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11-15

MANUFACTURE OF PROTOTYPES BY CENTRES 1/

by

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1/ The views and opinions expressed in this paper are those of the authors and do not necessarily reflect the views of the secretariat of UNIDO.
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United Nations Industrial Development Organization

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Vienna, 11th May 19[illegible]

SUMMARY

[illegible] 1/

by

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The paper contains six chapters on various topics in relation with prototype production centres; the summary of the individual paragraphs is given below:

First chapter (Organization of prototype production centres)
The task and aims of the centre, its necessity and usefulness to the local industry in the developing country. Further it deals with the problems of production, selection of prototypes and cost calculation. The end of the first chapter contains a proposition for a stepwise development of the centres activity during the first years.

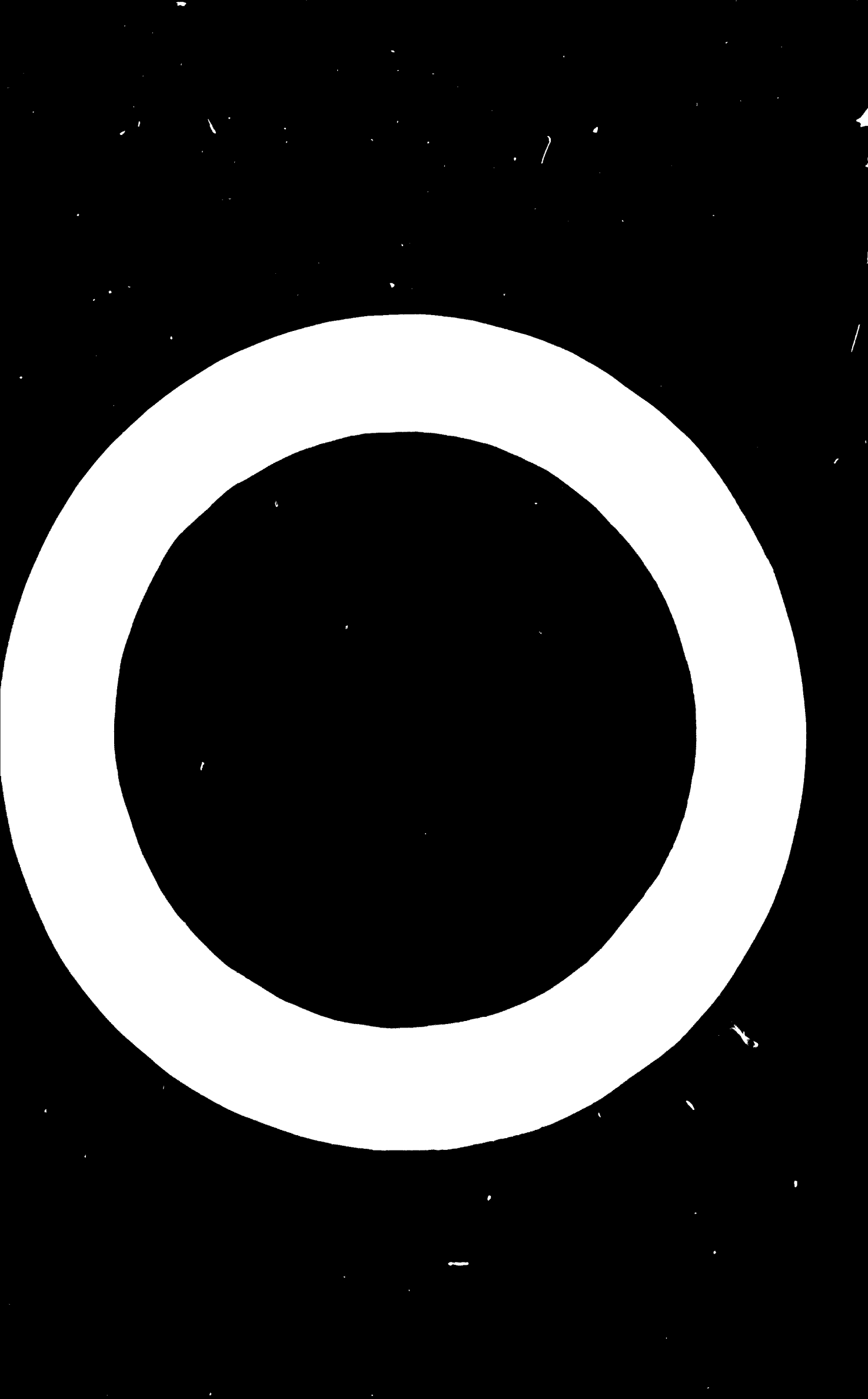
Second chapter (Staff organization and proposals)
The required staff for the centre, minimum qualifications and selection methods, salaries of technical staff in comparison with the wages paid by the private industry. Responsibility and competence of UN-experts. Professional training of the technical staff and possibilities of promotions within the organization.

Third chapter (Co-operation with industry)
The importance of co-operation and good relations with the local industry. Making available the centres technical equipment, the industry lacks, and accepting production jobs. Advices to the manufacturers regarding planning of factory layouts; Production-problems, assembly lines and inspection. Licence manufacturing and financial assistance.

Fourth chapter (Quality control)
An additional useful activity of the centre would be the quality control of locally produced articles, especially items being developed at the Design-centre for manufacturing later on by the local industry. Problems of quality problems and quality control among manufacturers and customers.

Fifth chapter (Design Centre)
The importance of practical workshop training and experience for the staff of the Design office; possibilities of such training at the prototype production centre.

Sixth chapter (Prototype production centre in the field of Precision Mechanics and Instrumentation.)
Possible collaboration of a Design centre with a Training center in the field of precision mechanics and instrumentation; the centre would in addition to its educational activity be in charge of the development of prototypes.
Recommendations for the required buildings, selection and training of personnel, fellowships for special training abroad and a list of the technical equipment for the centre for precision mechanics normally necessary.



PRODUCTION OF PROTOTYPES BY CENTRES AND THEIR INTRODUCTION IN VARIOUS BRANCHES OF INDUSTRY IN THE DEVELOPING COUNTRIES.

1. ORGANIZATION OF PROTOTYPE PRODUCTION CENTRES.

1.1. Tasks and aims.
1.2. Selection of prototypes to be developed.
1.3. Production.
1.4. Cost calculations.
1.5. Progress reports.
1.6. Tentative programme for the development of the centre.

2. STAFF ORGANIZATION AND PROPOSALS.

2.1. Qualifications for employment.
2.2. Salaries.
2.3. Promotions.
2.4. Competence of experts.
2.5. Training of personnel.

3. CO-OPERATION WITH INDUSTRY.

3.1. Advice to industry for new production.
3.2. Contacts with big, medium and small-scale industry.

3.3. Licence manufacturing.
3.4. Financial assistance.

4. QUALITY CONTROL.

4.1. Quality testing at the centre.
4.2. Public relations for quality control.

5. DESIGN SECTION.

5.1. Practical knowledge and training of design engineers and draughtsmen.

6. PROTOTYPE PRODUCTION CENTRE IN THE FIELD OF: PRECISION MECHANICS AND INSTRUMENTATION.

6.1. Collaboration of testing centres with established [illegible].
6.2. [illegible].
6.3. [illegible].
6.4. Skilled [illegible] and specialisation of personnel.
6.5. [illegible] training areas.
6.6. [illegible].
6.7. [illegible].
6.8. [illegible] tools and equipment.
6.9. [illegible].
6.10. [illegible].

1.ORGANIZATION OF PROTOTYPE PRODUCTION CENTRES.

1.1. Tasks and aims:

The necessity of fostering the design possibilities and prototype production in developing countries is self evident and will not be contested by persons concerned with the problem of technical development. This activity should even receive priority in industrial aid as many firms will not be able to progress sufficiently if they cannot be provided with the required designs. The output of these firms will remain small and uneconomical and their capacity in form of labour and equipment will not be used to its best advantage. They are condemned to remain copiers, or assemblers of imported components and will never be able to profit from the rapid development of new techniques and the application of new materials.

In most of the countries in question, manpower is available in abundance, but usually its training and proper utilization is inadequate. The local manufacturers should be encouraged to produce items involving a relatively large proportion of labour, instead of importing mainly prefabricated parts; this would at the same time help to save foreign exchange.

To determine the centre's activity, a thorough investigation of the local industry, meetings with industry associations and with the Ministry of Planning and Development are necessary to find out the most urgent and efficient contribution to the future industrial development of the country. Close collaboration between the centre and the industry is absolutely essential: a design and prototype production centre could never be successful acting alone.

In most of the developing countries the feeling for quality is badly lacking. Institutions for quality-control and standardization are either missing or ineffective. These two additional activities could be other useful tasks of engineering centres.

There are mainly two possibilities in running an engineering design centre, which should include the production of prototypes as well as certain gadgets, tools and gauges required for the manufacturing process.

a) A complete independent centre, incorporating all necessary divisions and offices, such as design office, sections for market studies, documentation, patents, materials, standardization, reproduction, laboratory and experiments, packing and transportation, and a workshop for the production of prototypes, with its various sections.

Such a centre would have the advantage of being run under one and the same management, with the attached production workshop entirely at its disposal. It would, however, mean the purchase of very expensive machinery, which could hardly be utilized fully. At the same time it would be difficult to find, or to train, the required operators and specialists for the prototype production.

b) The second possibility would be a centre working in close collaboration with a training centre, for instance for instrument mechanics. Such a centre would have the necessary facilities to produce prototypes in the mechanical, electrical, electronic and optical fields. (More details about the possibility of collaborating in the chapters 6.1. to 6.10).

1.2. Selection of prototypes:

In order to achieve a maximum contribution to the economic development of the industry and the production in the country, the selection of the prototypes to be produced is most important. The danger of developing "attractive" prototypes, without guarantee that the industry is really in a position to manufacture them, and perhaps even without a sufficient market and demand for them in the country, should by all means be avoided. The selection for the development of new engineering designs and the manufacturing of the corresponding prototypes depends mainly upon two factors:

a) a very good knowledge of the existing industrial facilities, and
b) the results of the latest market survey.

Very often, due to national or personal ambitions, the most advanced engineering items are being produced in developing countries, whereas simple yet very useful articles for day-to-day and domestic use are completely neglected. Articles used in households, offices, schools, etc., like electric switches, door locks, latches for steel-framed windows, handtools etc. are often of inferior quality, and no one cares to improve them. Therefore, we are of the opinion that the improvement of perhaps less attractive, but more useful articles should, at the beginning, be one of the centre's activities. It would be a better contribution and technical assistance than some sophisticated equipment which would benefit only a small minority. The possibilities for exportation should not be a prime target for the selection of a prototype; in the first instance, there should be a reasonably promising market in the country itself.

A very useful field of the centre's activity would be the development of demonstration instruments and equipment for educational purposes; these items are often badly needed for the different teaching subjects such as: physics, mechanical and electrical engineering at various levels of education, up to engineering colleges and universities.

The proper way of selecting a new engineering design would be to get in touch with the enterprise which is interested in manufacturing a new article after careful study of the consumer market. The centre could then develop the design permitting the entire production in the country itself. At the same time, it would guarantee that one or various enterprises would be ready to take up its production. The development of a new engineering design, including the production of its prototype, without an immediate subsequent production by the local industry would not only be disappointing, but also very bad for the reputation of the centre's activity.

Especially at the beginning the designs selected and their prototypes should aim rather at improving existing articles already produced in the country.
There are tremendous possibilities in improving the designs, not only to facilitate the manufacturing process, but also to improve the functional, practical, and even in certain cases the aesthetic aspects of certain items.

Since the decision for the selection of new designs and development of prototypes is really of great importance, it is suggested to appoint an expert, especially for industrial public relations and market survey, to supply the centre with the necessary information about the most useful and essential projects. This public relations expert should be a personage well familiar with the industrial conditions of the country and able to hold meetings on government level whenever required. This expert could at the same time be the assistant of the project manager and replace him in case of his absence.

1.3. Production

a) Production of prototypes:

The prototype production workshop should in all aspects be a model and a good example to the developing industry of the country. The equipment should be so selected that practically all jobs of the centre's various activities could be carried out in the production workshop itself.

The raw materials supply should include moderate quantities of all required locally available and imported items for the production of prototypes and the manufacturing of engineering items for the industry or other customers. As a rule, the development of prototypes in the production workshop should include the total manufacturing process for industrial production, including all the required jig and fixtures, presstools and control gauges for production, assembly and inspection.

c). Production of other items

During official meetings on government and management levels, details of production problems and difficulties on workshop levels are usually not discussed - for lack of knowledge, national pride or personal prestige. In order to become familiar with the actual industrial problems of the country, the only way is to collaborate with the manufacturers.

The well-equipped production centre may not be fully occupied all the time with the manufacturing and development of its own prototypes. The centre is likely to possess certain costly production and testing equipment which the local industry badly lacks. In brief, spare capacity in development projects must be offered to industry. This can create some of the much needed "good-will" and help to lay a basis of confidence between industry of the private sector and the centre. It combines isolated projects. This activity furthermore gives the staff of the centre an excellent opportunity to become experts in the various machine tools and in workshop equipment.

A survey of the production industry will in most of the developing countries reveal that there is no adequate tool-making industry that could serve as a basis of profitable high-class production. Trained personnel to run such workshops are rare and the precision machinery required very expensive.

Improving the production potential therefore begins with the creation of facilities for tool-making. One possible way could be the introduction of common facilities centres, or co-operatives, where the producers, who at the same time and at prices much below those of imported ones. A few such centres in industrialized cities of the country could improve the situation to a great extent.

These common facilities centres could also form part of the proposed prototype production centres, and at the same time train personnels required by the industries for their own tool-making sections. These common facilities could be expanded by the addition of auxiliary services for heat and surface treatment, etc. A modest start of such a centre has been made in Ahmadi (Iran-India) with the assistance of the Ford Foundation. The management showed much interest, and the demand for its services was very great.

In order to make possible the manufacturing of items in the most economic way, for reasonable prices and acceptable quality, a chain of such auxiliary facilities, in the form of feeder plants should be developed. In most of the developing countries local industry does not yet manufacture and supply "standard-parts" of good quality, such as screws, nuts and washers, rivets, pins, springs, handles, hand-wheels, plugs, etc. The producer of his products, for instance, is forced to manufacture these standard elements and other parts himself in small quantities, resulting in high costs of the finished article. Without developing such a supporting industry, with various specialized activities in limited fields, the producers will never be able to compete with goods coming from highly industrialized countries.

The plastics industry also forms a very important part of the feeder industry; the reason, why the plastic industry for precision parts is lagging in many of the developing countries is again related to the lack of tool-making possibilities and trained manpower.

One experiences similar difficulties with the supply of packing material and packing in general for finished goods. Without going into further details, it has to be mentioned that the problems of packing and transportation should get more attention in developing countries.

c). Service for repairs and maintenance

For the above mentioned reasons the centre should also offer service and repairs facilities to private and government industries and institutions like hospitals, universities and research centres. In addition to a very great help to all these organisations such repairs, when properly handled, can have an excellent training value for the workshop staff and for designers too. Comparing the advantages and disadvantages of various products and finding out their defects, they should be able to avoid certain mistakes others have made earlier.

[illegible]

[illegible]

[illegible]

1.0 Tentative program [illegible]

[illegible]

The site [illegible] the [illegible] the [illegible] period [illegible] individual [illegible] what type [illegible] the next [illegible] The plan [illegible] and equally [illegible] available [illegible] steps:

1. Arrival [illegible] representatives [illegible] planning [illegible] experts.

2. Beginning [illegible] with general [illegible].

3. Precision [illegible].

4. Electrical [illegible].

5. Electronics.

[illegible]

[illegible]

[illegible] centre is the [illegible]

[illegible]

[illegible] consultation [illegible]

[illegible] technical [illegible] human [illegible] behaviour, that can [illegible] psychologi- [illegible] results [illegible] mean. [illegible] should [illegible] knowledge [illegible] in [illegible] ty. [illegible] featuring [illegible] in [illegible]

[illegible]

[illegible] based on the [illegible] should [illegible] in [illegible] local [illegible] organization [illegible], number [illegible] personal [illegible] local [illegible] quality, [illegible] very [illegible]

[illegible] local staff [illegible] easily [illegible] by [illegible] such [illegible]

2.2. Salaries:

One of the major problems for the development of the centre and its successful handing-over to the partner organization is the stability of its staff. Frequent changes of well-trained personnel hamper the continuous progressive activity tremendously. Especially in a centre with a good reputation employees of high attractive offers from industries that will try without hesitation to lure away poorly paid but qualified staff. In order to reduce this "exodus", the salaries of well-selected and very useful employees of the centre, some of them perhaps even with special training abroad, should be above the scale of their equivalents working in private industry. The fixed salary system of most of the government organizations is absolutely unacceptable, and makes it almost impossible to create a dynamic atmosphere in a design and prototype development centre. This institution should not only be able to compete with the private sector, but give guidance and provide know-how to manufacturers.

2.3. Promotions:

The local personnel should have possibilities of promotion within the organization of the centre, as is the practice in private industry in industrialized countries.
Promotion should be based on performance.
The centre should arrange courses to improve the professional knowledge of its staff. Based on the results of tests and periodical qualification reports, employees with exceptionally good performance should be given a chance of promotion. Under good leadership work at the centre can be extremely interesting and beneficial to the professional knowledge of its staff.
The possibility of promotion to a higher salary class within the centre's organization would certainly help to reduce frequent changes of the local staff to a great extent.

2.4. Competence of experts:

Though it is against the general practice of the United Nations, it is strongly recommended that UNIDO experts working in design and prototype development centres should have, at least during the initial stage, full responsability and competence to organise the centre.

To set up a new training centre, a powerful, experienced director(project manager) should be appointed for the planning and the execution of the centre's various activities. Under his guidance other experts, specialists in their fields, should take over specific parts of the activities. Responsibility in the true meaning of the word can only be given to a person who has the necessary authority, competence and support to act effectively. The counterpart organization should, from the very beginning, have the opportunity to contribute its experience and ideas. Inefficient and timid counterparts can also cover behind the advisory role. Another problem is the prolongation of contracts for experts. Not infrequently they depend on the good will of the local head of the institution or even the counterparts. The latter can sometimes be so powerful that for all practical purposes they can veto extensions of individual contracts. Any expert carrying out his duty properly will have to come up with ideas and suggestions which will sometimes not please his partner; the easiest way not to accept these proposals is to get rid of the expert. He knows that his contract is at stake, and keeps quiet, even when it would be imperative to speak. In brief, the expert cannot contribute to the development of the centre as he is supposed to. The engagement of experts as "advisers" needs first of all a tremendous amount of diplomacy and usually hampers the progress of a centre.
On the other hand, the training of the local staff should be expedited, if not carried out in advance. Only when the local staff is well trained and in a position to take over certain charges should responsibility gradually be transferred from the UN experts to the local employees.

2.5. Training of personnel

The training of counterparts and other local staff members of the centre has to be planned accomplished in a systematic way on different working levels. This activity requires an additional quality on the part of all experts who should be not only specialists with excellent professional qualifications, but at the same time good teachers with pedagogic aptitudes. During this initial stage of systematic training it is again most essential that the competence and responsibility be with the UNIDO experts.
Since experienced personnel is usually not easily available in developing countries, their training has to be provided at the centre itself, and in order to be successful, not only by advice, but by clear orders and instructions.

3. CO-OPERATION

3.1.

4. QUALITY CONTROL.

4.1. [illegible]

[illegible]

4.2. [illegible]

[illegible]

5. [illegible]

5.1. [illegible]

[illegible]

with all practical details and aspects, including selection of the most suitable gear ratio and determination of the appropriate [illegible].

[illegible] would include a good [illegible] and training on the various [illegible] and supervision [illegible].

[illegible] the design [illegible] industry, [illegible] very good [illegible] with the [illegible] country, before they proceed [illegible] complicated design work in collaboration with [illegible].

. PROTOTYPE FACILITIES FOR THE FIELD OF PRECISION MECHANICS AND INSTRUMENTATION.

.1. Collaborative [illegible] with established, or [illegible]

[illegible] prototypes [illegible] with a [illegible]. In practice [illegible] fail to co-operate [illegible] with comparative-[illegible] ance of their [illegible] prototypes. Such a [illegible] production [illegible].

[illegible] would be an [illegible] the programme [illegible] centre; [illegible] products developed [illegible] and [illegible].

[illegible] risk [illegible] additional [illegible] for [illegible].

The design centre and [illegible] would run under two separate managements; the good collaboration and co-ordination between the project manager and the head of the training centre would be a condition for the smooth working of the two institutions.

6.2. Selection of site:

Selection of [illegible] site for a new centre has a great influence on its future success and future development. An agricultural centre, for example, well located in one part of the country and not [illegible] for [illegible] another, changing the two would almost totally [illegible] character. The conditions for a successful activity in the field of precision mechanics [illegible] stability of the industry in this particular activity, [illegible] climatic conditions (coastal areas usually require costly air-conditioned workshops and [illegible] offices, but [illegible] usually create many problems for [illegible] equipment). A third aspect is the question of transport facilities, by rail, road and air, and [illegible] the living conditions for experts and the local staff and their families, including possibilities for children's education. It is sometimes difficult to convince highly qualified personnel to move from a city with all its social and cultural facilities to an [illegible] small provincial town.

6.3. Buildings:

In exceptional cases existing buildings are made available by the partner organization. Where [illegible] possible, new buildings, built for the particular purpose, are certainly preferable. The buildings for the centre, offices and workshops should be well-planned [illegible] in all respects and [illegible] constitute an example to the developing industry of the country. It is not necessary, and in fact not recommended to build a monumental industrial palace. Everything should be practical, functional and of good quality. Consideration for natural and artificial light, electrical installations and water connections, ventilation and [illegible] arrangements and conservation of the various rooms, as well as possibility for a further extension [illegible] should be planned by experienced persons.

6.4. Selection, training and specialization of personnel:

The selection of the local staff for the centre should be made carefully by a team.

Good professional practical and theoretical knowledge are the minimum qualifications for all candidates appearing for tests and interviews. The final selection should however be made primarily on the basis of the results of practical and aptitude tests, held at the centre itself for the purpose in question.

Especially during the initial stage it will be unavoidable to engage expatriate technical experts for all technical personnel to organize them with all the working equipment. Subsequently, the staff should be enabled to work in complete independence according to the orders and specifications of technical drawings.

6.5. Fellowships, and training abroad

Fellowships should only be granted to exceptional qualified persons of the centre for a specialised training in one or various enterprises abroad. The training programme must be very well prepared in details and discussed in advance with the sponsoring firms. The training should mainly be of a practical nature, and on no account should it happen that trainees are spending several months abroad more or less as observers.

6.6. Standard equipment

The selection of all workshop equipment should be done by the project manager, in consultation with the expert in charge of the workshop. The activity of the centre must be known for at least the first period of one year. Accordingly the recommendations for purchase of the required machinery, tools and machine tools, measuring tools and additional equipment have to be worked out. It is preferable not to equip such a centre with the most modern automatic production machinery with electronical control. Such equipment needs highly skilled specialists for its maintenance also. Conventional machine tools of good quality with all necessary additional equipment, to make possible a maximum utilization, are much more useful. Along with the various machine tools, the corresponding cutting tools have also to be selected. In order to be independent from other industries, the necessary tool-grinding machines have also to be provided for the maintenance of all sorts of cutting tools.

For all general tools, measuring tools, special cutting tools, gauges, etc., a suitable tool crib has to be planned. The proper way of storing costly tools is usually not known, or at least neglected, in developing countries with the result of big losses due to unavoidable damage to expensive tools and equipment.

To avoid the purchase of expensive supplementary items, only the absolute minimum should be ordered at the initial stage. But for this it is necessary to provide within the first budget already an additional amount which enables the project manager at any later date to order additional equipment, required for new activities taken up by the centre.

6.7. Layout

As soon as the list of machineries and equipment has been completed, the planning of the workshop layout can be done in details, preferably with the help of a layout-model on a reduced scale (1 : 50).
The various departments such as machine sections, assembly, repairs, inspection and measuring room, tool grinding, heat treatment, smithy, welding, soldering and brazing, electroplating, painting, carpentry, raw material store, oil and fuel store, spare parts, but also foremen's offices and bathrooms have to be well separated from each other to assure good working conditions everywhere.

Sufficient spare space has to be provided in all departments for additional activities of the centre at a later date. The layout for each section should be perfectly planned in all details so that it may serve at the same time as an active example to the local industry.
(See Appendix: Layout Training Centre for Precision Mechanics) (Swiss Foundation - SENATI, Lima - Peru).

6.8. Measuring tools and equipment

It is hardly necessary to emphasize that the measuring tools and control gauges for such a centre have to be of top quality. The measuring equipment should include a profile projector, hardness tester, surface quality tester, microscope and all the necessary electrical and optical control instruments, according to the activity of the centre.

5.9. Additional equipment:

[illegible] activit[illegible] [illegible] additional equipment [illegible] independent of [illegible]. This [illegible] and [illegible] elementary [illegible].

5.10. LIST OF EQUIPMENT:

A. Machine [illegible]:

	Accessories:
6 Lathes Schaublin 102 VM	coolant equipment set of collets drill chuck driving plate 3-jaw chuck 4-jaw chuck grinding attachment face plate steady rest movable steady rest
5 Toolmaker Lathes Schaublin 102-[illegible]0	set of collets drill chuck driving plate 3-jaw chuck thread chasing attachment milling attachment grinding attachment turret attachment conical turning attachment spherical turning attachment

5 Toolmaker lathes Hardinge - 2	set of collets drill chuck face plate 3-jaw chuck 4-jaw chuck
2 Toolmaker lathes Schaublin 70	set of collets drill chuck steady rest driving plate 3-jaw chuck
2 Lathes Simonet 450	coolant equipment set of collets face plate driving plate steady rest drill chuck 3-jaw chuck
2 Lathes Menziken 185	coolant equipment 3-jaw chuck face plate steady rest movable steady rest driving plate
1 Lathe Gallic 14	coolant equipment face plate steady rest movable steady rest conical turning attachment drill chuck 3-jaw chuck 4-jaw chuck driving plate
7 Universal Milling Machines - Schaublin 13	coolant equipment universal table vertical milling head set of collets parallel vice 3-jaw chuck rotary table dividing equipment

1 Universal Milling machine Schaublin 53	coolant equipment swivel parallel vice set of collets 3-jaw chuck vertical milling head [illegible]
2 Universal Milling machine Zivis 20?	coolant equipment vertical milling head parallel vice set of collets clothing head
1 Multi purpose machine Meyer & Burger	coolant equipment 3-jaw chuck face plate steady rest dividing equipment set of collets
4 Sharpers Gack	machine vice
1 Sharper von Roll 3H 500	machine vice
1 Gear Hobbing machine Mikron 102	coolant equipment cutter support set of collets set of cutters set of exchange gears
1 Surface Grinding machine Maegerle F-7	coolant equipment magnetic chuck universal vice
1 Surface Grinding machine Tripet MHP 500	coolant equipment magnetic chuck dial indicator wheel balancing device
1 Cylindrical Grinding machine Studer - 1 /universal	coolant equipment dial indicator wheel balancing device internal grinding attachment steady rest set of collets face plate grinding vice

1 Cylindrical Grinding machine Tschudin HTG 400/universal	coolant equipment dial indicator wheel balancing device internal grinding attachment magnetic chuck 3-jaw chuck face plate set of collets grinding vice
1 Engraving machine Kuhlmann GMI/1	dividing head vice set of templates
1 Engraving machine Grafograph IT	dividing head vice set of templates
1 Band saw Moessner Record SM 320-B	
1 Screw press Lutny Ø 60	
5 Surface plates	400 x 500 mm
1 Radial boring machine Oerlikon	
2 Drilling machines Aciera 22 S-1 VR	coolant equipment drill chuck 0-13 mm drills 0-22 mm
2 Drilling machines Fehlmann P-18	coolant equipment drill chuck 1-13 mm drills 1 - 18 mm
2 Drilling machines Fehlmann TB-8	drill chuck 1 - 8 mm
1 Drilling machine Aciera 10 K-2	coolant equipment double spindle drilling and tapping 0-10 mm
1 Drilling machine Aciera 10 K-1	coolant equipment drill chuck 0-10 mm

1 Drilling machine Aciera 6 K-1	drill chuck 0-6 mm
1 Tapping machine Aciera GT-3	
1 Drilling machine Aciera E-3	drill chuck capacity 0-3 mm
1 Hand Shearing machine - von Arx	
1 Hand Bending machine Gmsgel	
1 Tube Bending machine Bykart AG	
1 Slitting saw Adige P-60	
1 Power Hack-saw LWB	
2 Arbor Presses	
2 Marking tables	

B. Tool grinding section:

1 Tool Grinding machine Kellenberger 57 - W	coolant equipment dividing equipment internal grinding attachment machine vice
1 Universal Tool Grinding machine/Dubied - 564	coolant equipment dividing head vice inclinable table
1 Cutter Grinding machine Kuhlmann SU-2	
1 Tool Grinding machine Ifanger Senior	coolant equipment twist drill grinding attachment

4 Tool [illegible]

1 Polishing [illegible]

C. [illegible]

1 [illegible]

1 [illegible] TESA

1 [illegible]

1 Profile [illegible]

1 [illegible]

1 Gear Tooth Caliper

Gear Tooth [illegible]	0-50 mm
Thread Micrometers	0-50 mm
Slip Gauges, quality DIN 1	0,5-100 mm
Slip Gauges, quality DIN 0	0,5- 50 mm

1 Measuring Cylinder

1 Sine Bar

1 Height Gauge 300 mm

1 Surface Plate, scraped 400 x 500 mm

2 Control Reamers, with illustrated magnifiers

D. Measuring Tools (All tool sets, for general utilization)

4 Precision Calipers	TESA	200 mm
2 Depth Gauges	TESA	150 mm
4 Precision Micrometers,	TESA	0 - 25 mm
2 Precision Micrometers,	TESA	25 - 50 mm
2 Precision Micrometers,	TESA	50 - 75 mm
2 Precision Micrometers,	TESA	75 -100 mm
1 Set Inside Micrometers		6 -100 mm
1 Set Depth Micrometers		0 - 25 mm

6 Dial Indicators [illegible] mm

1 Dial Indicator 1/1000 mm

2 Lever [illegible]

4 [illegible]

[illegible] Indicators

1 Band [illegible]

Gauges and [illegible]

1 Set [illegible] - Metal Ø 4 - 16 mm

1 Set [illegible] M2 - M 20

1 Set [illegible] M 3 - M 20

1 Set [illegible] Morse 0 - 4

1 Pre[illegible]

2 Star [illegible]

1 Centre Prisms

1 Spirit Level, square

1 Spirit [illegible], straight

3 Set Radius Gauges

4 Sets [illegible], concave - convex 1 - 25 mm

4 Sets Thread [illegible] Metric - English

1 Set Thread [illegible], interchangeable to grind cutting tools

2 Slide [illegible]

4 Measuring Tapes 2 m

1 Measuring Tape 20 m

10 Foot rules 200 mm

1 Rule 1 m

5 Precision straight edges

1 Set Plate [illegible] 630 x 630 / 400 x 630/ 500 x 1200

5 Precision try squares

5 Precision try squares with ivory edges

5 Try squares [illegible]

2 Precision [illegible] 750 x 750

2 Universal [illegible]

1 Centring [illegible]

4 Precision Tracing Straight Edges

[illegible]

4 [illegible]

2 [illegible]

1 [illegible]

1 [illegible]

1 [illegible]

1 [illegible]

1 [illegible] measuring electrodes

B. [illegible]

24 [illegible]

4 [illegible] with 4 drawers each, fixed under the workbenches, containing

1 Universal Caliper T83A 250 mm

1 Micrometer T83A 0- 25 mm

1 Bevelled straight edge

1 Try square with bev. edges

1 Measuring Tape 2 m

1 Foot Rule 200 mm

1 Centre Punch

4 Screw Drivers

1 Marking Compass

6 Chasers

1 Bench Brush

1 File Brush

1 Brush round

1 Brush flat

1 Divider

4 Precision Pliers

2 Chisels

1 Hammer 200 gr.

1 Hammer 500 gr.

1 Hand Cutting Tool

1 Parallel Clamps

1 Hacksaw

1 Oil Pump

1 Pair of soft jaws

1 Safety Glasses

1 [illegible] Caps

1 Oil [illegible]

1. General Mechanics

5	Gripping Pliers	
1	Set of Combination Spanners	6C - 125 mm
1	Set of Ca[illegible] Box Spanners	100 - 400 mm
2	Sets Double-ended Spanners	6 - 36 mm
1	Set Double-ended Spanners	5/16" - 1"
2	Sets Spanners	4 - 7,5 mm
1	Set Socket wrenches	5 - 32 mm
2	Sets Socket wrenches with plastic handles	2 - 10 mm
4	Sets Allen keys	1,5 - 12 mm
2	Spanners Hook type	180 and 250 mm
2	Sets Phillips Screw Drivers	Nr. 01 - 4
4	Sets Screw Drivers	
4	Sets Watchmaker Screw Drivers	
4	Sets Offset Screw Drivers	
2	Sets Dynamometric Screw Drivers	
2	Universal Pliers	
4	Side Cutting Pliers	
4	Flat Nose Pliers	120 mm
4	Round Nose Pliers	120 mm
4	Long Lever Round Nose Pliers	
2	Long Grip Pliers	200 mm
4	Adjusting Pliers, straight	
4	Adjusting Pliers, bent	
1 Set	Circlips Pliers - inside and outside	
1	Multi Grip Plier	

1 Pipe Tongues 3"

1 Vice Grip Pliers 175 mm

2 Cable Strippers

4 Tweezers - pointed and straight

4 Tweezers - blunt

4 Tweezers - with metal points

1 Universal Spring Winder

2 Sheet Metal Cutters - for Tin

2 Bolt Cutters

2 Lever Cutters

1 Set Paper Scissors

1 Set Carpenter Tools

3 Sets Various Hammers - Steel, Plastic, Rubber, Wood, Lead.

Flat Chisels

Cross Chisels

Groove Chisels

2 Sets Chasers

1 Set Pulley and Bearing Pullers

1 Set 3-Legged Puller for Ø up to 200 mm

2 Sets Screw Removers

2 Sets Tap Removers

4 Sets Hand Knurling Tools

4 Sets Numbering Punches 2 - 5 mm

4 Sets Lettering Punches 2 - 5 mm

1 Set Templates - Letters and Numbers 60 mm

100 Sets Tool Tokens

1 Electric Scriber for Metals

10 Sets Taps and Dies M 1 - M 16

2 Sets Taps and Dies/Pipe Threads 1/8" - 1"

1 Set Broaches for Key Ways

Various sizes and shapes of Hack- and Fret-saws

10 Sets Hand Reamers 0 - 20 mm

10 Sets Tapered Reamers, 1 - 50 2 - 9 mm

10 Sets Adjustable Reamers 6 - 20 mm

Various Brushes of different shapes

Various Oil- and Arkansas Stones - square, round and triangular.

10 Triangular scrapers

6 Flat Scrapers

6 Hand Engravers, burrishers

6 Soldering Irons - various sizes

Various Safety Goggels for: Soldering, filing and grinding.

Various Files of special shapes and sizes.

20 Sets Watchmakers - Files

2 Electric Hand Drilling machines PERLES

1 Electric Hand Grinder

1 Electric Plastic welding device

G. Machine Cutting Tools

5 Sets Shell End Mills Ø 30 - 80 mm

5 Sets Small End Mills for roughing Ø 50 - 63 mm

6 Sets Cylindrical Cutters Ø 50 - 63 mm

10 Sets End Mill Cutters with cylindrical shank, 2 flutes

10 Sets End Mill Cutters with cylindrical shank, 4 and more flutes

4 Sets Slit and Face Cutters, plain and staggered teeth, 0,4 - 15 mm

2 Sets Gear Cutters, Modul 0.5 - 3

2 Sets Gear Cutters (generating) M 0.3 - 2

6 Sets T-Slot Cutters - 12 mm

5 Sets Counterborers with guide Ø 5.9 - 30.5 mm

5 Sets Counterborers with guides Ø 5.9 - 14.5 mm

Various Double and Single Angle Cutters

Various Radius Cutters - concave and convex

4 Sets Slitting Saws

Drills:

10 Sets Twist Drills for Steel Ø 0.3 - 20 mm/Steps 0.1 mm up to 10 mm

5 Sets Twist Drills for Brass Ø [illegible] - 10 mm/Steps 0.1 mm

3 Sets Twist Drills for Aluminium Ø 2 - 10 mm.

4 Sets Flat Drills, Covered Carbide Tipped Ø [illegible] - 20 mm

4 Sets Twist Drills for Steel Ø 1/16" - 1"

10 Sets Machine Taps [illegible]

10 Sets Machine Reamers Ø 1.4[illegible] - 20 mm for various materials and tolerances

Turning Tools

10 Sets Tool Bits HSS [illegible] x 8, 10 x 10, 16 x 16, 20 x 20

5 Sets Thread Cutting Tool "FAMOS" 60° and 55°

15 Sets Facing Tools - left and right

10 Sets Parting Off Tools - various sizes

Various Clamped Carbide Cutting Tools for roughing, finishing, outside and inside turning.

Miscellaneous Machine Tools:

4 Sets Reduction Sleeves, Steel and Plastic - MT 1 - 4

3 Sets Chucking Tools - different systems

3 Sets Disc Cutting Tools for Ø up to 200 mm

4 Sets Turning Arbors Ø [illegible] - 40 mm

2 Sets Grinding Arbors Ø [illegible] - 30 mm

1 Set Jogs (Carriage) for Ø up to 250 mm

H. HEAT TREATMENT

1 Electrical Furnace, with timer
SAFED - Type LCB 42

1 Electrical Furnace, with salt bath
SAFED - Type LO M 30

1 Electrical Furnace with air circulation
SAFED - Type [illegible] 30

1 Container with [illegible] Oil

1 Container with [illegible] Water

1 Potassium Bath 1 Exhaust Fan

I. Welding-Section:

2 Mobile Gas Welding Sets CONTINENTAL

1 Arc Welding Generator BROWN-BOVERI

J. Painting and Sand Blasting Section:

1 Spray painting Booth - [illegible] P. ZUERICH

1 Electric Oven

1 Sand Blasting Unit - NEICO No 40

K. Electroplating Facility:

Electroplating Plant LANGBEIN & PFANHAUSER

Water Purification Plant

Refrigeration

Exhaust system

L. Smithy

Furnace with exhaust system

Anvil - Blacksmith-Vice - Various Hammers and Tongues

M. Sheet Metal Section:

1 [illegible] Machine

1 [illegible]

1 [illegible] Machine

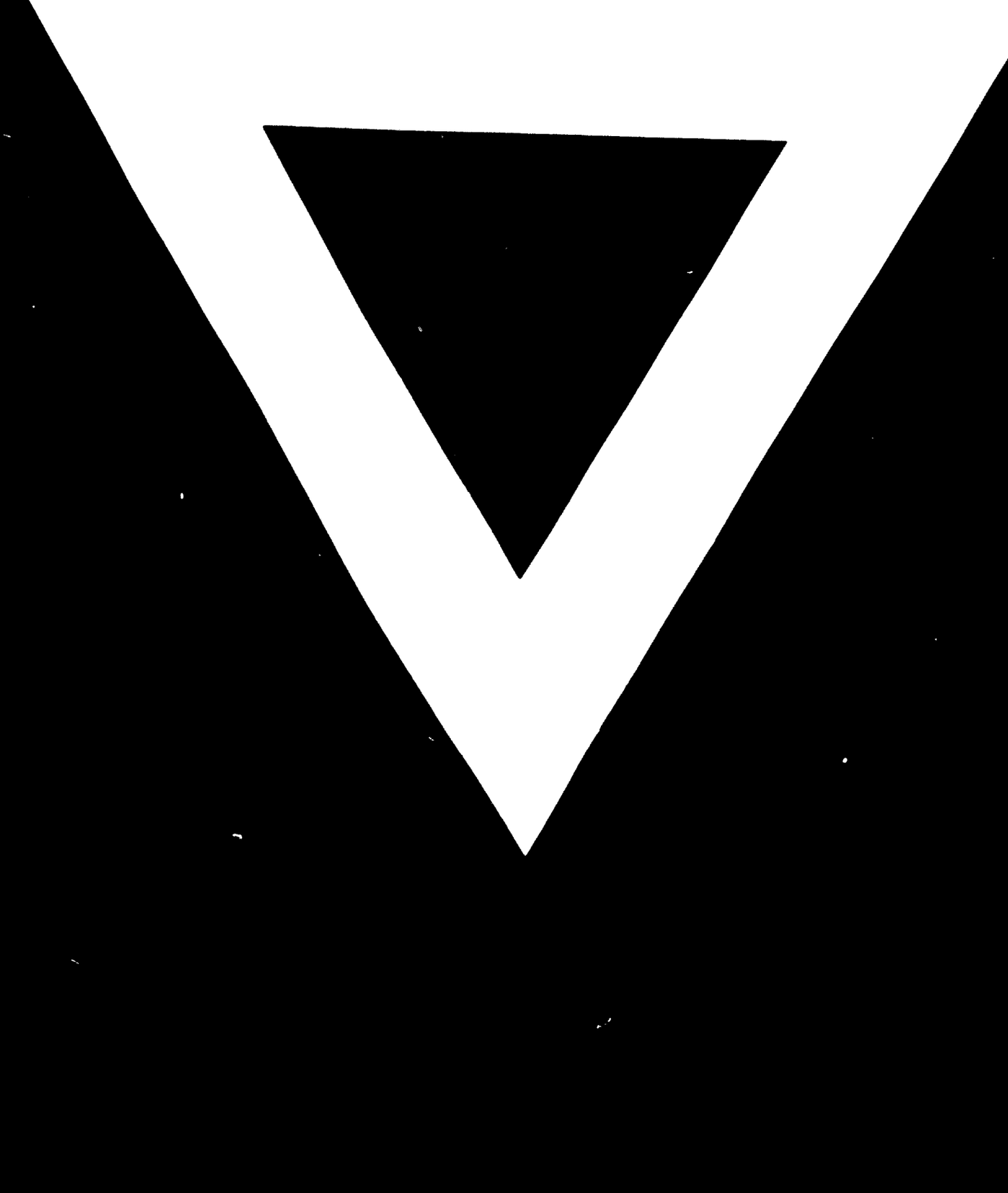
1 [illegible]

2 [illegible] with dies

Various Hand Tools, Soldering Irons etc.

N. Carpentry Section:

1 Circular Saw	1 Planer/Thicknesser
1 Band Saw	1 Moulding machine with dovetailing attachment
1 Drilling machine	1 Tool Grinder
1 Belt grinding machine	1 Circular Hand Saw
1 Fret Saw [illegible]	1 Hand Chain Mortising machine
2 Sets of Carpenters Hand Tools	1 Circular Saw Bench
1 Carpenters Bench	



15. 3. 72