Besides the intellectual software, we have however other objective sources, data bases, too. In the following we give you a short description of this.

a) *National Instrument Register.* The construction of the National Instrument Register reorganized in 1975 on the basis of the resolution of the Commission of Science Politics has already been described in detail. [6–8] Hereunder, we outline only the main characteristics of this system:

- *Collection field:* On basis of nation-wide resolution of the Chief Secretary of the Hungarian Academy of Sciences [9] it consists of data of instruments reaching 100.000 Ft purchase price and of equipment to be used for research-development purposes.
- *Data-Suppliers:* The operators of instruments belonging to the above collection field and the marketing firms.
- *System:* computerized data basis. Fetching can be effected by means of terminal available at the Consulting Department in case of both individual and statistical collections.

The data basis and the whole system of the National Instrument File are being developed and updated. Its importance grows constantly. At present data of several ten thousand instruments are stored.

b) *Prospectus Collection.* The Prospectus Collection and the National Instrument Register are information sources of the same importance in the consulting work. The Prospectus Collection contains the prospectuses of 2000 instrument manufacturers in grouping according to the manufacturers and to the subject name catalog. The collection field of the Prospectuses has been extended to the accessories and auxiliary materials, too. The data collection activity is determined by co-workers participating in the consulting work in knowledge of daily requirements and measuring technique trends, considering also the publications of stored and catalogized periodicals of the manufacturers.

Survey and registration of prospectuses, descriptions and brochures of instruments are kept in the index-cards according to names of manufacturers in alphabetical order and by special cards according to the classification order elaborated for the instruments of the National Instrument Register.

c) *National Instrument Service Register.* The information materials of this file are kept in cards and also include service representation contract summaries. Cont-

rary to the information sources mentioned above, there are no-code systems here, however, entering information is to be considered as data supply, too. The information to be obtained through the National Instrument Service Register refers to the home service representation of foreign instrument manufacturers and to their services. It has great importance in case of investment in certain instruments. At present the service representation data of abt. 250 manufacturers are kept here.

d) *National Free Instrument Capacity Register*. This is our latest register, applying a simple storing method. Here there are stored data about localized stationary instruments offered for use by other clients which are showing free capacity. Any client interested in this field may obtain information from these data. The purpose of this file is the promotion of better utilization of the instrument stock.

e) *Technical Library*. It serves as information background of the Centre's work, and has an outstanding role in consulting activity due to its special collection field. Its main data are as follows:

- number of subscribed professional periodicals in Hungarian: 33
- number of subscribed professional periodicals in foreign languages: 40
- number of volumes: 3700

Further sources are the data of surves, controls etc. made by the departments and National Research Equipment Committee.

The hire instrument list mentioned in the article [10] of the Instrument Hiring Department and the accession lists published in the Instrument and Measuring Technique News are useful additions to our information sources. Our review will be complete only with the following data concerning the sources and the activity of consultancy.

New data of abt. 4000 instruments are kept in the National Instrument Register. More than 1000 prospectuses arrive here regularly. We furnish consultancy 350 times on an average and prepare 60 background information. By the help of the above and by distribution of Instrument and Measuring Technique News issued in cooperation with the Consulting Department, we maintain regular relation with abt. 1500 experts. In connection with the National Instrument Register, we are in contact with the experts of nearly 1000 institutes, and consulted abt. 300 clients on ad hoc or other basis.

As far as the plans are concerned, we can point out the following:

- we are going to increase the measuring technique activity by which the measuring problems can be solved more quickly and at higher level, furthermore the

home instrument stock is better utilized.

- we are going to establish a closer relation between the Prospectus Collection and the National Instrument Register.

3. Nation-wide instrument technique activity

This activity is closely connected to the work of the Consulting Department. Before drawing the conclusion of this connection, let us look over the part of this activity connected directly to the work of the Centre, the operation and development of Committees helped by the Committee Secretariates acting at the Centre.

3.1. National Research Equipment Committee

The National Research Equipment Committee has been the inter-departmental consulting, and resulting body of the Committee of Political Sciences since 1977. The short description of its construction and tasks can be seen in the almanac of the Hungarian Academy of Sciences. [11]

On the basis of data of one of its reports its activity can be summed up as follows [12]: „In the first year after its foundation (1977) it made a proposal [1] concerning purchase of valuable instruments, establishment and activity of instrument committees [2]. In 1978 it made a proposal [3] concerning economical use of instruments. In 1979 the operation valuable instruments was checked at site, stating that the material, spare part and service supply can be considered as an objective hindrance of economical use. In 1979 the harmonizing of procedures of the instrument committees was also examined. In 1980 the problems of material, spare part and service supply of 3000 instruments of 300 research points were surveyed and five departments made proposals for their settling”.

As it is obvious from the description, this activity covers all fields of instrument technique from the point of view of political sciences and economy. In the framework of this most important task of the National Research Equipment Committee is the publication of proposals [13], [14] and descriptions [15], [16] contributing to better economy.

The National Research Equipment Committee – besides the departments represented by it directly – maintains relations with other departments and enterprise-research centres. Within the framework of these connections, the task of the Secretariate is preparation and organization of work.

3.2. Instrument Committee of the Hungarian Academy of Sciences

It is a specialized Committee established by the Secretary General of the Hungarian Academy of Sciences [17] summing up instrument technique problems of the Academy. The personal composition is shown in the Almanac [18] and the regulations are figuring in the Bulletin of the Academy. [19]

The Instrument Committee deals with classification of instrument investments of the Academy, with efficient operation of the already purchased instruments, with their development, improvement, material supply, considering the proposals of the National Research Equipment Committee and the inter-departmental, common, co-ordinated instrument programs.

3.3 Tendencies of development

The quantitative and qualitative development required by a general improvement of quality and by renewal of product structure are restricted by the sources. This latter has an unpleasant effect not only in case of purchase of new instruments but also at the material, spare part, auxiliary material, service-supply of already purchased instruments.

The purchase of new (especially imported) instruments and their operation have met with several difficulties. The question raised two years ago: hiring or investment [20], [21] will be decided to the benefit of hiring more and more. The increasing demands can be followed first of all by more intensive utilization of the instruments, already imported.

Investigating all this from the aspect of consulting and instrument technique activity, it is expected that the – importance and turnover of the National Free Instrument Capacity Register of the National Instrument Service Register will grow

- the instrument technique consultancy will be more important
- the modernization and development will push into the background sorting out and replacement of old instruments
- the development of measuring service and economic use of the instruments will contribute to the general improvement of quality and to the renewal of product resp. production structure.

During the past quarter of the century, the Centre developed to a nation-wide instrument institute. The Centre promotes the nation-wide undisturbed instrument technique activity. On one side, by hiring from the hire instrument park, and by its services on the other. There is an other important service activity in the field of special technologies (research filming, vibration tests, acoustic measurements, thermovision control, etc.),

namely the assumption of a part or the whole of tasks from the costumers.

This material activity is completed organically by consultancy. Its tasks and development directions are given. All these determine the necessary development. It may be said, our task is to make possible the necessary and then to realize the possible. It is not easy, however, we are convinced that it can be solved by the help of our partners.

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