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PRODUCTIVE ORGANIZATION OF GEODETIC, TOPOGRAPHIC AND PHOTOGRAMMETRIC CALCULATIONS

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Numerical data form the base of the activity of every Concern working in geodetic, topographic or photogrammetric fields.

To achieve the final result, that is the cartographic product, a long series of elaborations of numerical data is necessary, elaborations that begin with geodetic surveys, continue with topographic surveys, and at last, by aerial triangulation processes, supply the geometrical support to the photogrammetric plotting.

In a short time a Concern having an activity little more than modest, finds itself to have a very considerable mass of calculations to be executed, which absorbs the activity of numerous staff; to face the necessities, it's compelled to adopt simplified procedures at a loss of the quality of the work. Furthermore, a Concern, having a great activity, will find itself not able to face the calculation needs, though dedicating to it very numerous staff, if it does not use suitable means. And that because, though subdividing the calculations as much as possible among the staff, each of them will require such a time of execution that the rythm of production will not be kept by the departments which must utilize the results of the calculations.

At last, logarithmic or mechanical computing machine calculations, besides very much limiting the size of the resolvable problems (it's enough to think of the time necessary for the resolution of a system of only some tens of linear equations), are made heavy and slowed down by the numerical checks indispensable to correct the numerous errors that are inevitably made.

From the first appearance of electronic computers, it was evident that one of the fields of application, where the use of these new means seemed to be the most profitable, was the one of Geodesy, Topography and Photogrammetry. In fact, electronic calculation, besides allowing the execution of a very large quantity of little size calculations. in a very short time, so allowing the quick completion of field works and hence an increase of them, has made possible the practical solution of problems that remained at the state of mere theorical speculation till little time ago.

A typical example is represented by the adjustment of great geodetic nets. For example, the Italian first order triangulation net was subdivided in eight partial nets each of them with one measured base, and each one was separately adjusted, maintaining unvaried the length of the extended base and that of the junction perimeter with the adjacent net that had been previously adjusted. The calculations were executed by logarithms, in three copies. Field measurement had been completed before the end of the last century, and the results of the adjustment were published part in 1908 and part in 1919. Furthermore, after the adoption of the International Ellipsoid of reference in substitution of the Bessel's one, and of the 1940 definition for the point Rome M. Mario, the datum point for the net, the problem of a new calculation of the geographical co-ordinates arose: because of the complexity of the calculations based on the development in series of powers of the lengths of geodetic line arcs for the transport of geographic co-ordinates and azimuths, it was satisfactorily solved only after the adoption of the Gauss projection, performing the calculations on the projection plane.

In 1950, by an IBM 650 computer, a machine about a thousand times slower and with a storage capacity enormously reduced than the computers existing to-day, a junction adjustment of the European geodetic nets was performed by the U.S. Army Map Service. The nets were reduced to figures formed by chains of triangles, and the calculation was performed, with some analogies to the procedures followed for the ancient Italian net, by adjusting in a first time a group of nets of Central Europe and then a northern block and a southern block maintaining the perimeter of the central one unchanged. Therefore, by this artifice too, normal systems of over than two thousand five hundred equations were solved, which would not be possible by traditional means and methods. Again by an IBM 650, in 1960, the writer compiled a calculation program for the transport of geographic co-ordinates and azimuths along an arc of geodetic line, which allowed to calculate the co-ordinates and the azimuths of all the points of the first order Italian net in less than ten minutes.

To-day, an international agreement for a new adjustment in a unique block of the whole geodetic nets of the European Nations participating to the project, is in advanced phase: some calculation programs permitting the solution of the problem by a unique processing have been prepared.

From the preceding examples it appears evident that the use of an electronic computer forms the base on which the activity of a Concern, in which the execution of calculations is a pre-eminent part of the work, must be founded.

An efficient organization of a calculation centre implies the solution of many problems, each of which depends on various circumstances which often influence in opposite directions, so, after all, the best solution from all the points of view, may be considered inexistent. Then, it comes to adopting a solution of « optimum », allowing to get the greatest number of advantages at the less cost and with the least number of disadvantages.

The principal problems to be solved are: a) the type of computer to be adopted and its location; b) the surveying systems for field works, the production of data to be processed in home works, the calculation programs; c) the staff. We'll now consider the principal sides of these problems, showing what, in our opinion, are the fundamental principles to be followed.

a) Choice of the type of machine to use.

It's evident that all necessary calculations may be made with any machine: in theory, indeed, once the resolutive formulae have been established, every calculation may be executed by a person knowing the multiplication table and having at his disposal only a pencil and some writing-papers: it is evident, too, that the more powerful the means at his disposal will be, the more rapid the execution. Therefore, there is to considerate another side of the question: the more powerful the means are, the more complicated and expensive the organization of the calculation centre and the more onerous idle times become.

For example, an electronic computer of little capacity, of one of the numerous types to day at our disposal, is constituted by one unit, of about the size of a normal writing-desk, and it may be put in any room, without any need of special installations of electric power or of air- conditioning. Though enlarging it by some additional peripheral units, particular necessities of installation will not arise and the managing may be assured by only one operator: furthermore, a weekly preventive maintenance from an external technician will be sufficient.

In case of trouble, generally, however, of very low frequency, the wait for the technician will not cause a considerable economic damage and the cost of the repair will be contained in limits narrow enough.

On the contrary, one of the largest data processing systems to-day existent is formed by a central unit, connected with several tens of peripheral units, some of which are, in their turn, big computers. For its management, a team of well trained operators is necessary, a daily preventive maintenance is needed and a team of technicians must always be present to eliminate each trouble could happen, as rapidly as possible: because of the high number of units forming the system, evidently the frequency of the troubles is higher. Furthermore, for its location large rooms purposely constructed or qualified are necessary, with a particular source of electric power stabilized within very narrow tolerances, relatively to the tension as well as to the frequency, and a temperature and moisture conditioning system.

Between the above two limit cases, there is a vast scale of types, also because, generally, a data processing system may be provided with a very variable number of peripheral units. The ideal system allows, for the execution of a given calculation, to input the least number of data and, after starting the machine, to get the final results in the shortest possible time and without any necessity of manual intervention: in this way the human intervention, which is the principal and very frequent cause of errors, is reduced to a minimum.

To execute in such a way very complicated calculations on a great number of data, a very large data processing system, thus implicating a considerable organization for the use and a very high cost, is necessary: by such a system, evidently, it would also be possible to execute the simple calculations.

Such a solution, however, would not be rational from the economic viewpoint. In fact, let's consider the following sides of the question: first of all, a Concern could not have such a mass of calculation to conveniently exploit so powerful means as great its activity could be: then it would be necessary to institute a real calculation centre which execute works on behalf of a third party. In such way, therefore, a Concern in a Concern would be established with a serious prejudice for the functionality. Also, to adopt as a solution not to estabilish an one's own centre of calculation, but to use for all calculations an already existing centre equipped with a large size data processing system, would not be rational economically: in fact, the large size system is economically convenient in comparison with the little or middle size ones, because against a cost ratio which, in general, is around values included between 10:1 and 50:1, we have an increase of the operative speed which oscillates between about 50:1 and 500:1 or, if compared with small systems equipped with magnetic drum storage, it may exceed the value of 5000:1. However, this increase of speed is only in the actual time of calculation: for data input and output, the increase of speed is much more reduced.

For very complicated calculations, the time required for data input and output represents a rate, on the average, of $10 \div 20\%$ of the processing time, while for simple calculations it may raise up to 90%. It is clear that, in such cases, the large size system may result anti-economic.

Apart form the not economic convenience, there are difficulties of practic order too for the use of an external centre of calculations: even when it is situated in the same town as the Concern, which it doesn't always happen, it is necessary to take preventive agreements to execute the calculations and, in general, it will be necessary to plan their execution in successive time periods properly choiced, thus greatly reducing timing advantages that could be gotten.

Discarding, so, the solution consisting in the use of a large size system for all the calculations, and discarding small computers too, for easily understandable reasons, it is necessary to turn our attention to middle size data processing systems.

Modern trend, now followed by all manufactures, is to produce modular systems, consisting of a basic composition to which work storage units as well as peripheral input-output units and magnetic tape or magnetic disk storage units can be joined. A composition able to meet most of the requirements would consist of a processing system equipped with a magnetic core work storage, able to hold about 5 000 program instructions and a thousand numerical data, and with two magnetic tape or magnetic disk peripheral storage units.

For data input we believe, not claiming, by that, to judge better than those who might be of contrary opinion, that it is more convenient to use punched cards instead of punched paper tape, whereas for the output of the results we believe more convenient to have a card puncher and a printer on line. As for a more speed use, it could be obtained by a punched cards to magnetic tape data converter: in such case auxiliary magnetic tape storage units should be at least three.

Such a system could execute conveniently, that is without subdividing the calculations in parts, with manual intervention between one and the other, the most of calculation types that can arise in the development of technical work; being, moreover, a system with a somewhat high speed of execution, it could execute a great part of the book-keeping and administrative work.

Some calculation types, nevertheless, as the adjustment of large trigonometric networks or of large analytical aerotriangulation blocks of strips, couldn't be conveniently executed by such a data processing system, because they would need a continuous use of auxiliary storage or even the subdivision of the computation in successive steps, thus very greatly increasing the processing time, so that the machine couldn't be used for minor computations of current use. « Optimum » solution is, from the above considerations, to choice a system of medium size, with a composition suitable to the volume of computations it shall execute, and to resort to the service of a computation centre, equipped with a large data processing system, for the resolution of calculations of large size. They will occur with a frequency very smaller than those of current use, so that their processing can be easily distributed in the time, without any trouble at all.

Moreover, a careful consideration of whether it will be convenient or not for the Concern to install its own medium size data processing system, as said above, shall be made on the base of the volume of work. To dispose of its own data processing system, indeed, assures the possibility of utilizing it at every moment, whereas the service by an external computation centre will be, generally, possible in periods of time agreed upon: as for the cost, its own data processing system involves an about fixed expense, should or not the system be fully utilized, whereas the service of an external centre is paid on the base of the actual use. If, therefore, the Concern has such a volume of computations that the cost of the service approaches to that of self managing, there will be no doubt about the choice: on the contrary, it is necessary to estimate if timing advantages can balance the increased cost of the computation.

If it is decided to install a data processing system of one's own, it should be considered if it is more convenient buying or renting it. We believe that renting is the most convenient solution, by a series of reasons it should be too long to enumerate; we'll limit ourselves to the following considerations: first of all, all producing Houses are engaged to produce ever more improved types of data processing systems (let us compare the machines of current use ten years ago with those of today), so that if a system is now estimated to be very good, it isn't so after a few years; moreover, producing House ensures with the rent the maintenance of the system, for which, on the contrary, with the buying, a separate agreement should be made, as it is out of mind to have one's own maintenance staff. As the life of an electronic computer is limited, as an average, to less than ten years, and the maintenance becomes more and more expensive with the age of the machine, it is the interest of the produncing House too to substitute, after a certain time, the old system by a new one or by an improved type. The renting price, however, corresponds to about the depreciation allowance.

The basic criteria for the choice of the producing House are, in our opinion, two: the organization of which it disposes to assure the maintenance, and the «compatibility» between the various types produced. The last criterium is very important, because generally, after installing of a system has been decided, as pondered as the decision may be, and though it may be taken looking at future developments, managing experience will put clear many unforeseen questions, so after some years the convenience of changing the type of the machine might be advised: if the new type is compatible with the preceding one, there are practically no troubles because existing computation programs will be accepted, eventually with slight modifications, by it; on the contrary, it should be necessary to compile again all computation programs, which would involve a very great mass of work. Another not negligeable side to consider is the compatibility between the choiced data processing system and the large one it is envisaged to use; any computation program, indeed, that have some complexity, after the first draft shall be tested and « restated »: it happens very rarely, as a matter of fact, that it is not necessary to make improvements to it or correct some errors. Program restating phase by a large data processing system may result very long and expensive; if the smaller data processing system is compatible with the large one, restating phase shall be profitably executed by it, eventually subdividing the program in parts to be tested successively.

b) Organization of the procedures to be followed.

Contrarily to the idea widely diffused among the laymen as regards this matter, an electronic data processing system may be compared with a very diligent servant, lacking in every capacity of reasoning, but able to execute all the orders which are given him, with the greatest accuracy and speed, understanding only their literal meaning. The series of orders which the machine must execute is the calculation program: it must, then, foresee in the least details all arithmetic operations to be executed, considering all the particularities which may happen, or the form and the order in which data input are fed in the machine, and the form and the order of output data. Once the calculation program is fed in the machine, it is like a railroad on which the calculation will have to proceed: as it is not possible to make a train proceed on a different gauge railroad, so it will not be possible to execute a calculation if input data are not fed with the foreseen form and order; maintaining the analogy, the program shall foresee the throwing over all the points during the run to lead the calculation to the suitable results.

It's evident the narrow interdependence between the procedures for data measurements and the concerned calculation programs: if a given field operating procedure is executed, the program which is compiled for the calculation must reflect this procedure, trying to eliminate intermediate operations between the measurements and the calculations as far as possible; if, on the contrary, the calculation program is previously compiled, the operating procedure will have to respect strictly the prescriptions of the program. A very suitable example to clarify this idea is given by the aerial analytical triangulation: having a given instrument, mono or stereocomparator, by which a given technique of observation has been experimented and got ready, the calculation program shall be compiled as to use the data recorded by the instrument, without any alteration in the form and in the order of succession: if, on the contrary, the calculation program has been previously compiled, operators shall observe the points in the order and in the number foreseen by the program and according to very exact modalities. For this reason, generally, it happens rarely that a calculation program compiled by other people may be profitably utilized: in fact, it would be necessary to change operative procedures, wich might cause serious troubles, or manually to elaborate the data to put them in the form and in the order foreseen by the program, which would cause, inevitably, frequent errors, so, after all, it is more convenient to compile the program again, eventually on the pattern of that already existent.

For the installation of a centre of calculation it is necessary to have a library of programs which can effect the calculations pertaining to all the procedures followed by the Concern; these, in their turn, shall be reduced to a certain number of fixed outlines that shall be always followed without exception, which is always possible. There is, in that, an evident parallel with the establishment of a mass-production processing line. For the productive activity, the Concern will have to select a definite number of procedures, which have been tested suitable to give satisfactory results, and to organize its own work in similar way as the mass-production procedures. If the case be, it will be allowed to have scientific purposes too or to look for an improvement of the systems of work, but its study and research activity will not have to interfere with the productive process: the organization of the activity of research will have to be kept separate from the productive one as far as possible, and its results can be utilized by the production only when their procedures have been completely tested, otherwise some very harmful hitches will arise.

A Concern having a suitable potentiality may receive commissions for the most disparate works, in a range going from the execution of a technical spirit levelling line, to the survey of the town-plan of a municipality, or to the compilation of the cartography of a State in way of development, starting from the institution of the geodetic control net and of the fundamental vertical control net, till the photogrammetric survey and the drawing of the maps.

A survey of this last kind includes all the types of activity, so it will be sufficient to examine the necessary organization for this case.

Evidently, the examination will be limited to the side concerning the calculations.

The Concern shall have a field organization to execute:

— the net of geodetic levelling;
— the net of geodetic triangulation or trilateration;
— the topographic densification and the ground determinations for aerial triangulation.

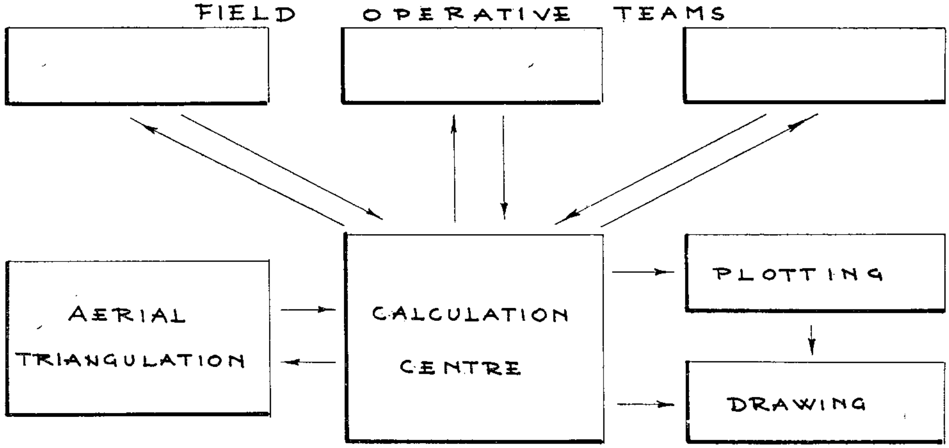
We don't consider, for our purpose, photogrammetric flights and reconnaissance operations.

The Home organization will have to execute:

— the aerial triangulation;
— the plotting;
— the drawing of maps.

Both organizations have their head in the Centre of Calculation, which is the heart of the whole complex: it receives field measurement data, processes them, gives starting elements to the aerial triangulation, processes its observation data, and gives the plotters and draftsmen their results and the data relative to the geometric frame of the map for the selected cartographic projection.

The organization may be synthetized by the following diagram:



The calculation by an electronic data processing system is based on a fundamental pre-supposition: the input data are like the used calculation program foresees them; any error or inattention isn't permitted, for the machine cannot recognize even the most coarse mistake. Therefore, it's indispensable that the data to be processed are minutely checked, and the checks must be made in all the steps preceding their feeding in the machine. The calculation programs can be more or less « intelligent », that is to foresee a certain number of checks to find errors, but we shall not exceed a fair limit, because by increasing the number and the complexity of analyses on the data, the processing time and the zone of the storage occupied by the program are increased; on the contrary, it is preferable that checks are reduced to the essential, for, generally, it will be more advantageous to repeat some calculations than to lengthen processing time for them all.

Checks shall begin, therefore, from the phase of data measurement: the field organization will have to foresee some work managers to assign to the operators the elements to be measured and to receive observed data. An intelligent distribution of tasks for a prompt progress of work is not the only or the most light task of a field work manager: having collected observation data, he will have to make a diligent check, by effecting all the verifications required. For example, in a spirit levelling net he will have to check the differences between the values of the opposite levelling runs, ordering the repetition of the measurements which don't result below the tolerance, he will have to check the closure errors of the polygons, and so on. In a triangulation net he will have to check the angular and lateral closure errors, to effect checks by means of graphic determinations, etc. In a trilateration net, preliminarily, or definitively if it is not foreseen by a calculation program, he will have to execute the reduction of the measured distances to the sea-level, to verify geometric conditions existent in the net, and so on. On the whole, he will have to effect all the necessary checks to avoid coarse errors and to assure the executed measurements have a precision suitable to the purpose to be reached.

The data so controlled will have to be written on forms devised so as to be directly given the operators charged with the card punching. As they are available they will be sent to the Calculation Centre.

The registration of observation data of the aerial triangulation too, analogically as well as analytically executed, will have to be made so as to avoid transcriptions of numbers as far as possible: the ideal thing would be to make it directly on puched cards.

The Calculation Centre shall have an organization able to accomplish the following tasks:

— Data punching and checking. It shall have a sufficient number of punching and of verifying machines. In this connection, it's necessary to keep in mind that the necessary time for data punching is very preponderant as to the time of calculation: to feed a small computer for one hour of calculation, days of time are necessary to punch the data.
— Managing of the installation, in the case that an one's own computer is installed.
— Compiling of programs and their restating. A library of calculation programs suitable to foresee all the necessities forms the base of the activity of a Calculation Centre. Furthermore, a calculation program, as well devised as it may be, will hardly be considered definitive, for during the daily practice it will often happen to recognize the opportunity to make some improvements, so that it may be said the work of the programmer is always necessary.

For the activity we are examining we believe necessary that the library of programs foresee the following cases:

1) Adjustment of a spirit levelling net.
2) Adjustment of a spirit levelling line between two bench marks of known altitude. Naturally, the program will have to foresee the use of the various kinds of staves that may be used, and the introduction of the measured or calculated values of the gravity.
3) Planimetric adjustment of a net of first order triangulation and/or trilateration.
4) Planimetric and altimetric adjustment of a densification net of triangulation and trilateration.
5) Calculation of astronomical latitude, longitude and azimuth.
6) Calculation of horizontal and vertical control traverses.
7) Calculation of single topographic points (direct, inverse, mixed intersection, polar co-ordinates).
8) Calculation of bridging of photograms and adjustment of blocks (or single strips) observed by analytical photogrammetry instruments.
9) Adjustment calculation of blocks observed by analogical instruments.

Naturally, the programs will have to be made as to exclude manual elaborations as far as possible and to foresee all the operative procedures used: moreover, operative teams will have to apply only the procedures foreseen by the calculation programs, and according to the established modalities.

Furthermore, a good program will have to foresee the greatest flexibility for the input data, as to make possible the choice of the instruments more suitable to the conditions under which the field work is done. Besides the above mentioned programs, therefore, others will be necessary for particular purposes, as, for example, for the transformation of co-ordinates from the geographic system to the ones of the cartographic projections used, etc. It will be opportune too, moreover, to have a series of programs for the preliminary check of data to be processed by large size computers by the programs mentioned in 1, 3, 8 and 9; before sending the data to the calculation it will be opportune to subject them to a series of checks, to absolutely avoid any error: the most quick and sure way to do so is the preliminary processing by the computer which the Calculation Centre disposes of, by programs making complete testings for debugging, lightening in such way the program of the large computer.

The work of the programmer staff isn't limited to the compilation of the calculation programs: it will be opportune they supervise the forming of decks of punched cards containing the data, adding the cards containing the indications needed by the calculation program to select the alternatives of the specific case: afterwards, when a calculation program is executed, it is also opportune that the programmer, who can intervene in case of troubles and eliminate them, is present near the machine;

— Checking of the results. All the results of calculations have to be checked: if some errors happened, the compiler of the calculation program will be able to find the cause;
— Organization of data reception, data distribution, filing and recording, supplying of the materials and, in short, accomplishement of all the bureaucratic practices.

Evidently, the whole organization of the Calculation Centre must be directed by a sole manager able to oversee and to co-ordinate the various activities.

c) Staff.

Staff is the keystone of any organization of this kind: by staff able to accomplish its own tasks also a rather faulty organization can give very good results, but by qualitatively insufficient staff even the most perfect organization will give poor results. This is true, first of all, for those who have to direct the various branches of activity.

In field operations it is necessary the operators are able to perform good measurements, but it is still more necessary they are led by a manager who can execute an efficient check of measurements and set them in the form needed by the calculation.

Above all, the Calculation Centre needs staff more than suitable. For data punching it's necessary the operators are very quick and exact: experience has shown everywhere that maximum yeld is gotten by young girls, and that male personnel is ill-suited to this work. On the contrary, men are superior as operators for the computing machine: naturally, it is necessary they perfectly know the use of the machine itself.

Programmer staff forms the principal part of the Calculation Centre, and it is the most difficult to find out.

A good calculation program may be compared with a work of art: to realize it a very good knowledge of the mathematic tool is not sufficient, but it is necessary « to feel » the logical organization of the process. The succession of the various computation sequences, as well as the selection of the methods to be applied, is the consequence of a series of pondered decisions and of a particular sensitiveness, so that the resulting program take complete advantage of the possibilities given by the machine, reduce to the least the arithmetic operations to be executed, use as far as possible the repetition of instruction sequences (to reduce storage occupation), and foresee all the possible alternatives that may happen.

Furthermore, besides a very good knowledge of the machine the program is designed for, the programmer must have a large experience of field works and a profound knowledge of operating and computing procedures relative to the problems to be programmed. In other words, he must not limit himself to code a calculation process, shown by others, in a language understandable by the machine: he himself must select the most suitable procedure for the case in question, for he is able, for his experience, to have well present all the sides of the problem, so as to achieve the best results by the least human intervention. For that, he could prescribe some changes in the operative procedures, modify the forms used for data recording, prescribe the checks to be made on the executed measurements, etc, to make as simple and efficient as possible the course of the operations from measurements to calculation.

As we have said, calculation programs that really can be called « good » need a programmer having a good mathematical preparation, to codify the calculation in the most opportune ways, and a profound knowledge of the nature of the problems: all these requirements are not possessed by a very great number of persons, and, moreover, a specific competence in all the branches of activity in a single person is very rarely found. In general, therefore, also because of the mass of work that the task involves, it will be necessary that a Calculation Centre have three programmers at least: one for geodetic problems, another for topographic, and the last for photogrammetric ones. Evidently, each of them will have to know the work made by the others, so that the works be all homogeneous and co-ordinate.

Calculation programs must be accompanied by instructions to be followed at every step of the processing, from data measurement, to the card punching and checking and the formation of the decks to be introduced in the machine, and to the operating procedures for the machine itself. An efficient organization of these instructions, too, needs not little experience and skill.

From what has been said, it results that the care a calculation Centre must use in selecting its own programmers will never be too much, and the greatest mistake the Management of a Concern could make would be to miss a good programmer. Especially in a competition among various Concerns, calculation programs have a very great value, for the productivity mainly depends on their efficiency: would a programmer leave the Concern after compiling and restating a series of very good programs, their utility would be always limited in the time. We have just mentioned that the field of electronic computers is in a continuous evolution, nor, on the other hand, the field of surveying and photogrammetric instruments can be called stationary: let's think to the revolution caused by electronic distance measurement devices, and to the analytical photogrammetry. Then, calculation programs which may be called unchangeable do not exist, and they will need modifications that only the compiler can make; on the other hand, a calculation program is the product of the talent of the compiler, and he will be always able to compile it again for competing Concerns, and even improve it on the base of the experience he has achieved.

What has been said about programmers is of weight, even more so, about the manager of the Centre. He must direct and co-ordinate all the activities of the Calculation Centre, so, besides being a very good programmer, he must be qualified in all the fields of activity. He must be able, not only to judge the compiled calculation programs and the organization for their execution, but he must check and lead the activity of the staff employed in card punching and in operating the machine, of the staff employed in the checks on data and results, and of the staff employed in the bureaucratic activity too. He must have made an adequate apprentiveship and have a large experience, besides being an expert of electronic computers too: in fact, it's his task to indicate, to the Management of the Concern, the type of machine to be adopted, or the substitution of an installed machine with another of more recent type.

The problem of the staff is the most difficult to solve satisfactorily, all the more because sometimes Concerns find themselves to have to adapt the technical necessities to opportunistic motives of other nature: therefore, it is necessary to keep well in mind, in an organization of the kind here examined, that the attribution of the tasks to the staff, not based on a serious evaluation of the capacities, inevitably turns into a damage for the productivity.

The present exposition, has been made on the base of the opinions formed in the writer out of the practice made, as well as out the examination made on various organizations of survey or of calculation, or of both things, with the aim of finding the merits or the faults of them. As far as the availability of external Calculation Centres is concerned, it reflects the situation that might be realized in many Italian towns, among which Florence. Evidently, we don't expect that our arguments can be considered the most valid in relation to the conditions existing in other countries.