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PRODUCTION OF WOODEN TEXTILE INDUSTRY ACCESSORIES

DP/VIE/80/027

VIET NAM

Terminal report*

Prepared for the Government of the Socialist Republic of Viet Nam
by the United Nations Industrial Development Organization,
acting as executing agency for the united Nations Development Programme

Based on the work of: T. Basinski
Consultant for the manufacture of metal shuttle hardware

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United Nations Industrial Development Organization

Vienna

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1. INTRODUCTION

The Government of Viet Nam places a great deal of emphasis on further development of the country's existing textile industry with a view to meet more readily the clothing needs of the population.

Although loom shuttles, pirns and picking sticks used by the textile industry have been produced locally since 1960, a number of constraints have developed in utilizing local materials resulting from their low quality. The low quality of the timber used has affected negatively the productivity of the textile mills and reduced the life of these locally produced accessories. The consumption of locally produced shuttles is about 2.2 pieces per 1.000 linear meters of cloth as against 1.7 pieces or less for imported shuttles.

The Government had identified the manufacturing of wooden accessories such as loom shuttle blocks and pirns, picking sticks and side levers as a serious problem area and had requested UNDP to provide assistance in this field. This request was transmitted by UNDP Hanoi to UNIDO on 24 October 1984. The preparatory assistance project document relating to this request was signed by UNDP Hanoi on 7 November 1984. The original project (VIE/80/027) foresaw the services of a woodworking expert to assess the problems related to wood processing and to draft a project document. However, during the course of this preparatory assistance mission, which was undertaken by Mr. Pietro Borretti, a woodworking specialist, from 22 February 1985 to 3 March 1985, it was found that the problem areas related to the selection of species to be used, the production of metal parts and the machining of wood. Cutting tools also required urgent improvement and eventually UNDP assistance. On the basis of Mr. Borretti's findings, an agreement was reached between the Government, UNDP and UNIDO to expand the original preparatory assistance to include a second phase of preparatory assistance which would provide the Government with detailed assessments and reports on the above mentioned newly identified problem areas.

The second phase of the preparatory assistance of this project foresaw the services of a metal working consultant and a woodworking tools manufacturing consultant for a period of one month each, as well as a subcontract to recommend, from the species of timber locally available, those best suited for the production of shuttles, pirns, picking sticks and side levers. This was to be determined based on a bibliographic search followed by actual tests on the most promising species.

Mr. T. Basinski, consultant in the manufacture of metal hardware for textile shutties, arrived in Hanoi on 14 August 1986 for a three week mission. Mr. Basinski's job description containing his tasks is given in Annex I.

He carried out this mission concurrently with Mr. Peter Haimburger, Consultant in the manufacture of woodworking tools, whose job description is given in Annex II.

This report gives an account of the current situation in factories manufacturing shuttles and metal shuttle hardware, identifies their shortcomings causing the poor quality of shuttles and hardware being manufactured, and recommends remedies to these.

A project proposal setting out the future UNDP assistance to the sector is given in Annex XI.

2. DESCRIPTION AND ANALYSIS OF THE EXISTING CONDITIONS

2.1 Survey of production of factories manufacturing shuttles and metal shuttle hardware.

The main production of shuttles and shuttle hardware is carried out in three factories which belong to the Union of Textile Enterprises in Nam Dinh at the north, 8 March in Hanoi, and Viet Tang near Ho Chi Minh City in the south.

Production of shuttles and, particularly, of metal shuttle hardware is also carried out in small factories and workshops, mainly in the south.

The most important manufacturer of shuttles and metal hardware is Factory of Shuttles and Spare Parts of Nam Dinh Union. This factory employs 500 workers, mainly for the production of spare parts (annual output 500 tons

approximately) and of shuttles. The annual output of the factory is 100.000 spindle shuttles for power looms mainly made in China, and 30.000 shuttles for automatic looms, as well as over 1 million pirns, half of which are designed for automatic shuttles.

In spite of that, the Mechanical Department for Spare Parts manufactures also metal hardware for shuttles and shuttle pirns. This department manufactures all metal shuttle hardware for China made looms (see Annex III), and pirn holders and self-threading devices for Texima automatic looms made in East Germany. Annual output reaches 30.000 pieces.

The second important manufacturer of shuttles in the north of the country is the Factory for Shuttles and Spare Parts of 8 March Union in Hanoi. The factory employs 250 workers and manufactures approximately 80.000 spindle shuttles for Chinese power looms and 300.000 pirns for spindle shuttles.

The factory manufactures also spare parts, and, for shuttles, only tip fastening springs. Other metal hardware is provided by other manufacturers.

In the south, the most important manufacturer of shuttles is the Factory for Shuttles and Spare Parts of the Textile Union in Viet Tang. At the moment it consists of two factories: one of which is located in Viet Tang and employing 130 workers, and the other in Thu Duc, approximately 1 km from the main one, employing about 250 workers.

Yearly, the Viet Tang factory produces 40.000 shuttles for power looms manufactured by Toyoda, Japan. The Spare Parts Department does not produce metal shuttle hardware at the moment.

The Thu Duc factory manufactures only tips for shuttles. Other metal shuttle hardware is delivered by different manufacturers, including small workshops.

2.2 Survey of existing machines for treatment of metal shuttle hardware.

Units for machining and working plastic in Nam Dinh, 8 March and Viet Tang factories are designed for manufacturing spare parts for textile machines, including many cast-iron elements which cause quick wear of units.

They have typical equipment for a workshop for repairs and manufacturing of spare parts, and are designed for piece production and small-lot production. Only a few machines can be used for manufacturing metal shuttle hardware.

A typical set of machines in these factories is as follows: centre lathes, milling machines, shaping machines, radical drilling machines, gear hobbers, etc. The specification of machines used in Nam Diny and 8 March mills is described in annex IV.

Machines used in Viet Tang factory are not specified, as they cannot be used in the pilot factory in Nam Dinh.

The factory in Thu Duc, built by specialists from the German Democratic Republic is designed for the production of spinning spindles and is provided with up to date machines for spindle manufacturing. This factory is provided with a complete set of tool machines for production and maintenance of tools, although they are currently not fully used.

2.3 Evaluation of the set of machines from the point of their suitability for manufacturing metal shuttle hardware

As can be seen from Annex IV, only suitable machines and equipment in the Nam Dinh factory can be considered. Of course, metal shuttle hardware can be manufactured using the existing machines, but they do not ensure the required productivity and precision.

Having analysed all the machines for hardware manufacturing, two centre lathes with templates for turning tips and spindle tongues, one universal milling machine, one bench drill, 25 ton and 5 ton eccentric presses (of low accuracy), and a friction forging press could be chosen.

However, it is not advisable to move them to the pilot factory, as they are also used for other production, as for example cast-iron elements.

It would be advisable to locate all existing tool grinders together with the new ones in one room in the pilot factory.

Attention should be paid to the fact that there are neither electric nor gas heating systems for heat treatment which are provided with temperature control, and that there are no machining devices designed for large lot production, automatic lathes, turret lathes, small universal milling machines, and typical devices for manufacturing steel pins.

There are also no basic units for removing burrs such as barrels, bells, or vibrating devices, necessary for lot and large-lot production.

2.4 Reasons for poor quality of shuttles

Based on conclusions from discussions with engineering supervision workers in Nam Dinh, Viet Tang and 8 March mills which use spindle shuttles for Chinese and Japanese power looms, and from our own observations, the reasons of poor quality and premature wear of shuttles can be divided into two groups:

- resulting from defective manufacturing of shuttles: 85-90%;
- resulting from wear and bad adjustment of looms: 10-15%.

The first group can be furthermore divided as follows:

Description of defect	Reason for defect	Amount %	Remarks
Cracking, delamination and splitting of shuttle body	Poor quality of material used for shuttle body: wood or laminated wood	55	
Cracking and deformation of springs	Bad heat treatment, wrong type or poor quality raw material (decarbonization)	8	
Deformation of shuttles during operation	Lack of protection of shuttle bodies from changing weather conditions	7	
Different diameter of wooden pins, causing wrong position of spindle	Material used for pin: wrong moisture content of wood used for pins	4	
Falling of shuttle tips	Wrong moisture content of wood, wrong mounting of tips	3	
Other: blunt tips, loose spindles	No heat treatment, wrong fit of spindles on bodies	12	Viet Tang & 8 March

Serious difficulties in the operation of shuttles are caused by the loosening of the screw joints (screw and nut assembly) protecting a shuttle body against cracking. It is caused by not using self-locking nuts (with plastic pieces).

2.5 Influence of the method of manufacturing shuttles on the mounting of metal hardware

The production process for shuttle production in Nam Dinh, 8 March and Viet Tang consists in the manufacture of a body of solid or laminated wood. The lots of raw material delivered differ seriously in strength and hardness.

Lack of material acceptance inspection results in manufacturing bodies of inadequate material, which leads to wrong mounting of metal hardware (too large or too small negative tolerance).

One type of fit of metal hardware is used for different types of material (wood or laminated wood) which often causes wrong fitting of the hardware.

Tolerances given on body drawings are not adhered to and depend mainly on the diameter or width of manually sharpened tools at the time of machining.

Too low rotation of cutting tools used for shuttle manufacturing (too low cutting speed, particularly for tools of small diameter) and wrong grinding cause considerable roughness of treated surface which, in consequence, leads to wrong mounting of metal hardware.

Individual preparation of drills for spindle/flat spring assembly causes different spacing, which seriously influences the location of a spindle in a shuttle body and the tension of the spring which supports the spindle.

A wooden fastening pin manufactured in the wrong way (different hardness, humidity, lack of guiding cant) causes a wrong fitting of the pin with respect to the spindle and the body of the shuttle.

2.6 Survey of constructions of metal spindle shuttle hardware used in Chinese and Japanese looms

The above mentioned shuttles consist of 11 metal elements, of which only pins and screws have different lengths.

Construction of hardware used in Nam Dinh and Viet Tang mills are very similar, they differ only slightly in size, but the differences are not significant and all these parts can be treated similarly. The analysis is based on the documentation used in Nam Dinh.

Deviations from significant dimensions and requirements referring to heat treatment and surface roughness are not precisely stated. Tolerances of unimportant dimensions are unnecessarily severe.

Generally speaking, the constructions are good and do not require any improvement.

The detailed analysis of constructions of metal shuttle hardware is given in annex V.

2.7 Survey and analysis of process technologies for metal shuttle hardware

Because of the existing machines, the technologies adopted cannot be used for lot and large-lot production. The technologies are not modern, although correct for the existing machines.

It should be stressed that the existing machines are ill-adapted for manufacturing of such elements (except for spindles), and therefore the technologies are ineffective. Inefficient production is also caused by a wrong form of raw material (lack of bars and strips).

A significant range of manual work is necessary because of a lack of basic trimming devices. Lack of machines for heat treatment makes it impossible to produce flat springs in the correct way and lowers the quality of shuttles.

Technologies adapted for manufacturing other elements do not influence their quality, if the production process is carried out in accordance with the construction and technological documentation.

Generally, there are no gauges used for large-lot production, and no equipment and devices for testing raw materials.

The detailed analysis of technologies adapted for producing metal shuttle hardware is presented in annex VI.

2.8 Survey of manufacturing method for pirns for shuttles

Construction and production technology for pirns are correct, and the existing machines and equipment are adequate, so pirn production does not cause any problems.

Also the production of wearing-irons for pirns by press forming is carried out with no difficulties. The problem here is the quality of wood, and particularly, its final moisture content.

The observations show, that pirns dry when used; this causes loosening of wearing-irons and makes the use difficult.

The second problem is the correct crampling of wearing irons on pirn collars, although there are possibilities to do it properly.

3. PLANS AND ASSIGNATIONS

It has been agreed with Vietnamese counterparts that shuttles and metal shuttle hardware will be manufactured in the Nam Dinh factory. This type of production will be stopped in the 8 March factory. Tools will be produced in the Thu Duc factory (Viet Tang Union near Ho Chi Minh City), the Nam Dinh factory will be provided with a complete set of machines for maintenance, and, if necessary, for the production of tools on a piece by piece basis.

Starting the production of tools in the Nam Dinh factory would require serious investments that are unnecessary, since the required machines are already working in Thu Duc.

The Viet Tang factory will be equipped with units for tool sharpening to improve production quality.

The present rate of production in the Nam Dinh and 8 March factories reaches 180.000 shuttles. It is assumed that if compressed wood is introduced, durability of shuttles will approximately double. The tests show, that the durability increases even three times in comparison with laminated wood shuttles. Therefore the factories in the North will manufacture about 95.000 shuttles and the corresponding quantity of metal hardware.

Later, if the demand is lower and productivity higher, the Nam Dinh factory will manufacture also shuttles for the Viet Tang Union. It is a complicated project because of long distances and problems with transport.

It is assumed, that the first part of this plan carried out as UNIDO assistance, should generally refer to shuttles designed for the Northern mills.

4. RECOMMENDED CHANGES

4.1 Recommended changes of construction of metal hardware

The standardization of metal shuttle hardware should be carried out in the pilot factory in Nam Dinh to make it possible to use these elements for all shuttles. An expert, who helps at application of production of shuttles and metal tools and hardware, if necessary, should also be present at the time the standardization is introduced.

Other recommendations refer to individual dimensions, sometimes very important ones, and to raw materials.

Detailed recommendations are given in Annex VII.

4.2 The optimal process for the Nam Dinh project

Annex VIII gives all important technologies from the modern ones to only slight modifications to the methods presently used, depending on the possibility to acquire new machines and the equipment available.

One or two alternatives can be introduced in Viet Nam: the first with medium investments (only typical machines and equipment) and the second with minimum investments.

These processes served as a basis for a specification of appropriate raw materials (see annex IX), of unified and approximate standard times, and necessary machines. The optimum project foreseeing a minimum investment is given in annex XA.

4.3 Recommended changes in shuttle body construction

The recommended changes in shuttle body construction refer mainly to tolerances of connected dimensions of elements and to replacing screws with rivets. If compressed wood is used, wooden pins for fastening of spindles should be replaced with steel ones of 5mm diameter or plastic ones of 7mm diameter. Such pins should be tested before replacing the wooden ones.

For detailed recommendations see annex XI.

4.4 Recommendations referring to pirns

Wood should be properly dried up to a moisture content of 7-8%. The wearing-iron on the pirn head should be mounted with greater care.

It is a problem to be solved by the Vietnamese counterparts.

5. GENERAL CONCLUSIONS

On the basis of the above analysis, the following conclusion can be drawn, namely that the factor which most seriously influences the quality of shuttles used in power looms is the material used for shuttle bodies, followed by the quality of body manufacture, surface finishing, and mounting of metal hardware.

Even the best metal hardware does not ensure good final products, i.e. shuttles, if the first three requirements are not met.

The specification of machines and technologies, in order of importance, is as follows:

The first and most important group are machines and equipment for compressed wood production (a)[1/], the second group are machines and equipment for shuttle manufacturing (b) together with the machines for manufacturing and maintenance of the required tools (c), then the system of machines for producing metal hardware (d). This heat treatment equipment listed under (d) should have equal priority to that in the (a) and (b) groups; and finally the system of machines for producing picking sticks (e). The latter group is of least importance, as 90 percent of this problem can be solved by using laminated wood as basic material rather than to the production technology currently used. Using compressed wood for picking sticks causes many serious problems and does not assure the desired results.

Laminated wood, sometimes compressed, is most commonly used now to obtain uneven specific gravity, which ensures uniform strength of a picking stick on its whole length.

Metal hardware of high quality can be manufactured using the same technologies as those currently used, excluding, of course, the heat treatment. The problem here would still be the high cost of labour because of low productivity, but it does not lower the quality of the shuttles.

1/ symbol of a group of machines in specification of equipment.

And a final remark, it should be made clear that problems arising from individual stages of production should be solved in an integrated way, and not partially. Therefore, two specifications of the necessary equipment have been prepared the first for an optimum project (see Annex XII) and the second for a minimum project (see Annex XIIA).

9. SCHEME FOR A UNDP/UNIDO PROJECT

The scheme for the UNDP/UNIDO project is presented in Annex XIII.

ANNEX I

JOB DESCRIPTION

DP/VIE/80/027/11-52

Post title — Consultant for the manufacture of metal shuttle hardware

Duration — 1 month

Date required — As soon as possible

Duty station — Hanoi and Nam Dinh

Purpose of project — To verify the suitability of selected Vietnamese wood species and establish the requirements of the production of high quality wooden accessories for the textile industry such as shuttle blocks, shuttle pirns, picking sticks and side levers and identify further technical assistance needs of the Union of Textile Enterprises (UTE) in the form of a detailed project document.

Duties — The consultant will be attached to the Union of Textile Enterprises (UTE) within the Ministry of Light Industries and work in close cooperation with the counterpart staff. In particular he will be expected to:

1. Survey the existing metal working workshops of the Union of Textile Enterprises operated by the Nam Dinh and 8 March textile mills;
2. Analyse the hardware component requirements of shuttles and pirns used in the Vietnamese textile industry of the pirn change and shuttle change types;
3. Specify appropriate raw materials and process alternatives;
4. Give detailed specifications of the processes chosen including manufacturing methods, standard times, tools and jigs needed.
5. Draw up the specifications and estimate the costs of additional equipment needed for industrial production;
6. Identify the areas in need of further technical assistance and recommend the assistance in this field to be provided under the UNDP/UNIDO financed project;
7. Prepare a technical report on the above topic;
8. To the extent possible and in collaboration with the other consultant (in manufacture of woodworking tools) draw up the draft project document.

Qualifications — Engineer or technologist with specific experience at factory level in the manufacturing cycle of shuttle hardware. Experience in the manufacture of hardware for the shuttle-change type preferred. The consultant must have experience in the actual production of the metal components of shuttle blocks, shuttle pirns, picking sticks and side levers used in the textile industry.

Language English or French

Background information:

In keeping with its aim to provide an increased supply of consumer goods for the population, the Government places great emphasis on reconstructing, rehabilitating and modernizing the country's textile mills as well as on research to exploit a number of natural fibres. One aspect identified in the Country Programme 1982-86 (DP/GC/VIE/R.2, 30 March 1981) that is of key importance to this programme is the supply of loom shuttles and other accessories. A total of US$ 1.000.000 over 4 years has been earmarked as a UNDP contribution for this purpose.

Some 230.000 shuttles (of the shuttle-change type) are produced annually by four shuttle plants attached to main textile mills (three in the North and one in the South) and operating under the Union of Textile Enterprises (UTE). The shuttle-blocks supplied to the shuttle plants are manufactured in two plymills located respectively in the North and South, with the Can Doung mill, near Hanoi, being responsible for the bulk of shuttle-blocks production as well as of picking sticks and side levers. The totality of pirn-change shuttles is imported at a rate of 50.000 to 60.000 per year.

Although loom-shuttles, pirns and picking sticks have been produced in the country since 1960, a number of constraints have developed in utilizing local timber species - especially in connection with the supply to the weaving industry of shuttles of appropriate quality. This has affected the productivity and quality of cloth production and reduced considerably the life in use of shuttles as compared with imported ones. In fact the consumption of locally-made shuttles is of about 2.2 pieces per 1.000 linear meters of cloth as against 1.7 pieces and lower for imported shuttles.

Due to the non-availability of timber species suitable for solid-wood shuttles, these are produced by the veneer-lamination process. Because of the exacting requirements of this particular process and the inadequacy of equipment, as well as of the cost of importing phenolic glue, the Vietnamese Government wishes to identify alternative processes, such as wood compression, resin impregnation, etc. which would allow the utilization of a wider range of species than is currently possible and allow a streamlined and efficient production of shuttle blocks.

A second major constraint experienced in the performance of loom shuttles is the prevailing low quality of related hardware (in particular of the steel-tongues, tongue-springs and steel tips) contributing to the reduced serviceable life of shuttles and frequent hold-ups

in loom operation. Main problems in this respect are: loose tips, misalignment of tongue, tongue-springs loosing tension. Shuttle hardware is partly manufactured at the metal workshops operated by the Nam Dinh, Viet Tang and 8 March textile mills, and partly supplied by metalworking workshops under the Ministry of Metallurgy.

A third cause of defective shuttles and pirns, and their high rejection rate during wood processing is to be traced to the poor conditions of wood-machining cutting tools which are in many cases entirely made and sharpened by hand, in spite of the fact that at least some of the machines in the machine-tool workshops operated by the Nam Dinh, Viet Tang and 8 March textile mills, could be utilized for this purpose.

The Vietnamese Government wishes to identify the steps to be taken to extend the know-how and facilities of the existing UTE metal working and machine tool workshops to fulfill efficiently the demand for shuttle hardware of its weaving mills and for wood processing tools of its shuttle manufacturing plants.

As a result of the above, a UNIDO expert undertook a six week preparatory mission early in 1985. He identified the need for further preparatory assistance, namely, two one-month consultancies, one in manufacture of metal shuttle hardware and the other in the manufacture of woodworking tools, prior to UNDP and UNIDO providing the full technical assistance.

ANNEX II

JOB DESCRIPTION

DP/VIE/80/027/11-53

Post title — Consultant for the manufacture of woodworking tools

Duration — 1 month

Date required — As soon as possible

Duty station — Hanoi and Nam Dinh

Purpose of project — To verify the suitability of selected Vietnamese wood species and establish the requirements of the production of high quality wooden accessories for the textile industry such as shuttle blocks, shuttle pirns, picking sticks and side levers and identify further technical assistance needs of the Union of Textile Enterprises (UTE) in the form of a detailed project document.

Duties — The consultant will be attached to the Union of Textile Enterprises (UTE) within the Ministry of Light Industries and work in close cooperation with the counterpart staff. In particular he will be expected to:

1. Survey the existing machine tool workshops operated by the Nam Dinh, Viet Tang and 8 March textile mills;
2. Analyse the special milling, boring and turning tools used in wood processing operations relating to the manufacture of wooden shuttles and pirns;
3. Study the characteristics and machining properties of the timber species to be used;
4. Based on this information design all the tools needed;
5. Identify the appropriate raw materials and manufacturing alternatives for the production of these tools;
6. Give detailed specifications of the production processes chosen including manufacturing methods;
7. Identify the additional equipment needed, draw up the technical specifications and estimate the costs;
8. Identify the areas needing further technical assistance and recommend the assistance to be provided under the UNDP/UNIDO financed project;
9. Prepare a technical report on the above topics;
10. To the extent possible and in collaboration with the other consultant (in manufacture of metal shuttle hardware) draw up the draft project document.

Qualifications — Engineer or technologist with specific experience in the manufacture of milling, boring and turning tools. Experience in the manufacture of the special woodworking tools used in the manufacture of wooden shuttles and

pirns highly desirable. The consultant must have experience in the actual production of the special woodworking tools needed for the machining of the wooden blocks into shuttles, pirns, pick9ng sticks and side levers used in the textile industry.

Language English or French

Background information:

In keeping with its aim to provide an increased supply of consumer goods for the population, the Government places great emphasis on reconstructing, rehabilitating and modernizing the country's textile mills as well as on research to exploit a number of natural fibres. One aspect identified in the Country Programme 1982-86 (DP/GC/VIE/R.2, 30 March 1981) that is of key importance to this programme is the supply of loom shuttles and other accessories. A total of US$ 1.000.000 over 4 years has been earmarked as a UNDP contribution for this purpose.

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A second major constraint experienced in the performance of loom shuttles is the prevailing low quality of related hardware (in particular of the steel-tongues, tongue-springs and steel tips) contributing to the reduced serviceable life of shuttles and frequent hold-ups in loom operation. Main problems in this respect are: loose tips, misalignment of tongue, tongue-springs loosing tension. Shuttle hardware is partly manufactured at the metal workshops operated by the Nam Dinh, Viet Tang and 8 March textile mills, and partly supplied by metalworking workshops under the Ministry of Metallurgy.

A third cause of defective shuttles and pirns, and their high rejection rate during wood processing is to be traced to the poor conditions of wood-machining cutting tools which are in many cases entirely made and sharpened by hand, in spite of the fact that at least some of the machines in the machine-tool workshops operated by the Nam Dinh, Viet Tang and 8 March textile mills, could be utilized for this purpose.

The Vietnamese Government wishes to identify the steps to be taken to extend the know-how and facilities of the existing UTE metal working and machine tool workshops to fulfill efficiently the demand for shuttle hardware of its weaving mills and for wood processing tools of its shuttle manufacturing plants.

As a result of the above, a UNIDO expert undertook a six week preparatory mission early in 1985. He identified the need for further preparatory assistance, namely, two one-month consultancies, one in manufacture of metal shuttle hardware and the other in the manufacture of woodworking tools, prior to UNDP and UNIDO providing the full technical assistance.

ANNEX III

SPECIFICATION OF METAL HARDWARE FOR SHUTTLES FOR CHINESE WEAVING LOOMS (dimensions in mm)

1. Tip diameter 20 x 32
2. Spindle 10 x 13 x 120
3. Flat spring 9.2 x 2
4. Tip fastening spring diameter 10 x 9.5
5. Weft guide I
6. Weft guide II
7. Pins diameter 3
8. Screws M4
9. Knurled nut M4
10. Clamp for head of tongue
11. Enamelled self-threading device.

ANNEX IV

SPECIFICATION OF EQUIPMENT USED IN MECHANICAL DEPARTMENTS IN THE NAM DINH AND 8 MARCH MILLS

Machines

Specification of machines/ equipment	Number	
	Nam Dinh	8 March
Centre lathe	28	10
Turret lathe	-	1
Shaping machine	5	4
Universal milling machine	5	1
Vertical milling machine	-	1
Hobbing machine	2	1
Slotting machine	1	1
Grinding machine for shafts	1	1
Surface grinder	1	-
Double-wheel grinding/polishing machine	1	3
Tool grinder	1	1
Pillar drill	2	2
Multiradial drilling machine	2	2
Bench drill	1	1

Machines for working plastic

Specification of machines/ equipment	Number	
	Nam Dinh	8 March
Eccentric power presses (100 T-1, 50T-1, 25T-2, 5T-3)	7	-
Eccentric manual press 1 T	2	-
Friction forging press	1	-
Power hammer 150 kgs	4	2
Rolling mill	2	-

Machines for heat treatment

Specification of machines/ equipment	Number	
	Nam Dinh	8 March
Electrode salt bath furnace 1500°C	-	1
Electric box type furnace	-	1
Forging furnaces	4	2

Note: Electric furnaces in the 8 March factory are little used, but they have no control devices and their condition is very poor, so the possibility of using them in the pilot plant in Nam Dinh seems doubtful.

Annex V

ANALYSIS OF CONSTRUCTION OF METAL SHUTTLE HARDWARE

1. **Tip**

The construction is generally correct. The necessary longitudinal grooves on the shank of tin do not exist. Tolerance of dimensions 14; 32; 7 should be changed to 14.0-0.2; 23.0-0.4; 7.0-0.1. The St5 steel used is inappropriate for hardening. The distance that should be hardened from the point to the tip is not marked.

2. **Spindle 10 x 13 x 120**

The construction is generally correct. There is a lack of essential dimensions for the location of an axis opening and for the location of the ball diameter 5. Unnecessary severe dimensional tolerances.

3. **Flat spring 9.2 x 2**

Correct construction. Lack of dimensions, or wrong dimensions given. Inappropriate material 50, i.e. with a carbon content of 0.5 percent.

4. **Tip fastening spring diameter 10 x 9.5**

Correct construction. Inappropriate, although acceptable type of material 5 OHS as heat treatment is not available.

5.&6. **Weft guides I and II**

Correct construction.

7. **Pins diameter 3**

Inappropriate, although acceptable type of material 45, as there is no heat treatment.

8. **Screws M4**

Correct construction. Unnecessary guiding of cant on the screw head. It refers to the nuts used, which are inappropriate for joints in a shuttle.

9. **Knurled nut M4**

Correct construction, but the nut is not appropriate for operation in a shuttle.

10. **Clamp for head of tongue**

Correct construction

11. **Enamelled self-threading device.**

No full technical documentation. This element is not produced at the moment.

Annex VI

ANALYSIS OF TECHNOLOGIES ADAPTED FOR PRODUCING METAL SHUTTLE HARDWARE

1. Tip diameter 20 x 32

The technology used, which is given in the following table, is generally correct, although it is highly material consuming and does not ensure a high productivity. Difference in hardness of heads of tips are significant, but acceptable.

Operation No.	Treatment No.	Description of operation/treatment	Equipment	Accessories
1		Final turning of prepared material	Lathe	
2		Riveting		
	1	Heating	Forging furnace	
	2	Riveting	Friction spindle press	Die
3		Turning of head of tip	Lathe	Template
4		Hardening		
	1	Heating	Forging furnace	
	2	Cooling	Water tank	Cooling device

The technology can assure an appropriate quality of tip, if the construction and technological requirements are observed.

Operation No.	Treatment No.	Description of operation/treatment	Equipment	Accessories
		A. Head of tongue		
1		Rolling of square bar from round bar, dimension of cross section of spindle bar: 10mm	Rolling mill	
2		Planing/milling of bar to obtain dimension 13	Planer/ miller	
3		Parting of bar according to head dimensions	Miller/ Circular saw	
4		Drilling	Driller	
	1	Drilling diameter 8 drill		
	2	Canting diameter 8 drill		
	3	Drilling diameter 3 drill		
	4	Drilling diameter 8 drill from front of head		
5		Milling of cavity for a ball	Vertical milling machine	Fastening device
		B. Tongue of spindle		
1		Final turning	Milling Machine	
2		Milling of a flat place of locking lip	Milling machine	
		C. Locking lip of spindle		
1		Die shearing	Eccentric press	Blanking Die
2		Trimming	Manual	
		D. Assembling		
1		Clamping of tongue in a head	Eccentric press	Cutting tool
2		Hard soldering (brass like)		
	1	Soldering of tongue of spindle with head	Manual	Locking Lip soldering device
	2	Soldering of locking lip of spindle		
3		Blacking		
4		Ball clamping	Manual	

Generally, the technology is correct and well-adapted for the existing machines.

Lack of appropriate raw material causes increased labour costs and lengthening of the process.

3. Flat spring 9.2 x 2

Operation No.	Treatment No.	Description of operation/treatment	Equipment	Accessories
1		Shearing the length of metal sheet	Cutter/shear	
2		Shearing the width	Shear press	
3		Bending		Bending device
	1	Heating	Forging furnace	
	2	Bending and groove making	Manual	
4		hardening		
	1	Heating	Forging furnace	
	2	Cooling in oil		

Wrong technological process. Lack of appropriate material: strip with natural (non sharp) edges, causing increased labour costs, a longer manufacturing process and higher forsprings tendency to crack (formation of notches when shearing, lack of trimming). Hot bending by heating in a forging furnace can lead to surface decarbonization in spite of the carbon monoxide atmosphere.

The same situation appears when hardening. Heating temperature of springs to be treated is adjusted by guessing, solely on the basis of change in colour.

Lack of process control leads to wrong structure of material which causes cracking of springs.

Lack of tempering after hardening and no quenching stress relief give the same results.

The process should be changed.

4. Tip fastening spring diameter 10 x 9.5

The technology adapted is correct and appropriate for the existing set of machines; the coiling and cutting of springs is carried out by means of special equipment.

5+6. Weft guides I and II

Correct technology, well-adapted for the existing set of machines.

Operation No.	Description of operation/treatment	Equipment	Accessories
1	Cutting the length	Eccentric press	cut-off die
2	Bending	Eccentric press	bending die
3	Blacking		

7. Pins diameter 3

Adapted technology: cutting the wire by means of an eccentric press, removing burr manually and blacking is not correct.

The process is labour-consuming because of the manual removal of burr; the cant is not guided. This causes difficulties when fitting pins into shuttle bodies.

8.&9. Screws M4, Knurled nuts M4

Screws and nuts are bought from factories specializing in such products and their quality is good.

Sometimes, screws and nuts are machined on lathes. Own production is ineffective because the existing set of machines is not designed for batch production of such small elements.

Note: the construction of nuts is not appropriate for the requirements of shuttle operation because the screw/nut joint is not protected against loosening caused by vibrations.

10. **Clamp for head of tongue**

Operation No.	Treatment No.	Description of operation/treatment	Equipment	Accessories
1		Shearing metal sheet into strips	Shear/cutter	
2		Die shearing of shape	Eccentric press	Blanking die
3		Pressing		
	1	Bending I	Eccentric press	Press forming die
	2	U-bending II	Eccentric press	Press forming die
4		Blacking		

Correct process.

11. **Enamelled self-threading device**

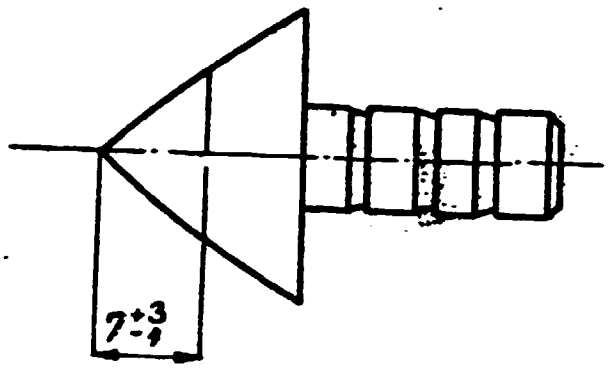
This component has not yet been manufactured locally. It was imported from China and India.

Annex VII

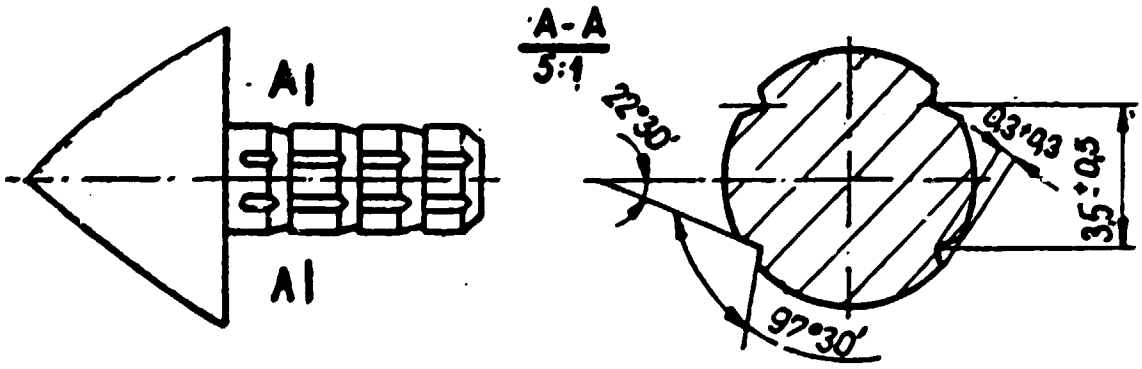
RECOMMENDED CHANGES IN CONSTRUCTION

1. Tip diameter 20 x 32

- Introduce tolerances, as follows: 14-0.2, 32-0.4, 7-0.1
- Mark the hardening area (Hardening the whole length of tip head is inadmissible as it causes cracking at the connection of the head with the shank).



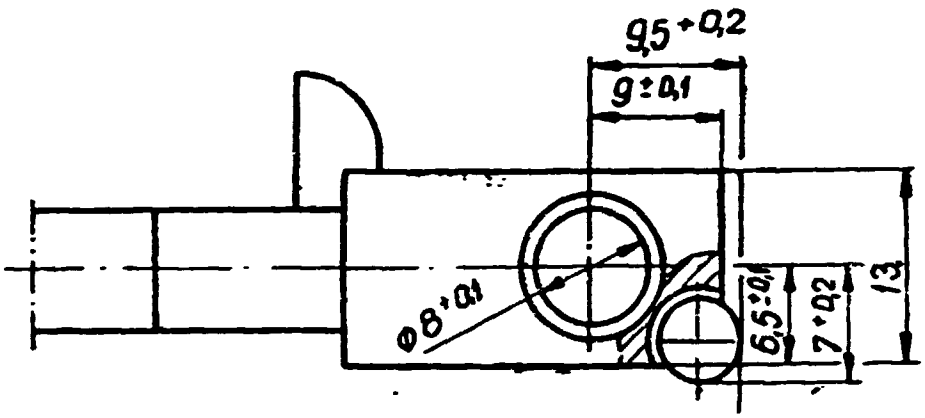
- Introduce longitudinal grooves formed by a press to ensure proper mounting of a tip on a shuttle, to remove any air that may have been compressed from the hole and facilitate distribution of glue under the mounted tip (it is not essential but recommended).



- Change the type of initial material (St5 steel does not guarantee proper heat treatment) to steel 45.
- Lengthen the tip shank to 20 mm, and overall length to 34 mm to ensure better a mounting on a shuttle. (It is not essential but recommended.)
- Change the shank diameter from diameter 7 to diameter 8 to ensure better mounting of a tip on shuttle and lower labour input in the manufacture of tips. (It is not essential but recommended.)

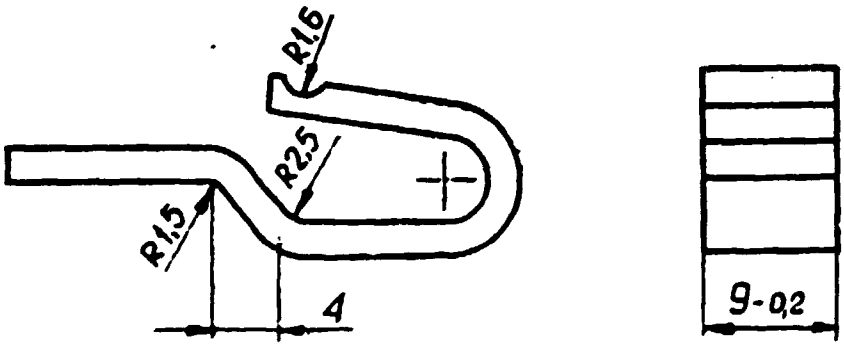
2. Spindle 10 x 13 x 120

- Introduce dimensions and change tolerance according to the drawing:



3. Flat spring 9.2 x 2

- Introduce dimensions according to the drawing:



- Change material to 65G or 50HSA.

4. Tip fastenirg spring

- Change material to steel wire of the following strength: (Rm) ranging from 981 to 1177 MPa (100 to 120 kg/mm^2).

5.&6. Weft guides I and II

- No changes necessary.

7. Pin diameter 3

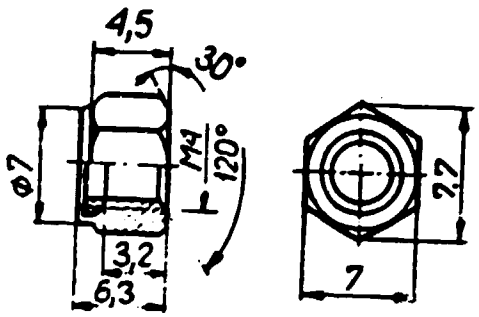
- Change material to steel wire of the following strength: (Rm) ranging from 785 to 1177 MPa (80 to 120 kg/mm^2).

8. Screw M4

- Do not make a cant on a screw heat (it is not necessary)
- Use All free cutting steel if elements are machined on an automatic lathe or turret lathe.

9. Knurled nut

- Change the nut construction into a self-retaining one with a plastic piece, as shown on the drawing, or use rivets instead of nuts.



- Use All free cutting steel if elements are produced on an automatic lathe or a turret lathe.

10. **Clamp for head of tongue**

- Use strips or sheets of steel for pressing.

11. **Enamelled self-threading device**

- Make an engineering drawing.

General remarks:

Introduce marking of surface roughness (Ra)[1/] changing old symbols of classes, or parameter Rz[1/] which is not essential in case of not precise elements of considerable roughness.

1/ As per ISO standard 468-1982, 'Surface roughness - Parameters, their values and general rules for specifying requirements'.

Annex VIII

CHOICE OF OPTIMUM AND SATISFACTORY TECHNOLOGICAL PROCESSES FOR NAM DINH PROJECT

1. Tip diameter 20 x 32

Technical conditions in Nam Dinh, financial conditions of the project, and rate of production (approximately 200.000 tips per year) do not allow the introduction of modern technologies of heading and hardening in an automatic or semi-automatic cycle.

The optimum technology for the Nam Dinh project is as follows:

Operation No.	Treatment No.	Description of operation/treatment	Equipment	Accessories
1		Turning		
	1	Turn a prepared material from a diameter 12 bar	Turret lathe	Set of turning tools
2		Quality control		
	1	Check the shank diameter		Caliper gauge
	2	Check the shank length		Caliper gauge
	3	Check of the overall length		Caliper gauge
3		Barrel finishing	Vibrating device	
4		Heading		
	1	Heat in a resistance furnace mounted on a friction spindle press	Heating device	
	2	Riveting	Friction spindle press 25T	Set of dies
5		Quality control		
	1	Check the height of head of tip		Gauge
	2	Check the diameter of head of tip		Gauge
6		Turning		
	1	Turning of head of tip	Lathe	Template
7		Quality control		
	1	Check the height of head of tip		Gauge
	2	Check the diameter of head of tip		Gauge
8		Pressing		
	1	Forming of longitudinal grooves diameter 8 (diameter 7)	Eccentric press	Cutting tool
9.		Quality control		
	1	Check the shank diameter after making of grooves		Gauge

Operation No.	Treatment No.	Description of operation/treatment	Equipment	Accessories
10		Heat treatment		
	1	Heat in forging furnace	Forging furnace	
	2	Cooling in water		Hardening plate
11		Barrel finishing		
	1	Cleaning after hardening	Bell-shaped barrel	
12		Quality control		
	1	Check the tip hardness	Hardness tester	Clamping device
13		Final production control		
	1	Check that the tip conforms to the drawing		Gauges

Operation time: approximately 5.5 minutes.

The technology is satisfactory for Vietnamese conditions. Add to the technology used until now barrel finishing after turning and cleaning after hardening. Also introduce control operations.

Former operation time: approximately 10 minutes.

Necessary machines and equipment:

(a) For optimum technology:

- turret lathe admitting diameter 12 mm bars.
- resistance furnace for heating of prepared material.
- vibratory device 125 l for removing burrs.
- bell-shaped device 50 l for cleaning and removing burrs.
- longitudinal grooves making for 25 T press.

(b) For satisfactory technology

- vibratory device for removing burrs.

2. Spindle 10 x 13 x 120

No change in the technology is needed but the following reservations must be noted:

- Use appropriate initial materials for spindle elements: diameter 10 of ST5 quality for a tongue (13 or 10x13 drawn bar of ST5 quality for head of tongue 3 x 18 steel strip of ST2S quality for locking lip).
- Introduce barrel finishing of a head of tongue in a vibratory device after machining.
- Introduce barrel finishing of a locking lip after die shearing; use a vibratory device.
- Introduce inter-operation quality control; use gauges;
- Introduce final quality control.

Necessary machines and equipment

Vibrating device 100 l for removing burrs.

Operation time: approximately 25 minutes.

3. Flat spring 9 x 2

The optimum and satisfactory technologies differ only in using a new eccentric press instead of the existing 25 T eccentric press.

Initial material: steel strip 9x2 of 50HS quality in the soft or non-soft annealed (raw) condition. In the latter case - the strip should be annealed for protection against decarbonization.

Operation No.	Treatment No.	Description of operation/treatment	Equipment	Accessories
1		Pressing I		
	1	Cut and bend a spring initially form a groove	Eccentric press	Die
2		Barrel finishing		
	1	Remove burrs after cutting	Vibrating device	
3		Pressing II		
	1	Final bending according to drawing	Eccentric press	
4		Quality control		
	1	Check the spring shape		Gauge
	2	Check the location and dimensions of grooves		Gauge
5		Hardening		
	1	Heating to 860°C; protect against decarbonization by means of cast iron fillings or charcoal	Electric box-type furnace	
	2	Cooling in oil	Oil tank	
6		Tempering, HRC 46°-50°		
	1	Soaking in a temperature of 300°C	Tempering furnace	
	2	Cooling in the open		
7		Quality control		
	1	Check the spring hardness	Hardness tester	
8		Barrel finishing		
	1	Cleaning of tarnish after heat treatment	Bell-shaped barrel	
9		Final quality control		
	1	Check that the spring conforms to the drawing.		Gauges

Operation time: approximately 1 minute.

Necessary machines and equipment:

(a) For optimum technology

- Eccentric press with a set of accessories
- Electric box-type hardening furnace 400 x 400 x 600 for temperatures up to 1000°C.
- Electric soaking furnace for tempering, diameter 500, for temperatures up to 650°C
- Vibrating device 100 l, for removing burrs
- Bell-shaped barrel 50 l, for cleaning
- Oil tank, approximate one cubic meter, with coil water cooling (to be manufactured locally)

(b) For satisfactory technology

- Set of accessories (dies) for eccentric press 25T (already being used in Nam Dinh)
- Hardening furnace
- Tempering furnace
- Vibrating device
- Bell shaped barrel
- Oil tank

4. Tip fastening spring

There is no need to change the technology being used. Switching to automatic coiling is unprofitable if the demand is only approximately 250.000 pieces.

Raw material - steel wire with a tensile strength RM of 981 MPa.

Introduce production control operations.

5 & 6 Weft guides I and II

There is no need to change the technology being used. Introduce quality control operations.

7. Pins diameter 3

(a) Optimum technology

Operation No.	Treatment No.	Description of operation/treatment	Equipment	Accessories
1		Cutting		
	1	Straighten and cut to length	Straightening machine	
2		Quality control		
	1	Check length and diameter of pin		Gauges
	2	Check the quality of cutting		Pattern

Operation No.	Treatment No.	Description of operation/treatment	Equipment	Accessories
3		Barrel finishing		
	1	Remove burrs after cutting	Bell-shaped barrel	
4		Grinding		
	1	Single-sided grinding of cant	Grinder for pins	
5		Quality control		
	1	Check the cant		
6		Final quality control		Gauge.

Operations time: approximately 0.4 minutes.

This is a cheap technology, well-adapted for batch production, with a minimum utilization of the machines.

This technology can be adapted if steel pins diameter 5 are used for spindle mounting instead of wooden ones of diameter 8.

(b) Satisfactory technology

Operation No.	Treatment No.	Description of operation/treatment	Equipment	Accessories
1		Cutting		
	1	Cut the length	Eccentric press	Cut-off Die
2		Quality control		
	1	Check the length		Gauge
3		Barrel finishing		
	1	Barrel finishing for rounding the edges R 0.2 + 0.4	Vibrating device	
4		Quality control		
	1	Check the rounding		Gauge
5		Final quality control		
	1	Check that the pin conforms to the drawing		Gauge

Using a radium R 0.2 + 0.4 instead of countersunk bevel is admissible for this diameter and negative tolerance of 0.1 to 0.2 mm of shuttle body.

Operation time: approximately 0.5 minutes.

Necessary machines and equipment:

(a) For optimum technology:

- Hammer-type straightening machine for wire, max diameter 6
- Grinder for pins, maximum diameter 6
- Bell-shapred device for trimming

(b) For satisfactory technology:

- Vibrating device for removing burrs, 100 l

8.&9. Screws M4, Knurled nuts M4

It is recommended to stop the production of screws and nuts and replace them with rivets. In such a case, rivets and a radial riveter for riveting diameter 3 rivets in shuttles should be bought.

If screws and nuts are used, it is recommended to buy them from factories specializing in such products.

10. Clamp for head tongue

There is no need to change the technology, but only to remove the burrs after die shearing (trimming operation) by means of a vibrating device, and to introduce quality control operations using gauges.

Initial material: strip of steel for press forming.

Machines necessary for satisfactory technology:

Vibrating device 100 l for trimming.

11. Enamelled self-threading device (process based on Chinese design).

Initial material: drawn bar diameter 10, quality All (free-cutting steel.

Generally speaking, the optimum technology would be to use a set of automatic lathes with threading heads and chasing devices and one operator for each two lathes. Because only one automatic lathe is needed it is unprofitable, being too expensive and not increasing productivity correspondingly.

(a) Optimum technology:

Operation No.	Treatment No.	Description of operation/treatment	Equipment	Accessories
1		Turning	Turret lathe	
	1	Facing		
	2	Cross-turning of cavities 3.5/2x0.5		
	3	Straight turning diameter 8 x 17.5		
	4	Threading M10 x 10		
	5	Drill along the axis diameter 4		
	6	Cavity at front, radius R1		
	7	Cutting off		
2		Quality control		
	1	Check the self-threading device dimensions after turning		Gauges
3		Drilling	Bench drill	Fastening device
	1	Make drill diameter 2.5		
	2	Cavity with diameter 2.5 drill, radius R1		
4		Quality control		
	1	Check the diameter 2.5 drill		Gauges
5		Milling		
	1	Milling of grooves 1.5 x 2.5 (20 off at a time)		Fastening device
	2	Milling of cavities 1.2 x 17.5, through, to diameter 4		Fastening device
	3	Milling of 1.2 cavity at an angle of 45°		Fastening device
6		Quality control		
	1	Check the cavity's width		Gauges
7		Barrel finishing		
	1	Removing burrs	Vibrating device	

Operation No.	Treatment No.	Description of operation/treatment	Equipment	Accessories
8		Quality control		
	1	Check the edge rounding and thread blunting		Pattern
9		Enamel painting		
	1	immersion painting with enamel (protect the thread)		
	2	soaking in box-type furnace	box furnace	
10		Final quality control		
	1	Check that the self-threading device conforms to the drawing		gauges patterns

Necessary machines and equipment:

- turret lathe diameter 12 with complete tooling
- universal milling machine diameter 25 complete with tooling
- vibrating unit for trimming
- drill jig (designed and produced locally)

Time of milling (for a production of at least 2000 pieces) approximately 3.5 minutes, which gives, for 95,000 pieces approximately 5550 hours.

Working two-shifts only gives 4896 hours (306x16).

Assuming that the efficiency factor is 0.8, we obtain an actual available working time of 3916 hours. It is not enough for producing the whole quantity with one milling machine. However, we expect that self-threading devices installed on shuttles that have broken down could be retrieved and used on another (new) shuttle.

Total operation time: approximately 8 minutes.

(b) Satisfactory version:

Based on observations and discussions, it was noted that self-threading devices are used only in the 8 March mill (about 40.000 pieces) while in the Nam Dinh mill porcelain eyes are used instead of self-threading devices. This solution has been used long in Europe, and it causes only a slight difficulty at weft passing during the replacement of a shuttle.

This technology should also be adopted in the 8 March mill and to abandon self-threading devices.

Calculation of necessary number of turret lathes:

Time for preparing the material for the tip: 1.5 minutes.

Number of pieces: 200.000 per year

Time for manufacturing self-threading device: 3.5 minutes

Number of pieces: 47.500 per year (if used twice)

Total operation time: 7770 hours

Actual available working time at one lathe: 3916 hours (306x16x0.8)

Necessary: two turret lathes accepting bars with a diameter of 12 mm.

Note: Because of a large-batch production of metal shuttle hardware, inter-operation and final quality control should be carried out on a statistical basis.

It is recommended to work out technical specifications of acceptance. The final quality control should be carried out according to these specifications.

ANNEX IX

SPECIFICATION OF INITIAL MATERIALS FOR METAL SHUTTLE HARDWARE

Pos.	Element	Type of material	Dimensions	P N		C o s t		D I N	
				Symbol	Standard	Symbol	Standard	Symbol	Standard
1	Tip diameter 20 x 32	rolled bar	Diameter 12	45	PN-75 H-84019	45	1050-60	C45	1651 1970
2	Spindle 10-13x120 - head of tongue	drawn bar	10 x 13 13	ST 5	PN-72 H-84020	BCTkn2	380 1971	ST50-2	17100 1966
	- tongue	rolled bar	Diameter 10						
	- locking lip	cold-rolled strip	3 x 14	ST 2		BCT2kn2		USt34-2	
3	Flat spring 9.2 x 2	cold-rolled strip with natural edges	9 x 2	50 HS or 65G	PN-73 H-84032	50 x CA or 65 r	14959-69	En48	BS 970-55
4	Tip fastening spring diameter 10x 9.5	drawn bar	Diameter 1.75	medium carbon steel Rm=981 MPa	PN-80 M-80028	medium-carbon steel Rm=981 MPa	2771-1957	medium-carbon steel RM=981 MPa	177 1971

1	2	3	4	5	6	7	8	9	10
5&6	Weft guides I & II	Drawn bar	Diameter 1.5	45	PN-75 H-84019	45	1050-60	C45	1651 1970
7	Pins, diameter 3	Drawn bar	Diameter 3h11	Medium-carbon steel R_m=981 MPa or 45	PN-80 M-80028 PN-75 H-84019	medium-carbon steel R_m=981 MPa or 45	2771-1957 1050-60	medium-carbon steel R_m=981 MPa or C45	177 1971 1651 1970
8	Screws M4	Drawn bar	Diameter	All or	PN-73 H-84026	A12	1414-54	10S20	1651 1970
9	Knurled nut M4			ST5	PN-72 H 84020	BCT5cn2	380 1971	St50-2	17100 1966
10	Clamp for head of tongue	cold-rolled strip	1.25 x 15	steel strip for pressing or	PN-73 H-92327	steel strip for pressing	503-701	steel strip for pressing	2623-71 Blatt 1
				St2S	PN-72 H-84020	BCT2kn2	380 1971	USt34-2	17100 1966
11	Enamelled self-threading device	drawn bar	Diameter 10	A 11 or	PN-73 H-84020	A 12	1414-54	10S20	1651 1970
				St5	PN-72 H-84020	BCT2kn2	380 1971	St50-2	17100 1966

Annex X

NECESSARY MACHINES, EQUIPMENT AND ACCESSORIES FOR MACHINING OF METAL SHUTTLE HARDWARE; OPTIMUM VERSION

Pos.	Specification	Quantity	Unit price US$	Total value US$
1	Turret lathe diameter 12	2	12.000	24.000
2	Electric box furnace max. 1000°C, chamber dimensions 400x400x600	1	10.000	10.000
3	Pit furnace for tempering maximum 650°C, diameter 500	1	10.000	10.000
4	Universal milling machine, spindle diameter 25, with complete tooling for machining self-threading devices	1	22.000	22.000
5	Wire straightener, maximum diameter 6, hammer type	1	4.000	4.000
6	Grinder for canting of steel pins	1	5.000	5.000
7	Vibrating device, 100 l, for removing burrs	1	6.000	6.000
8	Bell-shaped barrel with adjustable axis for removal of burrs, 50 l	1	3.000	3.000
9	Eccentric press with complete accessories for manufacturing flat springs	1	16.000	16.000
10	Electric resistance heating system for heating tips before forging on friction forging press	1	6.000	6.000
11	Making of grooves at shank tip	1	1.700	1.700
12	Diamond indenter of Rockwell hardness tester (Polish product)	1	300	300
13	Tensile testing machine	1	9.000	9.000
14	Steeloscope (for spectroscopic analysis of steel)	1	4.000	4.000
15	Unit for quantitative analysis of carbon and sulphur in cast-iron and steel, provided with Mars' pipe furnace (to determine the carbon and sulphur content of the steel)	1	1.200	1.200
16	Radial riveter for riveting diameter 3 rivets on a shuttle	1	6.000	6.000
	Total machines			128.200
	Spare parts and tools 10%			12.800
	Transport 12.5%			16.000
	Total			157.000

Annex XA

NECESSARY MACHINES, EQUIPMENT AND ACCESSORIES FOR MANUFACTURE OF METAL SHUTTLE HARDWARE: SATISFACTORY (MINIMUM) VERSION

Pos.	Specification	Quantity	Unit price US$	Total value US$
1	Electric box furnace max. 1000°C	1	10.000	10.000
2	Pit furnace for tempering, max. 650°C, diameter 500	1	10.000	10.000
3	Vibrating device, 100 l, for removing burrs	1	6.000	6.000
4	Bell-shaped barrel 50l, with adjustable axis, for removing burrs	1	3.000	3.000
5	Set of press-forming dies for flat spring production, for 25 T eccentric press	1	6.000	6.000
6	Diamond indenter of Rockwell hardness tester (Polish product)	1	300	300
7	Tensile testing machine	1	9.000	9.000
8	Radial riveter for riveting diameter 3 rivets on a shuttle	1	6.000	6.000
	Total machines			50.300
	Spare parts and tools 10%			5.000
	Transport 12.5%			6.300
	Total			61.600

If this version is accepted, the technology would not be changed, and slight differences would refer to trimming. The technology for manufacturing flat springs would be changed.

Production of screws and nuts would be stopped.

Production of the self-threading device would be stopped, as this element is not necessary, because Nam Dinh mill uses porcelain eyes at the moment.

Elimination of the machines and equipment from the optimum version should not seriously influence the metal hardware quality, but it would influence productivity.

Of all the control equipment only the tensile testing machine has been retained. It can be used for testing the compressed wood (tensile, compressive, shear, and bending strengths).

Annex XI

RECOMMENDED CHANGES IN SHUTTLE BODY CONSTRUCTION

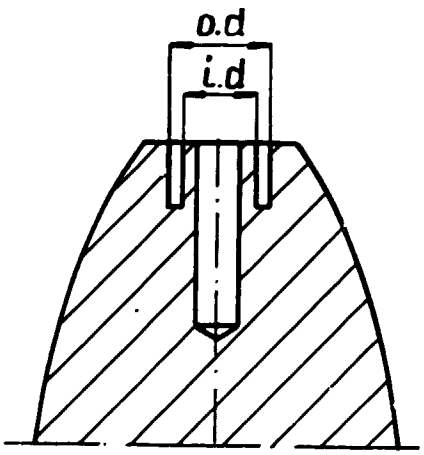
1. Replacing screws and nuts with rivets diameter 3.

2. Replacing the wooden pin with a steel pin diameter 5, if laminated wood is used (to be considered by the Vietnamese authorities).

3 Make drills for steel elements according to the following instructions:

- Drill for shank of tip
  - for compressed wood and laminated wood — diameter 6.8 mm
  - for non-compressed wood — diameter 6.5 mm
- groove for tip fastening spring
  - for non compressed wood — i.d. 10.4 mm, o.d. 14.0 mm
  - for compressed wood and laminated wood — i.d. 10.2 mm, o.d. 14.0 mm
- drill for diameter 8 pin — diameter 7.8 mm
- drill for diameter 3 pin — diameter 2.8 mm
- drill for diameter 5 pin — diameter 4.8 mm

(if wooden pins diameter 8 are replaced by steel ones diameter 5).



i.d. - inner diameter
o.d. - outer diameter

Annex XII

GENERAL REQUIREMENTS (MACHINES, EQUIPMENT, ACCESSORIES) FOR THE PRODUCTION OF SHUTTLES, PICKING STICKS, FOR PRODUCTION AND MAINTENANCE OF TOOLS, AND FOR PRODUCTION OF METAL HARDWARE

OPTIMUM VERSION

Pos.	Specification	Quantity	Unit price US$	Total value US$
	A. Machines and equipment for producing compressed wood			
1	5-daylight hydraulic press 800x800, capacity 630 T, for pressing timber for shuttles	1	200.000	200.000
2	Device for semi-automatic control of kiln drying process (similar to "Lignomat", produced by Relutherm AG CH-4055 Basel)	2	5.000	10.000
3	Manual electrode hygrometer	2	500	1.000
4	Brinell hardness tester	1	4.000	4.000
	B. Machines and equipment for shuttle manufacturing			
5	Four-sided planer, 5-spindle, with one spindle inclinable (also for Group A)	1	50.000	50.000
6	Router, 18.000 rpm	1	20.000	20.000
7	Double-sided oscillating mortising machine (similar to Helma-Holland model HL120PE)	1	12.000	12.000
8	Horizontal milling machine with horizontally and vertically sliding plate for making cut-outs on shuttles min. 9000 rpm (similar to H. Reinhard AG, Switzerland, Model WSF-H)	1	15.000	15.000
9	Horizontal band sander	2	1.200	2.400
10	Double sided sanding polishing machine	2	2.000	4.000
11	Multi-spindle boring machine with 3-spindle exchangeable head for drills for spindle and spring assembly (similar to Mayer, FRG, model MBBFQ)	1	7.000	7.000
12	Radial riveter for riveting in a shuttle rivets diameter 3 and diameter 4	1	6.000	6.000
	C. Machines for production and maintenance of tools			
13	Semi-automatic grinder for circular saws	1	8.000	8.000
14	Universal tool grinder with tooling (similar to Vollmer, FRG, model for dry & wet grinding, spiral grinding and with a dividing head).	2	22.000	44.000
15	Bench centre device for static balance testing	1	1.000	1.000

Pos.	Specification	Quantity	Unit price US$	Total value US$
	D. Machines for producing picking sticks, side levers, and slays			
16	Thicknessing machine (also for Group B)	1	4.000	4.000
17	Spindle moulder with feeding device (also for Group B)	1	5.000	5.000
	E. Machines and equipment for metal shuttle hardware production			
18	Electric box furnace, max. 1300°C, chamber dimensions 400 x 400 x 600	1	12.000	12.000
19	Pit furnace for tempering max. 650°C, diameter 500	1	10.000	10.000
20	Universal milling machine with table and movable head, and tooling for production of self-threading device (including tools	1	25.000	25.000
21	Hammer-type wire straightener	1	4.000	4.000
22	Grinder for canting of pins	1	5.000	5.000
23	Vibrating device for removing burrs	1	6.000	6.000
24	Bell-shaped barrel, 50 l, with adjustable axis, for removing burrs	1	3.000	3.000
25	Eccentric press with set of accessories for manufacturing flat springs	1	16.000	16.000
26	Electric resistance furnace for heating tips before forging by means of a friction forging press	1	6.000	6.000
27	Tool for making grooves on tip shank	1	1.700	1.700
28	Diamond indenter of Rockwell hardness tester (Polish product)	1	300	300
29	Tensile testing machine (also for Group A)	1	9.000	9.000
30	Steeloscope (for spectroscopic analysis of steel)	1	4.000	4.000
31	Unit for quantitative analysis of carbon and sulphur in cast iron and steel, with Mars' pipe furnace, to determine the carbon and sulphur content of the steel	1	1.200	1.200
	Total machines			496.600
	Spare parts and tools 10%			49.600
	Transport			62.000
	Total			608.200

Note: The set of machines for hardening ensures the possibility of hardening of carbon and alloy tool steel, but not high-speed steel.

All machines will be provided without pneumatic systems, since the plant has no compressors.

All machines will be provided with overload switches and tropically insulated motors.

Precalculation of press size

It is assumed, that 400.000 pieces of timber will be pressed yearly, and it means that at a 25% timber utilization factor for the first and second class, 700 to 900 cubic meters of wood will be processed, depending on density.

Calculations have been done for two limit values of wood density, i.e. 0.63 kg/dm3 and 0.72 kg/dm3, assuming that wood will be pressed to 1.12 kg/dm3.

Required dimensions of timber are given in the following table.

Process stage	Dimensions (mm)	
	for density 0.72	for density 0.53
Planing after pressing	40 x 53 x 340	40 x 53 x 340
Pressing	40 x 62 x 340	40 x 71 x 340
Planing before pressing	62 x 62 x 340	71 x 71 x 340
Drying	64 x 64 x 355	74 x 74 x 340
Cutting from balk	70 x 70 x 355	80 x 80 x 355

Dimensions of press platens will be: 800 x 800 mm. Each platen can hold 2 x 10 = 20 pieces of timber, subtracting area for limit strips in the less advantageous case if the density of initial material is lower.

Pressing area 4216 cm2

Pressure per timber 140 bar

Force necessary for pressing 589 T

Pressing time: t approximately 3.5 hours (including loading and unloading).

Number of pressing operations daily: 4 (two shifts)

Press utilization factor 0.8

Number of working days per year 306

Number of openings $\frac{100.000}{306 \times 0.8 \times 4 \times 20} = 5.1$

630 T, 5 daylight press can be accepted.

The remaining machines for wood treatment are not fully loaded so they do not require any calculations.

Annex XIIA

GENERAL REQUIREMENTS (MACHINES, EQUIPMENT, ACCESSORIES) FOR PRODUCTION SHUTTLES, PICKING STICKS, FOR PRODUCTION AND MAINTENANCE OF TOOLS, AND FOR PRODUCTION OF METAL SHUTTLE HARDWARE (MINIMUM VERSION)

Pos.	Specification	Quantity	Unit price US$	Total value US$
	A. Machines and equipment for producing compressed wood			
1	5-daylight hydraulic press 800x800. capacity 630 T, for pressing timber for shuttles	1	200.000	200.000
2	Semi-automatic device for the control of drying process (temp.,humidity) (eg. Lignomat)	2	5.000	10.000
3	Manual electrode hygrometer	2	500	1.000
4	Brinell hardness tester	1	4.000	4.000
	B. Machines and equipment for shuttle manufacturing			
5	Four-sided planer, 5-spindle, with inclinable spindle (also for Group A)	1	50.000	50.000
6	Router, 18.000 rpm	1	20.000	20.000
7	Double-sided mortiser	1	12.000	12.000
8	Horizontal milling machine with horizontally and vertically sliding plate for making cut-outs on shuttles min. 9000 rpm	1	15.000	15.000
9	Horizontal band sander	2	1.200	2.400
10	Double sided sanding/polishing machine	2	2.000	4.000
11	Multi-spindle boring machine with 3-spindle exchangeable head for drills for spindle and spring assembly	1	7.000	7.000
12	Radial riveter for diameter 3 and diameter 4 rivets in a shuttle	1	6.000	6.000
	C. Machines for production and maintenance of tools			
13	Semi-automatic grinder for circular saws	1	8.000	8.000
14	Universal tool grinder with tooling	2	22.000	44.000
15	Bench centre device for static balance testing	1	1.000	1.000
	D. Machines for producing picking sticks, side levers, and slays			
16	Spindle moulder with feeding device (also for Group B)	1	5.000	5.000

Pos.	Specification	Quantity	Unit price US$	Total value US$
	E. Machines and equipment for metal shuttle hardware production			
17	Electric box furnace, max. 1000°C, chamber dimensions 400 x 400 x 600	1	10.000	10.000
18	Pit furnace for tempering max. 650°C, diameter 500	1	10.000	10.000
19	Vibrating device for removing burrs	1	6.000	6.000
20	Bell-shaped barrel, 50 l, with adjustable axis, for removing burrs	1	3.000	3.000
21	Set of dies for flat spring manufacturing (2-off)	1	6.000	6.000
22	Diamond indenter of Rockwell hardness tester (Polish product	1	300	300
23	Tensile testing machine (also for Group A)	1	9.000	9.000
	Total machines			433.700
	Spare parts and tools 10%			43.400
	Transport			54.200
	Total			532,300

Note: The set of machines for hardening ensures the possibility of hardening of carbon and alloy tool steel but not high-speed steel.

If the equipment should be more limited, the following machines can be omitted according the the given order of priority.

Pos.	Specification	Quantity	Unit price US$	Total value US$
1	Router, 18.000 rpm	1	20.000	20.000
2	Bell-shaped barrel, 50 l, with adjustable axis for burr removal	1	3.000	3.000
3	Universal tool grinder with tooling	1	22.000	22.000
4	Horizontal milling machines for making cut-outs on shuttle	1	15.000	15.000
5	Drill lathe. Leave only three-spindle head (US$ 3.000) which can be used with the existing equipment	1	4.000	4.000
	Machines total			64.000
	Spare parts and tools, 10%			6.400
	Transport 12.5 %			8.000

Note: If the above mentioned machines are not purchased the quality of production will be slightly lower.

If the horizontal millling machine and the drill lathe are not purchased, the rotation speed of the existing machines should be increased to at least 3000 rpm.

Annex XIII

The project proposal

I. Development Objective

To contribute towards improving the operative efficiency and productivity of the weaving industry in keeping with the priority assigned to the development of the manufacture of clothing and other essential consumer goods in the current five-year state plan (1981-1986).

II. Immediate objectives

1. To obtain good quality raw material for shuttle bodies.
2. To improve the quality of metal shuttle hardware.
3. To obtain high quality tools for the production of wooden accessories for the weaving industry and particularly of shuttle manufacturing.
4. To improve the quality of shuttles produced in Viet Nam.

III. Outpuvs

1. Output related to objective 1:

   Starting of compressed wood production in pilot plant in Nam Dinh.

2. Output related to objective 2

   Modernization of the production technology of metal shuttle hardware.

3. Output related to objective 3:

   Starting the production of tools for wood processing in the Viet Tang (Thu Duc) plant, and introducing the appropriate tool maintenance operations in the Viet Thang and Nam Dinh plants.

4. Output related to objective 4:

   Modernization of the shuttle production technology in the pilot plant, based on items 1 and 3.

IV. Activities

1. Activities related to output 1

1.1 Determining most suitable timber species for pressing

1.2 Optimizing the processing of logging, drying and pressing of timber

1.3 Establishing the technical specifications of the equipment necessary for starting the production.

1.4 Purchase of machines and equipment.

1.5 Installation and start-up of machines and equipment.

1.6 Starting the production of compressed wood (timber cutting, drying, preparations for pressing, pressing).

1.7 Elaborating the technical specifications of acceptance and quality control procedures.

1.8 Organizing a laboratory for testing solid and compressed wood.

1.9 Introducing raw material, in-process, and final quality control procedures.

2. Activities related to output 2

2.1 Establishing the technical specifications of the modernization of the processing technology for metal shuttle hardware production.

2.2 Purchase of machines and equipment

2.3 Installing and start up of machines and equipment.

2.4 Introducing new technologies or modernization of those currently used.

2.5 Designing and manufacturing equipment, tools and gauges necessary for introducing new technologies.

2.6 Elaborating the technical specifications of acceptance and quality control procedures.

2.7 Introducing raw material, in-process, and final quality control procedures.

3. Activities related to output 3

3.1 Elaborating the technical specifications of the processing tools for the production of wooden accessories for the weaving industry.

3.2 Establishing the technical specifications of the necessary equipment.

3.3 Purchasing the machines and equipment.

3.4 Istalling and start-up of the machines and equipment

3.5 Starting the production of tools.

3.6 Elaborating and introducing a system of planning and controlling of the maintenance of wood processing tools (giving out tools, checking the degree of wear, sharpening, and eventual scrapping).

4. Activities related to output 4

4.1 Elaborating the shuttle production technology

4.2 Elaborating the picking stick production technology.

4.3 Establishing the technical specification of the necessary equipment.

4.4 Purchasing the machines and equipment.

4.5 Installing the machines and equipment

4.6 Introducing the new technologies.

4.7 Elaborating the production

4.8 Elaborating and introducing quality control procedures for raw materials.

4.9 Elaborating the design of, and manufacturing of the missing or poor jigs, tools and gauges.

4.10 Preparing and making necessary modifications to the machines and equipment.

4.11 Elaborating the process, and introducing the appropriate protection of wooden accessories for the weaving industry against local prevailing weather conditions.

4.12 Elaborating the technical control procedures.

4.13 Introducing raw material, in-process and final quality control procedures.

V. General inputs

1. Government inputs

1.1 Construction of new buildings and/or modifications to existing buildings to suit the process and the equipment provided by the project.

1.2 Preparing the foundations, and connections for electric wiring, steam, water and dust exhaust systems, according to the instructions of the machine and equipment suppliers.

1.3 Providing workers, equipment and transport for the installation and start up of machines and the introduction of the technologies recommended by the experts.

1.4 Lodgings, interpreters, secretarial services and means of transport for UNIDO's expatriate staff and those of subcontractors appointed under the project.

1.5 Supply of basic and auxiliary raw materials necessary for the operation of the machines during the start-up and the introduction of the new technologies.

2. UNDP Inputs

B/L 42-00 Purchase and delivery of machines, equipment and tools, according to annex 10a — US$531.000

21-00 Supervision of the installation and start-up of the machines provided by the project by a subcontractor (consulting firm) - 3 assemblers for a duration of 18 man/months — US$ 90.000

31-00 Training of Vietnamese specialists in plants manufacturing compressed wood, shuttles, metal shuttle hardware and wood processing tools (total of 9 persons during one month each) (from Nam Dinh plant) — US$ 70.000

(a) One technician supervising the preparation and drying of wood

(b) One technician supervising the production of compressed wood

(c)&(d) one master workman and one foreman supervising the production of shuttles

(e) one tool room technician.

(from Viet Tang plant)

(f) One technician supervising the production of shuttles

(g) tool room technician

(h)&(i) two interpreters.

11-50	Four experts for total duration of 19 months	US$ 142.500
15-00	Local travel	US$ 5.550
16-00	UNIDO staff travel	US$ 5.000
21-02	Subcontract for the elaboration of a technology for protecting shuttles against prevailing weather conditions, using materials and equipment available in Viet Nam	US$ 50.000
51-00	Miscellaneous and reporting costs	US$ 10.000
	Grand total UNPD inputs	US$ 914.050

VI Detailed description of inputs for each activity

1. Government input related to activity 1

1.1 Preparing and despatching chosen species of wood to be tested by the subcontractor (ROMCONSULT/ICPID)

1.2 Manufacturing shuttles from compressed wood received from the subcontractor and carrying out performance tests.

1.3 Ensuring the supply of at least 300m^3 of the chosen species necessary for start-up of machines and introduction of the technology.

2. UNDP inputs related to activity 1

2.1 Choosing the species of wood appropriate for pressing (carried out under the preparatory assistance under the subcontract with ROMCONSULT/ICPIL).

2.2 Manufacturing timber samples from compressed wood and sending them to Viet Nam (ditto).

2.3 Adjust the test results

2.4 Technical assistance during starting and running the production according to the new technology, carried out by: one expert in storage and air and kiln drying of saw wood and timber and on wood quality control operations before, during and after drying.

Duration 4 months

Place: Nam Dinh and Viet Tang

One expert in the selection of wood for pressing, in sawing according to the appropriate sawing pattern, technology and equipment for compressed wood production, and quality control of inputs to the press and of the final product.

Duration 4 months

Place Nam Dinh.

3. Government inputs related to activity 2

3.1 Ensuring the supply of raw materials and auxiliary materials, and particularly min. 200 kgs of steel of the 50HS or 65G grade, in strips and approximately 500 l of hardening oil.

3.2 Manufacturing oil tank provided with coil water cooling.

3.3 Provision of a design office and a draughtsman for designing (according to the UNIDO expert's instructions) all equipment necessary for production and gauges for in-process and final quality control.

3.4 Ensuring quick manufacturing of the above mentioned metal equipment.

4 UNDP inputs related to activity 2

4.1 Technical assistance in the starting and running of the production according to new or improved technologies provided by:

One expert in hot and cold working, surfacing, heat treatment, raw material quality control, and in-process and final quality control, including introduction of metal shuttle hardware prodution, designing and manufacturing of missing tools, equipment and gauges, standardization of metal shuttle hardware and elaboration of technical specifications and quality control procedures.

Duration 3 months

Place: Nam Dinh.

5. Government inputs related to activity 3

5.1 Providing efficient machines and equipment and preparing the tool room in Thu Duc (Viet Tang) for manufacturing wood processing tools.

5.2 Providing the materials (tool steel) necessary for starting the production.

6. UNDP inputs related to activity 3

6.1 Technical assistance in starting the production and maintenance of tools, provided by:

one expert in design, production technology and maintenance of wood processing tools (including heat treatment), machines and equipment for treatment of tools, methods and organizing of quality control of tools, organizing of tool distribution in a factory (issuance, control of wear, sharpening and scrapping).

Duration 4 months

Place, Viet Thang and Nam Dinh

7. Government inputs related to Activity 4

7.1 Providing material for shuttle bodies and metal hardware for assembling for at least a three month period.

7.2 Carrying out a modification of the circular saw for shuttles into a dimension saw, and increasing its speed of rotation.

7.3 Increasing the speed of rotation of the driller for drilling the tip and tip fastening spring.

7.4 Increasing the speed of rotation of the milling machine for cutting out of shuttles.

7.5 Providing at least 30.000 rivets diameter 3.

7.6 Offering a design office and a draughtsman for designing(according to the expert's instructions) the necessary equipment and gauges.

8. UNDP inputs related to activity 4

8.1 Technical assistance on starting and running the shuttle production, provided by:

one expert in technology of shuttle production and machines and equipment for such production, wood processing tools, methods for initial quality control of materials used for shuttle manufacturing in process and final quality control: including developing of a shuttle manufacturing process, drawing up technical specifications and control procedures designing and manufacturing the missing tools, equipment and gauges and implementing of the new technology for shuttle manufacture.

Duration 4 months

Place: Nam Dinh and Viet Tang.