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19891

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DP/ID/SER.A/1602
14 October 1992
ORIGINAL: ENGLISH

ASSISTANCE IN THE ESTABLISHMENT OF A PILOT FURNITURE PLANT

DP/DRK/86/011

THE DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA

Technical report: Introduction of new machines and training for machine operators*

Prepared for the Government of the Democratic People's Republic of Korea
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of Radmilo Malis,
Expert in furniture production

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* This document has not been edited.

V.92-57604

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INTRODUCTION

The Furniture Production Expert and Chief Technical Advisor (CTA), Radmilo Malis, assigned to the project, carried out this mission from 18 May to 27 August 1992. This mission was aimed at accomplishing the work plan given in the project revision agreed upon by the Government of the People's Republic of Korea (DPR Korea), the United Nations Development Programme (UNDP) and the United Nations Industrial Development Organization (UNIDO) as the executing agency, and signed on 11 October 1991.

According to the original project document, the project was aimed at improving the country's furniture industry in order to gainfully utilize available wood resources, increase efficiency in production, and to produce furniture of a satisfactory quality for local consumption and, eventually for export.

Since the original project budget was sufficient only for the completion of the production line for panel-made furniture, the project was revised to improve also the production of solid wood furniture. The Pyongyang Solid Wood Branch Factory was selected and proposed to be developed into a Pilot Furniture Plant. To achieve this, UNDP's inputs were increased by US$ 391,800, and the Government's inputs (in kind) were increased by Wons 412,900.

At the end of the project the following outputs are expected:

- The Pilot Furniture Plant will be in a position to produce double the quantity of medium quality furniture that was produced at the beginning of the project;

- A system of internal standards for products, based on interchangeable parts and components with new designs would have been introduced;

- Staff would have been trained in the efficient use of available manufacturing equipment and tool maintenance;

- A system of safety and work protection measures would have been introduced; and

- Design of the overall factory organization, with established work preparation, cost accounting and management procedures, with managerial staff trained in (a) factory management based on modern industrial production methods and (b) the basic elements of marketing.

This mission is the second of three missions foreseen to be carried out by the Furniture Production Expert (CTA) during the project's one year extension. His duties are given in Annex I.

First, the expert accompanied three Korean participants on a study tour in Slovenia, and then he proceeded to the project site in Pyongyang.

Great attention was paid to the installation of the new machines provided by the project and their introduction into the production processes. The machine operators have been trained on the main machining and surface finishing operations. Additional training in the construction of jigs and standardization of products/parts/materials has also been given. The expert also assisted the counterpart in the implementation of the new factory layout, including the installations for compressed air and dust extraction systems.

During this mission, the expert also prepared the Project Progress Evaluation Report (PPER).

This report covers the following topics:

- Conducting the study tour,
- Preparation of the PPER,
- Inspection and installation of the new machines,
- Training of machine operators,
- The expert's other activities and observations.

Five training manuals were prepared during this mission. These cover the following topics:

1. Cross-cutting and ripping sawn timber.
2. Surface planing and thicknessing.
3. Moulding and routing.
4. Tenoning, mortising and drilling.
5. Sanding and surface finishing.

They will be issued as separate technical reports. The list of persons he collaborated with is given in Annex II.

1. The project's background

The initial UNDP/UNIDO assistance to the DPR of Korea's woodworking sector was an SIS project in 1986 (SI/DRK/86/880). It consisted in the recruitment of a consultant by UNIDO to make a survey of the status of the furniture manufacturing industry in the country and to prepare the draft of a project for the Establishment of a Small-scale Pilot Furniture Plant, financed from UNDP/IPF funds.

The existing furniture factory of the Pyongyang Wood Complex was selected for transformation into a Pilot Furniture Plant for the production of solid wood and casegoods furniture products. At the beginning of the project's execution the counterpart decided to use another factory building for the Pilot Furniture Plant, and to equip it completely with the new equipment. Due to the limited budget (US$ 300,000) the project's objectives were reduced to only cover the production of panel (casegoods) furniture.

The projet lasted from March 1988 to November 1989.

Realizing the success of the panel furniture production line, the Government requested a revision of the project to reinstate the original objectives of a Pilot Furniture Plant capable of producing both solid wood and panel furniture.

A thorough assessment of the needs and requirements was done by a UNIDO consultant in May 1991, who advised that the Pyongyang Solid Wood Branch Factory should be transformed into the Pilot Furniture Plant for the production of solid wood furniture.

The parties involved in the project accepted the consultant's views and agreed to make a major revision of the project by providing additional funds for equipment, consultancies and training, and to extend the project's duration by one year, i.e. until the end of 1992.

2. Findings

The findings that will be considered in this report are related to the following questions:

1. General production situation in the Pilot Furniture Plant.
2. Reconstruction of the factory building.
3. Construction of the new dry kilns.
4. Reconditioning of the existing equipment.
5. Delivery and inspection of the new machines.
6. Installation and testing the performances of the new machines.
7. Implementation of the new factory layout.
8. Installation of lines for the distribution of compressed air.
9. Installation of the dust extraction system.

2.1 General production situation in the Pilot Furniture Plant

Production activities in the factory were rather slow during this mission. This was caused mainly by the construction of the dry kilns, the replacement of the log bandsaw and relocation of the woodworking machines in accordance with the new factory layout. However, the factory was maintaining some production work all the time producing several small items in limited quantities.

The quantity of logs stacked at the factory was sufficient, but their quality was rather poor and the sawnwood produced from them was hardly fit for manufacturing medium quality furniture.

The new bandsaw and three sawdoctoring machines (saw sharpener, bandsaw stretcher and saw-teeth setting machine) have been installed immediately after their inspection and since then used regularly in everyday production.

The other new machines have been installed and tested, but not yet regularly used because of the inadequate supply of compressed air and the delay in the commissioning of the dust extraction installations.

2.2 Reconstruction of the factory building

According to the new factory layout the factory building needed some alternation. As per the project work plan, this task was the responsibility of the counterpart.

The reconstruction work on the building was done in due time. The counterpart made some deviations with regard to the layout, but without significantly interfering with the technology proposed.

2.3 Construction of new dry kilns

The counterpart constructed the new dry kilns completely ignoring the expert's proposal. Four new chambers have been built in the place of the old dry kilns. They will be heated directly by flue gases, and without any possibility to regulate and control the circulation and humidity of the air. The drying capacity was increased by building higher chambers so that the stacks will be 2m high in the new kilns instead of 1 m in the old ones.

Needless to say that the production of medium quality furniture (the project's objective) requires a precisely controlled and regulated wood drying process.

2.4 Reconditioning of the existing equipment

The spare parts needed for reconditioning the existing machines have been ordered and purchased, but had not yet been received at the project site. In the meantime, the machines have been moved and positioned according to the new factory layout, and after their installation they were used regularly.

Since most of the existing machines were purchased in 1990, only minor reconditioning is needed and it will be done later without delaying the completion of the project.

2.5 Delivery and inspection of the new machines

The new machines provided by the project and received at the project site are listed hereunder, with their major technical characteristics.

High speed router (UNIDO purchase order No. 15-2-0207N; price US$ 8,445)

Model R9
Manufacturer: SCM, Italy
N AB 64197, Ref. 030810
Year 1992

Work table size:	905 x 770 mm
Throat clearance:	915 mm
Vertical table movement:	200 mm
Vertical spindle movement:	100 mm
Minimum distance between work table and spindles:	20 mm
Maximum distance between work table and spindles:	300 mm
Tool setting:	Morse tapered shank MK²
Spindle rotation speed:	10,000 and 20,000 rpm
Electric connection:	200 V, 3-phase, 60 Hz.
Electric motor power:	4 kW
Working pressure of compressed air:	6 bar
Consumption of compressed air:	25 l/min.
Dust extraction duct:	Ø 120 mm
Dust extraction air:	V_{min} = 25 m/sec. Q = 1,000 m³/h
Noise level:	80 - 83.5 dB (A)
Overall dimensions (L x W x H):	1,650 x 1,630 x 1,905 mm
Weight:	721 kgs.

Four-side planer/moulder (Purchase order No. 15-2-0201N; price US$ 19,806)

Model: KP5-180
Serial No. 920310
Year 1992
Manufacturer: Shun Kuang, Chinese Province of Taiwan.

5 spindles Ø 40 mm	Diameter of tool	Motor power	Rotation speed
First bottom horizontal	125 mm	3.75 kW	6,000 rpm
Right vertical	100-160 mm	3.75 kW	6,000 rpm
Left vertical	100-160 mm	3.75 kW	6,000 rpm
Top horizontal	100-160 mm	5.50 kW	6,000 rpm
Last bottom horizontal	200 mm	5.50 kW	6,000 rpm

Feeding motor power: 1.5 kW
Elevation motor power: 0.4 kW
Electric connection: 220 V, 3-phase, 60 Hz
Feed speed: 7-30 m/min
Side of feed rollers: Ø 140 x 40 mm
Workpiece dimensions:
- maximum width x thickness: 180 x 125 mm
- minimum width x thickness: 18 x 8 mm
- minimum length: 550 mm

Working pressure of compressed air: 6 bar
Consumption of compressed air: 200 l/min.
Dust extraction: 5 ducts, Ø120 mm each
Dust extraction air: v_{min} = 25 m/sec, Q = 5,000 m³/h
Overall dimensions (L x W x H): 3,600 x 1,600 x 1,700 mm
Weight: 2,000 kgs

Wood turning lathe with copying template and tools (purchase order No. 15-2-0202N; price: US$ 5,400)

Model: TC 1200
Manufacturer: Centauro, Italy
Serial No. 308, Year 1992
Maximum length of workpiece: 1,200 mm
Maximum workpiece cross section: 65 x 65 mm
Rotation speeds: 900, 1,500, 2,220, and 3,000 rpm
Electric connection: 220 V, 3-phase, 60 Hz
Spindle motor power: 1.0 kW
Tool moving motor power: 0.5 kW
Dust extraction ducts: 2 x Ø 100 mm
Dust extraction air: v_{min} = 25 m/sec., Q = 1,400 m³/h
Overall dimensions (L x W x H): 3,000 x 500 x 1,300 mm
Weight: 400 kgs

Single-side tenoner for rounded-end tenons (purchase order No. 15-2-0203N; price: US$ 11,000)

Model: TSU
Manufacturer: Pade, Italy
Matric NO. 8607
Year 1992
Adjustable sizes of tenons:
- Length: 5 - 50 mm
- Width: 0 - 100 mm
- Thickness: 4 - 30 mm

With selectors for: horizontal, vertical and cylindrical tenons
With anti-splittering selector
Two tiltable work tables:

- on the front side	0° - 20 °
- on both lateral sides	0° - 15°
Work table adjustments:	
- vertical	100 mm
- horizontal	20 mm
Moving speeds of the work tables and the cutterhead:	adjustable
Dimensions of the tool:	
- cutterhead:	D = 80 mm
	L = 90 mm
	d = 40 mm
- hogging unit:	D = 130 mm
	B = 30 mm
	d = 80 mm
Tool rotation speed:	8,000 rpm
Electric connection	220 V, 3-phase, 60 Hz
Motor power:	3.5 kW
Capacity:	700 - 800 tenons/hour
Working pressure of the compressed air:	7 bar
Consumption of compressed air:	210 l/min
Dust extraction:	2 ducts, Ø 100 mm each
Dust extraction air:	V_{min} = 25 m/sec, Q = 1,400 m^3/h
Overall dimensions (L x W x H):	1370 x 1110 x 1210 mm
Weight:	900 kgs

Single-side, single spindle slot mortiser (purchase order No. 15-2-0203N; price: US$ 4,440)

Model: MSO
Manufacturer: PADE, ITaly
Matric No.: 8606
Year: 1992

Dimensions of mortises:	
- Maximum length:	120 mm
- Maximum depth:	55 mm
Worktable: tiltable on both lateral sides	0° - 25°
Feeding speed of the worktable:	adjustable
Electric connection:	220 V, 3-phase, 60 Hz
Electric motors:	
- For spindle rotation:	2800 rpm, 2.2 kW
- For spindle oscillation:	950 rpm, 1.1 kW
Rotation speed of the spindle:	8,130 rpm
Chuck for drill shanks:	Ø 13 x (50-60) mm
Orientation of drilling:	Left, counterclockwise
Working pressure of the cojmpressed air:	6 bar
Consumption of compressed air:	25 l/min.
Capacity:	5-12 mortises/min.
Overall dimensions (LxWxH):	910 x 910 x 1000 mm
Weight:	420 kgs

Single spindle dovetailing machine (purchase order No. 15-1-1669N; price: US$ 5,500)

Model: OMEC 750
Manufacturer: OMEC, Italy

Maximum workpiece width:	480 mm
Maximum workpiece thickness:	60 mm

Fixed pitch:	25 mm
Length of pins:	adjustable from 6 to 18 mm
Tool shaft rotation speed:	18,500 rpm
Number of joints machined per minute:	25 - 35
Electric connection:	220 V, 3-phase, 60 Hz
Electric power:	
- Spindle motor:	1.1 kW
- Cutter translation motor:	1.1 kW
Dovetail milling cutter:	
Shank	Ø 12 x 30 mm
	NL = 23 mm
	GL = 60 mm
Working pressure of the compressed air:	7 bar
Consumption of compressed air:	50 l/min.
Overall dimensions (L x W x H):	900 x 1,300 x 1,450 mm
Weight:	350 kgs

Horizontal log bandsaw (purchase order No. 15-2-0204N; price: US$ 64,970)

Model: "Tom Sawyer" Bandmill
Electric, static type
Manufacturer: Forestor, England
Serial No. 164 TSSE, Year 1992

Diameter of band wheels:	900 mm
Width of band wheels:	90 mm
Width of saw blade:	100 mm
Thickness of saw blade:	1 mm
Length of saw blade:	6 m
Band wheel speed:	640 rpm
Saw blade speed:	30 m/sec
Maximum log diameter:	810 mm
Maximum log length:	5 m
Maximum depth of cut:	600 mm
Maximum depth of cut with flitch remover:	450 mm
Maximum elevation of blade:	635 mm
Maximum feed speed (forward and reverse):	45 m/min.
Electric connection:	220 V, 3-phase, 60 Hz
Electric power:	
- Main motor:	22 kW
- Hydraulic pump motor:	3 kW
Work space required:	8,400 x 3,200 x 2,900 mm

Universal saw grinding machine (purchase order No. 15-2-0207N; price: US$ 19,670)

Model: Cana/E
Manufacture: Vollmer, Germany
Fabr. No. 9415
Year: 1992

Diameter of circular saws:	
- saw blade D	Ø 120 - 1250 mm
- central hole d	Ø 10 - 160 mm
Bandsaw blade width:	60 to 260 mm
Saw blade thiCkNess:	up to 4 mm
Grinding wheel diameter:	Ø 250 mm
Grinding wheel central hole:	Ø 20 mm

Tooth pitch:	from 10 to 90 mm
Tooth depth:	up to 40 mm
Hook angle:	from 10° negative to 30° positive
Bevel grinding:	5°, 10°, 15°, 20°, 25°, and 30°
Feeding speed:	30, 50 and 75 teeth/min.
Four basic tooth shapes:	NV, NU, KV, and PV
Electric connection:	220 V, 3-phase, 60 Hz
Motor power:	2 motors, 0.75 kW each
Required space for grinding bandsaw blades:	3,500 x 1,500 x 1,800 mm

Bandsaw blade roll stretcher (purchase order No. 15-2-0205N; price: US$ 12,375)

Model: VWM
Fabr. No. 2970
Year 1992
and **Tensioning bench**
Model: VRB
Fabr. NO. 1435,
Year 1992
Manufacturer: Vollmer, Germany

Blade thickness:	unlimited
Blade width:	up to 200 mm
Bench length:	2,180 mm
Bench width:	502 mm
Number of stands:	3
Electric connection:	220 V, 3-phase, 60 Hz, 0.37 kW
Required space (L x W x H):	3,700 x 600 x 2,090 mm

Teeth setting machine for circular and bandsaws (purchase order No. 15-2-0205N; price: US$ 16,739)

Model: Adn/VII
Fabr. NO. 9550
Year 1992
Manufacturer: Vollmer, Germany

Diameter of circular saw blades	from 105 to 800 mm
Bandsaw blade width:	up to 220 mm
Tooth pitch:	5 to 65 mm
Blade thickness:	from 0.6 to 4.0 mm
Feeding speed:	45 and 90 teeth/min.
Electric connection:	220 V, 3-phase, 60 Hz, 0.5 kW
Required space for bandsaws (L x W x H):	3,500 x 1,100 x 1,450 mm
Weight:	122 kgs

Spindle brush and drum sanding machine (purchase order No. 15-2-0206N; price: US$ 540)

Model: CW-001
Serial No. 92002
Year 1992,
Manufacturer: Chun Weii Machinery Co., Taiwan Province of China

Brush diameter:	Ø 220 mm
Brush length:	155 mm
Drum diameter:	Ø 110 mm
Drum length:	230 mm

Electric connection: 220 V, 3-phase, 60 Hz, 1.5 kW
Dust extraction air: v_{min} = 20 m/sec, Q = 1,100 m³/h.

Airless spray gun (Purchase order No. 15-2-0207N; price US$ 3,200)

Model: FM 57 S **with a pump**
Model: FM 78-30
Manufacturer: Falcioni, Italy
Year: 1992
Maximum lacquer pressure:
- Pump: 200 bar
- Gun: 300 bar

Pressure ratio: 1:30
Maximum pumping capacity: 2.6 l/min
Compressed air connection: 6 bar
Maximum air consumption: 180 l/min
Gun weight: 0.6 kgs

Vertical multi-spindle drilling machine with six adjustable drilling heads (purchase order No. 15-2-0206N; price: US$ 2,240)

Model: CWB-52
Serial No. 92001
Year 1992
Manufacturer: Chun Weii Machinery Co., Taiwan Province of China
Electric connection: 220 V, 3-phase, 60 Hz, 1.5 kW
Motor rotation speed: 1,720 rpm
Rotation speed of spindles: 5,160 rpm

Universal vertical edge sanding machine (Purchase order No. 15-2-0208N; price: US$ 4,310)

Model: UNILEV 15 N
Manufacturer: Samco, Italy
Serial No.: N AN 003700
Ref.: 6392
Year: 1992
Sanding belt length: 2,170 mm
Sanding belt length: 150 mm
Work table length: 1,440 mm
Width of both work tables: 710 mm
Tilting work table: 0° to 45°
Sanding belt speed: 10 and 20 m/sec.
Vertical adjustment of oscillating sanding unit: 150 mm
Electric connection: 220 V, 3-phase, 60 Hz
Sanding motor power (two speeds): 2.2/3 kW
Suction hood diameter (two hoods): Ø 120 mm each
Suction capacity: 900 m³/h
Working pressure of compressed air: 6 bar
Consumption of compressed air: 25 l/min.
Overall dimensions (L x W x H): 1,440 x 710 x 1,500 mm
The machine is supplied with an additional work table and three drums for sanding curved parts on the pulley.

Set of pneumatically powered hand tools (Purchase order No. 15-2-0413N; price: US$ 615)

Manufacturer: De Poan Pneumatic Corp. Taiwan Province of China

- Speedy nailer with magnetic hammer No. DPN-643.6/R10.7-100	1 piece
- Medium duty nailer No. DPN-617.20/F32M0	1 piece
- Air stapler kit No. DPN-621.1 AK	1 piece
- Medium duty stapler No. DPN-6110T.2A/1025J	1 piece
- 3/8" heavy duty air drill, nonreversible No. DPD-816	2 pieces
- Air screw driver, reversible No. DPSD-140	2 pieces
- 4 boxes nails 5,000 each -	20,000 pieces
- 12 boxes staples 5,000 each - in sizes corresponding to the staplers	60,000 pieces

Automatic power feeder with four rollers (Purchase order No. 15-2-0206N; price: US$ 1,320)

Model: CWG-80
Serial numbers: 92003 and 92004
Year: 1992
Manufacturer: Chun Weii Machinery Co., Taiwan Province of China
Electric connection: 220 V, 3-phases, 60 Hz, 0.2 kW
Adjustable feeding speed
Feeder can rotate to press the workpieces against the work table or against the fence.

All the machines have been unpacked and inspected in the presence of the expert. Although the majority of the machines were well protected and received in good condition, the following should be noted:

- Some shipments did not contain a packing list and it was impossible to check the contents of spare parts and tools. The declaration "two year spare parts" is not enough to check whether anything is missing. Both machines from Chun Weii have been delivered without any spare parts.

- Two machines (the multi-spindle drill and drum/brush sander) have been received without any documentation, poorly protected and with rusted parts.

- There are significant differences in the construction of some machines when compared to that shown in the technical documentation received with the machine.

- Only one machine was received with some small parts damaged and they were replaced within a short time and free of charge.

The counterpart and the Government authorities expressed satisfaction with both the selection of equipment and its delivery in a short time.

2.6 Installing and testing the performance of the new machines

The new machines have been bolted down and connected to the electric wiring according to the technical requirements prescribed by their producers. The work was done correctly by the counterpart's maintenance staff, under the expert's guidance.

The training of machine operators was synchronized with the installation of the machines. The operators were instructed on how to set and use correctly each single machine.

Provisional connections to the compressed air (one machine at a time) was done only in order to start the machine and for a short trial run to check its performance. The machines were operated without dust extraction, but they cannot be included into the regular production as long as the dust extraction system is not installed and the machines fully connected to it.

All the new machines are highly precise and yield good quality machining.

The only tools available for the new machines were those sets or single tools supplied with the machines. Some machines were received without any tools and even the demonstration of the work on these machines was of a rather provisional nature.

2.7 Implementation of the new factory layout

Prerequisites for the implementation of the new factory layout are: construction/alternations of the factory building, positioning of all the existing and new machines in accordance with the new layout, electrical wiring and compressed air and dust extraction systems installed in compliance with the requirements of each machine. This also includes an efficient internal transport system.

Under the supposition that the necessary woodworking tools and jigs will be provided by the time all the installations will be completed, it would mean that the factory will then have the complete production "hardware".

In order to function efficiently, the factory must also be provided with "software". In other words, planning of products, materials, processing operations, production documentation, tools, jigs etc. should be done in a way which ensures maximum utilization of the installed capacities, i.e. maximum factory output with minimal costs of production. This optimalization of the production process requires more knowledge, systematic work and discipline than introduction of any new equipment. Unfortunately this is often overlooked and neglected leading to low utilization of capacities and to a poor overall performance of the factory.

This warning has been written because of the expert's feeling that the counterpart's full attention is focused on the new equipment and very little care is devoted to the production planning and optimalization of the process from an economic point of view.

The new factory layout is designed for a production system different from the one used by the factory so far. All the people in the factory must be informed about the main elements of this system and its advantages. Otherwise, they will tend to follow the old system, and that would be a big obstacle for a successful production.

The new production system is explained in detail in the manual entitled "Organization and Planning of Production in Furniture Factories" and should be applied.

2.8 Installation for distribution of compressed air

The two existing compressors in the factory have a sufficient capacity and working pressure for all the factory's current needs. However lines and accessories for the distribution of compressed air have not yet been installed and most of the new machines cannot be used until this has been completed.

The counterpart intends to install an additional tank and the necessary lines for the compressed air circuit.

The expert advised the counterpart to design a "ring system" for the distribution of air and to cover all the factory's sections: machining, assembling and surface finishing. This was accepted and, according to the expert's assessment, it could be completed within the next three months.

The completion of the pipeline with the necessary water separators, oiling and regulation units and adequate pneumatic couplings for easy connections and disconnections of machines and tools to the compressed air installations is of utmost importance.

2.9 Installation of the dust extraction system

The existing dust extraction system in the factory is insufficient to satisfy even the earlier existing machines. The pipes are installed under the concrete floor and all the system is rigid and inaccessible. The expert's recommendation that a new dust extraction system should be designed with pipes hung from the ceiling was not taken seriously until the new machines were received. Then, the counterpart realized the necessity of making new dust extraction installations dimensioned in accordance with the technical requirements of the machines.

The expert also recommended a separate dust extraction system with a filter for a group of sanding machines installed in the factory.

The expert offered his own assistance in designing the dust extraction system, but the counterpart wants this to be done by Korean engineers.

This job should be considered as the most critical for the protection and full utilization of the woodworking machines installed and used in the factory.

3. Activities

During his mission, the expert carried out the following activities:

1. Accompanying the counterpart's participants on the study tour to Slovenia.

2. Inspecting the machines purchased for the project and received at the project site.

3. Assisting in the installation and testing of the new equipment in processing operations.

4. Selecting the woodworking tools and spare parts.

5. Preparing training manuals for machining operations in the production of solid wood furniture.

6. Training the wood machining operators.

7. Training the counterpart's technicians in the design and construction of jigs.

8. Instructing on a basic system for standardization of products, parts and materials in the Pilot Furniture Plant.

9. Preparing the Project Progress Evaluation Report.

10. Performing other activities related to the CTA's duties in the project.

3.1 Accompanying the counterpart's participants on a study tour to Slovenia.

The expert accompanied the Koreans on the study tour in Slovenia from 28 May to 11 June 1992. From 19 to 27 May, the expert waited for them in Milan, Italy as planned. During that time, the expert visited the INTERBIMALL Woodworking Machinery and Tools Fair and the SASMIL Fair for Auxiliary Products which tool place in Milan from 21 to 26 May 1992. The fellows did not arrive in Milan because of difficulties one of them had in obtaining an Italian visa.

A detailed study tour report, prepared by the expert is given in Annex III.

3.2 Inspecting the machines purchased for the project and received at the project site.

The 16 items of equipment purchased for the project were received and inspected. The equipment has been received in a fairly good condition. The technical characteristics of the equipment are given in chapter 2.5 above. After a detailed inspection of the machines received, an appropriate confirmation that the goods were received in good condition was signed and sent to UNIDO Headquarters.

3.3 Assisting in the installation and testing of the new equipment in processing operations.

All the new machines received were placed and bolted down according to the new factory layout and the technical requirements. The electric connections have also been completed.

The machines were tested with provisional connections to the compressed air line but without dust extraction. The machines have a high accuracy and satisfactory performances.

In order to regularly use and to fully utilize both the already existing and the newly received machines, the counterpart must complete the installations for the distribution of compressed air and for dust extraction.

Data for designing both the compressed air and dust extraction installations are given hereunder, including all the machines installed in the factory.

(a) **Data for the design of compressed air installations.**

Layout Position	Machine to be connected	Working Pressure (Bar)	Total consumption (l/min.)	Built in trio control unit
[illegible]	Four-side planer	6	200	Yes
16	Tenoner for rounded tenons	7	210	Yes
19	Slot mortiser	6	25	Yes
21	Dovetailing machine	7	50	Yes
22	High speed router	6	25	Yes
27	Wide belt sander	6	80	Yes
28	Universal edge sander	6	30	Yes
39-42	Pneumatic hand tools (5 pieces)	6	150	No
44	Air spray gun	4	360	No
45	Airless spray gun	4	180	No
51	Upholstery staplers (2 pieces)	4	50	No
	Total		1,260 l/min.	

The installations should be designed and made for a 50 percent increase in consumption to permit the future connection of assembling benches and presses and for a further mechanization of the production process.

(b) **Data for the design of the dust extraction system**

Layout Position	Machine to be connected	Number of ducts	Ø of duct (mm)	Min. speed of air (m/sec)	Total quantity
2	Cross-cut saw	1	100	20	560
3	Multi-blade circular saw	1	200	25	2830
4	Four-side planer	5	120 each	25	5080
5	Circular saw	1	120	20	815
6	Surface planer	1	120	20	815
7	Surface planer	1	120	20	815
8	Thicknesser	1	140	25	1385
9	Thicknesser	1	140	25	1385
10	Circular saw	1	120	20	815
11	Circular saw	1	120	20	815
12	Turning lathe	2	100 each	25	700
13	Tenoner for rectangular tenons	3	120 each	25	3050
14	Narrow bandsaw	1	100	20	560
15	Single-spindle moulder	1	120	25	1020
16	Tenoner for round ended tenons	2	100 each	25	700
20	Chain mortiser	1	100	25	700
21	Single spindle moulder	1	120	25	1020
22	High speed router	1	100	25	700
	Subtotal				23775
27	Wide-belt sander	1	250	20	3530
28	Universal edge sander	2	120 each	20	815
29	Disc sanding machine	1	100	20	560
30	Drum/brush sander	2	100	20	1120
	Subtotal				6025
	Total				29800

It would be advisable to design a separate dust extraction system with a filter for the group of sanding machines, positions 27 to 30.

The only problem faced during installation and testing of equipment appeared when the counterpart's mechanics tried to set and start a machine without the expert and without reading the instructions. Such rushing could be dangerous not only to the machine, but to the operator as well. Fortunately, there was no harmful consequence to their trial.

3.4 Selecting woodworking tools and spare parts

The technical data of the new machines and the designs of the products were used to determine the woodworking tools needed for the Pilot Furniture Plant. Also, the most critical spare parts which have not been supplied with the machines have been selected and specified for purchase by the project.

Specifications of woodworking tools for machining furniture parts in the factory and spare parts necessary for safe permanent operation of the machines are given in Annex IV.

Though some machines have been delivered with some spare parts, these are far from enough for a two year operation as declared by the manufacturers. Bearing in mind the very long time necessary to obtain a spare part from Europe (usually 4 to 6 months), the counterpart wants to ensure a higher reliability of the production process.

Also, some materials such as flexible pipes for dust extraction, hydraulic and lubrication oils etc are not obtainable on the domestic market.

3.5 Preparing training manuals for machining operations in the production of solid wood furniture

The expert prepared the following five training manuals for training machine operators on the proper machining of furniture parts:

1. Cross-cutting and ripping sawn timber.
2. Surface planing and thicknessing,
3. Moulding and routing,
4. Tenoning, mortising and drilling,
5. Sanding and surface finishing in manufacture of furniture.

These training manuals were translated into Korean, copied and distributed to the trainees at the beginning of each training course. These manuals will be issued later as separate technical reports.

3.6 Training the wood machining operators

Short training courses, lasting two to three days, for both the theoretical and practical part on the machines have been conducted. Though the number of trainees was not limited, the counterpart wanted only the operators to be trained, so the total number of machinists trained during this mission was only 14.

The list of trainees is enclosed to this report as Annex V.

Because of the very slow production during the training period, it was not always possible to assess the results of this training with respect to quality and productivity.

On the new machines, the trainees follow the instructions learned during training, while on the old ones they tend to continue work in the old ways, not following the advice for improvements suggested by the expert.

The main problem is that the team leaders (foremen) and production managers do not attend training courses and sometimes do not understand the proposed improvements.

3.7 Training the counterpart's technicians on the design and construction of jigs.

A training manual on tools and jigs was prepared, and a training course on this topic conducted during the expert's preceding mission in February 1992. This time, the expert instructed the counterpart's technicians in greater detail on how to design and construct various machining and assembling jigs for the manufacture of solid wood furniture.

Following this instruction, the technicians should design and construct three machining and two assembling jigs until the expert's next mission.

3.8 Instruction on a basic system for standardization of products, parts and materials in the Pilot Furniture Plant.

The Pilot Furniture Plant has not yet reached the level at which a complete standardization system could be introduced. The work on detailed drawings of parts and making part lists has not yet been completed. So far some principles of standardization have been followed, but only in the work of the consultant in furniture design. The introduction of standards must be gradual and follow a certain system.

During this assignment, the expert explained to the counterpart's production planning staff the basic principles of a simple standardization system that could be suitable for their factory, and they were advised on how to prepare information bases for that system. Also, a code system for standardized elements has been proposed.

Standards should be defined by using descriptions, drawings, numbers, code classification, formats, specifications, graphs etc. Only well studied and optimalized elements should be standardized.

The purpose of standardization is to keep a number of variations in the production at a reasonable level and to simplify the planning and management production processes.

Only products repeatedly produced in series should be standardized. The standard for products should contain:

- Type of product and its function,
- Code,
- Overall dimensions,
- Raw material,
- Finish, or type and colour of fabrics for upholstery,
- Quality level,
- Part list with codes for each part,
- Orthogonal and axonometric drawings (eventually pictures).

All interchangeable parts and other parts used in standardized products should be standardized. The standards of parts should contain:

- Description and function of the part,
- Code,
- Detailed drawing with all dimensions and tolerances,
- Type of raw material and standardized waste factor,
- Quality of material,
- List of products in which the part is used with code number of that part in each product,
- Sequences of processing operations.

Materials for standardized parts should be standardized, containing the following information:

- Type of material,
- Code,
- Species of the wood,
- Dimensions with standard tolerances,
- Required moisture content,
- Quality level,
- Standard utilization and percentage of waste.

Tools should be standardized and the standards should contain:

- Type of the tool,
- Code,
- Dimensions,
- Material,
- Number of cutting edges,
- Shape and angles of cutting edges,
- Orientation or direction of rotation,
- Maximum rotation speed,
- Name and code numbers of the machines on which the tool can be used,
- Name and code numbers of the operations for which the tool can be used,
- Detailed drawing of the profile (for profiled tools),
- Other relevant information.

Processing operations for making standardized parts and products should be standardized with the following standard elements:

- Type of operation,
- Code,
- Code of the machine or work place,
- Code of the tool(s) used,
- Code of the jig(s) used (if necessary),
- Quality requirements,
- Feeding speed,
- Cutting speed,
- Short description of the processing method,
- processing time (min/piece),
- Time allowances (min/piece),
- Total production time (min/piece).

Jigs for standardized operations should be standardized as well, with the following information:

- Type of jig.
- Code.
- Code of the operation.
- Code of the machine.
- Detailed drawing with specifications of the materials and components used for its construction.
- Codes of parts and profiles (or assembly operations) that should be machined (or assembled) using the jig.

Production documentation should be standardized with:

- Name of the document.
- Code.
- Size of paper.
- Content and format.
- Circulation (distribution scheme).

The code system proposed for the Pilot Furniture Plant is extremely simple. It contains only a one digit classification number with identification numbers of three digits.

All standardized elements are classified in 10 major groups marked from 0 (zero) to 9.

All the elements within a major group (class) are marked simply by identification numbers ranging from 001 to 999 for each single class and are chosen as the ordinal numbers.

The expert has proposed the following classification groups:

Elements to be coded:	Classification code number:
- Documentation	0
- Products	1
- Parts	2
- Materials	3
- Components (hardware etc.)	4
- Tools	5
- Jigs	6
- Machines and working places	7
- Operations	8
- All other elements	9

A complete code will contain four digits as follows:

X-XXX

Classification number | Identification number

For example, if a chair has as identification number: 018, then the full code number for that chair is: 1-018, or if a tool has as identification number: 172, then the full code number for that tool is: 5-172.

This system was proposed mainly because of its simplicity so that it could be easily understood, accepted and used. However, if it would be necessary in future to make a more detailed classification it would be easy to replace the one digit classification number with two digit numbers or letters.

This system is proposed for internal use only and it is without any linkage to the national standards or code system, which, as far as the expert knows, are not yet established in a complete form for the wood processing industry of the country.

3.9 Preparing the Project Progress Evaluation Report.

During this mission, the expert prepared the Project Progress Evaluation Report for the period ending 30 June 1992. The report was submitted to UNIDO Headquarters and UNDP, Pyongyang.

3.10 Other activities related to the CTA's duties

Acting as the project's CTA, the expert liaised and collaborated with the national project staff and with the UNDP Office in Pyongyang, taking part in some meetings and assisting the counterpart in solving some of the problems that arose.

CONCLUSIONS

Based on the work so far completed in the execution of the project, the following conclusions can be drawn:

1. The execution of the project is proceeding fully as foreseen in the project work plan and in line with the project's objectives. Its completion time will depend mainly on the counterpart's ability to finish his tasks in time.

2. The counterpart did not accept the expert's proposal regarding the design of the dry kilns, and the new dry kilns were construction using the old technology, i.e. with no possibility to control and regulate the drying process. This cannot ensure a satisfactory quality of dried sawnwood.

3. The poor supply of raw materials, tools and hardware components will be the major obstacle for achieving the project's objectives.

4. The Pilot Furniture Plant does not have an adequate machine for grinding tungsten carbide tipped tools and cannot benefit from the advantages of using such tools.

5. In the surface finishing section, coating is done by using spray guns without spray booths. This is inadmissible from an ecological and industrial hygiene point of view and is a big fire risk.

6. The existing installed capacity for the production of thermal energy can hardly satisfy one third of the factory's needs, especially during the winter time.

7. The counterpart's attention is mainly focused on the new equipment, while less attention is devoted to training and production planning activities.

8. The old machines have not yet been reconditioned and this must be done before the end of the project's execution.

9. The factory does not devote enough consideration to the economic factors of production such as fixed costs, utilization of installed capacities, productivity, cooperation with other furniture producers etc.

10. The factory does not have clear goals nor a strategy with regard to its future development.

RECOMMENDATIONS

The recommendations given in the expert's preceding report No. DP/ID/SER.A/1598, are still current and are reiterated herewith. The following are additional recommendations:

1. The counterpart should equip the factory with installations for the distribution of compressed air and dust extraction in the shortest possible time.

2. The counterpart should provide two spray booths for surface finishing in order to be able to maintain the minimum internationally permissible working conditions and safety in the finishing rooms.

3. The counterpart should endeavour to provide a good universal tool grinding machine for tungsten carbide tipped woodworking tools, because accuracy of machining depends to a very large extent on the quality of sharpening of the tools.

4. In order to better utilize the installed capacities of the Pilot Furniture Plant, the counterpart must ensure regular supply of materials and thermal energy.

5. The factory must introduce screws instead of nails in assembling furniture.

6. The counterpart's production planning staff should prepare all the production documentation for products to be produced in series, at the latest by the time the expert arrives on his next mission, so that the production can be organized based on a new and improved production system.

7. The factory should produce the appropriate jigs for machining the furniture parts with irregular shapes as well as other jigs and fixtures necessary for the production of interchangeable parts which can be assembled with no further adjustment.

8. The group training abroad foreseen in the project's work plan is of utmost importance because the key production personnel (team leaders) will get a chance to see and to learn more efficient production methods and accept the expert's recommendations with more

confidence. UNIDO should try to organize this training as soon as possible.

9. The counterpart should prepare enough copies of all the training manuals prepared by the experts and translate them into Korean, for use at the workshop that will be organized for the participants from other Korean furniture factories.

10. UNIDO should give the highest priority to the purchase of tools and spare parts with the remaining funds.

11. The factory should make some initial steps towards entering foreign markets in order to learn about international marketing procedures, to sharpen quality criteria and to earn the hard currency necessary for its further development. With a better selection of raw materials and using the newly installed equipment, some products could meet the international criteria for medium quality furniture.

ANNEX I

Date: 22 October 1991

PROJECT OF THE GOVERNMENT OF PEOPLE'S DEMOCRATIC REPUBLIC OF KOREA

ASSISTANCE IN THE ESTABLISHMENT OF A PILOT FURNITURE PLANT

JOB DESCRIPTION

DP/DRK/86/011/11-01 Rev.1 (J-13101)

Post title: Expert in furniture production (Chief Technical Adviser)

Duration: Eight months (3 split missions of 2 months each and two one month study tours)

Date required: As soon as possible in 1992

Duty station: Pyongyang (6 months total)
Europe (2 months, accompanying two study tours)

Purpose of project: The project aims at facilitating the creation of a model furniture production unit for the manufacture of items of satisfactory quality. To do so it will:

(a) establish a modern pilot furniture plant for industrial production within the existing furniture factory of the Pyongyang Wood Complex;
(b) train wood technicians and machine operators in the efficient operation and maintenance of the machinery and tools;
(c) design and produce a product line based on standardized interchangeable furniture parts;
(d) train managerial staff in overall management techniques.

Duties: The expert will be attached to the Pyongyang Furniture Complex. He will lead a team of three short-term consultants comprising also a furniture designer and a tool maintenance expert (the former for six months and the latter for three months). In order to achieve this, he will be specifically responsible to:

- Assist in designing a new technology for the pilot furniture plant;
- Assist in the selection, installation and commissioning of the equipment purchased by the project;
- Train team leaders, wood technicians and machinists in the full and efficient use of production equipment available under actual production conditions, and training assemblers and finishing operators;
- Develop and introduce standards for the products of the Pilot Furniture Plant;
- Develop the required production fixtures;
- Conduct a study tour and group training abroad;

- Introduce machining methods suitable for serial production with interchangeable parts;
- Introduce basic quality control procedures for work in process and control of finished products;
- Design and introduce improved production organization, production planning and cost accounting methods;
- Train the management in improved organization methods and basic export marketing techniques;
- Prepare technical reports, project performance evaluation reports and the project's terminal report;
- Cooperate with the National Project Director in carrying out the above duties.

Qualifications: Wood technologist or engineer with considerable experience in the operation, at the floor level, and in management of a modern medium-sized furniture plant producing average quality products in series. Experience at policy making level necessary. Experience in developing countries highly desirable.

Language requirements: English preferred, Russian acceptable.

Background information: The Democratic People's Republic of Korea is a predominantly mountainous country with some 9 million hectares (or 74 percent) of its land, designated as forest areas. The total growing stock of wood is estimated to be about 620 million cubic meters, allowing an average annual cut of approximately 6.5 million cubic meters. The primary wood processing industry is supplied with some 1.8 million cubic meters of sawlogs domestically produced and with a limited quantity of logs imported from the Soviet Union. The furniture production in the country has been developed mainly within the wood processing complexes which produce also sawnwood, joinery, and various wood based panels.

The level of development of the wood processing industry, and of the furniture manufacturing in particular, is lagging behind the general level of development of the country. Productivity and product quality are at a very low level in the factories where machines are old. Furthermore, although a large number of professionals are educated at the University level and at various other specialized schools, they could benefit further by being exposed to new technologies in the field of furniture production. The lack of know-how and modern equipment are major impediments to the development of this industry.

On the other hand, the Government is giving high priority to the improvement of the living standard of the population. This calls for the increase in production and improvement of the quality of the furniture produced in the country. To this end, the Government has requested UNDP/UNIDO assistance in this field.

The furniture factory within the Pyongyang Wood Complex has been selected for its transformation into a Pilot Furniture Plant. This complex also has a sawmill with a nominal annual capacity of 100,000 cubic meters of sawn logs, a plywood factory with a nominal capacity of 600,000 square meters of plywood and 500,000 square meters of veneer, a particle board factory with a nominal capacity of 5,000 cubic meters, a joinery factory with a nominal capacity of 100,000 square meters of doors and windows and a furniture factory with a nominal capacity of 100,000 pieces of furniture per annum. It employs 1,100 people and has an annual value of production of approximately 8 million Wons. The Pyongyang Wood Complex belongs to the General Bureau for Building Materials which is an independent government sector enterprise controlling about 20 percent of the country's wood processing industry. The balance is controlled by the Ministry of Forestry.

The Pilot Furniture Plant was originally intended to produce both solid wood and panel furniture. Due to shortage of funds it was subsequently decided to produce only panel furniture. Because the results achieved were deemed satisfactory, the authorities decided to allocate additional funds and inputs in kind to expand the project again to its original aims.

ANNEX II

LIST OF PERSONS THE EXPERT CONTACTED AND WORKED WITH

Mr. Kim Ha Chun	Managing Director, Pilot Furniture Plant (PFP)
Mr. Kim Li Yong	Chief Engineer of the PFP and guide.
Mr. Kim Gi Un	Deputy Chief Engineer, PFP
Mr. Choe Si Jun	Deputy Chief Engineer, General Bureau for Building Materials, Pyongyang
Mr. Ko Ju Chol	Senior Officer, General Bureau for Cooperation with International Organizations (GBCIO)
Mr. Li Yon Ho	Production Manager
Mr. Song Dok Ryob	Senior Officer, GBCIO
Mr. Pak Yong Iae	Mechanic
Mr. Li Yong Su	Mechanic
Mr. Li Gun Sik	Electrician
Mrs. Kim Hye Nam	Interpreter
Mr. Kim Yang Sik	Driver

ANNEX III

REPORT OF THE STUDY TOUR TO VISIT FURNITURE FACTORIES IN THE REPUBLIC OF SLOVENIA

Prepared by

Radmilo Malis
Furniture Production Expert

INTRODUCTION

This study tour has been organized to accomplish the output planned in the project: Assistance in the Establishment of a Pilot Furniture Plant (DP/DRK/86/011).

Originally, the four week study tour was planned for four participants, but the counterpart reduced their number to three.

One week was planned for visiting the INTERBIMALL and SASMIL fairs (woodworking machinery and tools, and auxiliary materials respectively) in Milan, Italy, from 21 to 26 May 1992. One week was foreseen to visit furniture factories in Slovenia and the remaining time for visiting selected furniture factories in Bosnia and Herzegovina.

Unfortunately, an Italian visa was not issued to one of the participants (allegedly because of difference sin the spelling of his name in the application for visas and in the passport), and, because they chose not to split, they were not able to travel to Milan. Also, because of the war in Bosnia, the study tour programme has to be rearranged and limited to a two-week visit of selected factories In Slovenia.

The study tour participants spent four weeks on the trip: one week they stayed in Beijing waiting to get the Italian visa, two weeks in Slovenia and one week travelling.

The original funds allocation for the study tour (bl 32) was US$ 41,700 (for four participants).

BASIC DATA

Project title	Assistance in the Establishment of a Pilot Furniture Plant
Project number	DP/DRK/86/011/I/01/37
Country	The Democratic People's Republic of Korea
Executing Agency	UNIDO, Vienna
Host Country	Republic of Slovenia
Duration	3m/m (4 weeks for three participants)
Time	15 May to 15 June 1992
Funds (bl 32)	US$ 31,700 (for three participants)
Language	English
Participants	Kim Hwa Chun, Managing Director, Pilot Furniture Plant Choi Ji Jun, Deputy Chief Engineer, Technical Department, General Bureau for Building Materials Jo Jong Nam, Senior Officer, Interpreter
Study tour accompanied by:	Radmilo Malis, Furniture Production Expert, Chief Technical Adviser

ITINERARY[1]

20 May 1992	Vienna/Milan (by plane)
27 May 1992	Milan/Ljubljana (by train)
29 May 1992	Ljubljana/Nova Gorica/Ljubljana (by car)
1 June 1992	Ljubljana/Kamnik/Ljubljana (by car)
2 June 1992	Visiting LESMA Woodworking Equipment Fair in Ljubljana
3 June 1992	Ljubljana/Maribor/Ljubljana (by car
4 June 1992	Ljubljana/Cerknica/Loz/Unec/Ljubljana (by car)
5 June 1992	Ljubljana/Pivka/Logatec/Ljubljana (by car)
6/7 June 1992	Week-end
8 June 1992	Visiting the NASTRO woodworking machine factory in Ljubljana
9 June 1992	Ljubljana/Zeleznik/Bled/Bohinjska Bistrica/Ljubljana (by car)
10 June 1992	Ljubljana/Dekani/Ljubljana (by car)
11 June 1992	Visiting the Ministry of Science and Technology, Department for International Collaboration
12 June 1992	Ljubljana/Zurich (by plane), on the way to Pyongyang to continue mission.

STUDY TOUR PROGRAMME

The original study tour programme, prepared by the expert prior to the organization of the tour, had to be changed due to the circumstances already mentioned in this report. The following topics were emphasized in the original programme:

- Product development, design and standardization of products and parts.
- Production planning.
- Furniture manufacturing technology.
- Equipment for the production of furniture.
- Organization of production.
- Utilization of materials.
- Utilization of woodworking machines.
- Quality control.
- Construction and use of jigs.
- Motivation and productivity.
- Maintenance of tools and equipment.

In order to satisfy the interests of the study tour participants, the Ministry of Science and Technology, Department for International Cooperation

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[1] The itinerary of the study tour participants from Pyongyang to Ljubljana and from Ljubljana to Pyongyang was different and will be shown in their reports.

and the Chamber of Economy of Slovenia collaborated with UNIDO and prepared a two-week study tour programme in Slovenia, comprising visits to:

- Eight companies producing various types of furniture.
- Two companies producing hardware for furniture and joinery.
- One sawmill.
- Two factories producing wood based panels (plywood and blockboard).
- One furniture and joinery testing institute at the University of Ljubljana.
- One technical middle school for wood processing industry.
- One fair of woodworking machines and tools, LESMA in Ljubljana.
- One furniture department store and a couple of smaller furniture stores.
- Five companies producing various woodworking equipment.

The organization of accommodation and transport within Slovenia which was carried out by the Kompas Travel Agency was beyond reproach.

The study tour was conducted in accordance with the programme prepared in Slovenia.

VISITS OF FACTORIES

Furniture factory "MEBLO", Nova Gorica

This is one of the largest furniture factories in Slovenia. It is part of the Holding Company "Meblo", whose diversified product line comprises: particle board, case furniture made of woodbased panels, upholstered furniture, mattresses, furniture made of laminated wood, metal furniture, metal-plastic products (lighting fixtures and traffic signs) and some woodworking equipment (laminate cutting saws, lath sanders and filters for wood dust).

The visit was limited to the furniture factory. The production technology in this factory consists mainly of automated panel machining and surface finishing lines. Furniture is produced and delivered knock-down, packed in cartons. Highly standardized parts and components are produced for modular systems.

The company has its own marketing, engineering and retail sales organizations. Design is done either by its own designers or bought from outside designers. An active marketing, superior designs, high quality products and high productivity are the attributes of this company which exports about 40 percent of its output. MEBLO is a typical large-scale producer of furniture that depends on big market and strong marketing. Its main shortcoming is a low degree of flexibility.

Neither the size of the production nor the type of equipment are suitable for the furniture industry in Korea at this moment, because both require a high investment and an excellent supply of good raw materials, i.e. conditions which could hardly be met in Korea. The metal furniture that MEBLO manufactures for gardens and restaurants could be of greater interest under Korean conditions because the country has a better supply of metal than of wood.

Detailed information and well-illustrated catalogues were handed over to the study tour participants and they received complete answers to the many questions they asked.

Furniture factory "Stol", Kamnik

This is a well known factory with a long tradition in the production of high quality chairs. Recently, "Stol" has diversified its product line and it now produces: chairs, dining sets and office furniture. A significant part of its output is sold through its own engineering service for furnishing various touristic and institutional facilities.

"Stol" is a big exporter and the great majority of its output is sold abroad, mainly to the USA and to Western European markets. "Stol" has its own designers and it gives very careful consideration to product development. This was especially emphasized recently when the company lost a part of the domestic (former Yugoslav) market and had to open additional markets abroad.

What was very interesting and useful for the Korean participants in this factory was to see how very complex parts of furniture are made with simple machines by using various tools and jigs. It was also impressive to see the outstanding management and the maintenance of tools and jigs in this factory. The conclusion is that in the production of chairs, it is not the machines, but the jigs and tools that make the difference in quality and productivity.

All the major production factors: an excellent design, high quality raw material, well selected and maintained tools, rational organization of production, and outstanding workmanship and obviously successful management are employed in this company, resulting in very competitive products on the international market. This is a good example of a successful production and development strategy which adheres to the basic production factors.

Wood Processing Enterprise "Marles", Maribor

"Marles" is a big holding company. It has a big sawmill, production of prefabricated houses, joinery, kitchen and other household furniture. The factory producing kitchen and other household furniture was visited. The production system and the technology are more or less similar to that seen in "Meblo". The use of the post-forming technology on laminates is applied here more often because of its suitability in the production of kitchen furniture.

The huge capacities and rigid production lines that have been seen in "Marles" would be very expensive and hardly utilized under the conditions prevailing in the DPR of Korea.

Furniture factory "Brest", Cerknica

This is one of the factories belonging to the holding company "Brest", Cerknica. This is a medium-size plant manufacturing solid wood chairs, with equipment and a production system that could be applied in the DPR of Korea. Automated woodworking machines are mostly used. Many jigs are used for machining profiled and curved parts. Recently, the company has bought two CNC routers which are fully utilized. Gluing of wood to get bigger parts is commonly done, using mechanical cold presses. Solid wood glued panels are used to make chair seats and table tops. Quality control is done by the

operators who are trained to maintain the required quality criteria. The chairs are packed and delivered semi-assembled.

Almost all the factory's capacity is used to produce for export.

This factory created a special interest and raised the attention of the Korean participants.

A visit was also organized to the factory producing woodworking machines. This factory's production programme consists of cold gluing presses, narrow belt sanding machines, vibrating lacquer sanding machines, curtain coating machines and diaphragm pumps. Some of these machines, especially the cold gluing rotating presses for gluing solid wood panels could be very interesting and useful under Korean conditions.

Factories belonging to "Javor", Pivka

"Javor" is a big enterprise possessing various factories. The furniture factory visited by the study tour participants manufactures chairs made of laminated wood pressed to the desired forms and later machined into furniture parts. Solid wood parts are also used.

The study tour participants wanted to see the production of plywood and blockboard, and this was accepted by the management of "Javor". These two factories producing wooden panels are highly automated and products are of high quality. Due to the quantity and quality of wood available in the DPR of Korea, such large capacities and expensive technologies could hardly be justifiable in that country. However, this visit was useful for the Koreans to realize that serious consideration should be given to increase some of their capacities for wood based panels.

The next factory visited in "Javor" was the one producing woodworking machines. They produce complete veneering lines including presses, double end tenoners, edge banding machines, wide belt sanders and multi-spindle drilling machines. All these machines could be very suitable for the Korean furniture industry. Some of these machines have been seen in the production processes in "Javor" and in the other factories visited.

Wood Processing Industry KLI, Logatec

This is also a well-known producer of solid wood furniture, mainly chairs and tables, for export. KLI is also a big manufacturer of joinery products: doors and windows, which are made in a separate factory.

This company has a sawmill and the majority of the raw material is produced by sawing logs delivered by the local forestry enterprise.

The furniture production system is very similar to the one seen in "Brest", Cerknica. The attention of the study tour participants was drawn to the modern dry kilns with fully automated controls for drying wood.

Like most of the factories visited, this factory also makes an effort to introduce some key CNC machines in order to get a more flexible technology, ready to accept special customers' orders.

KLI also showed the production of some woodworking machines (wood turning lathes and high frequency presses), which are designed and made by using sophisticated components.

Furniture factory "Alples", Zelezniki

"Alples" is one of leading Slovenian factories producing case furniture made of wooden panels and solid wood components. The assortment of this factory consists of: wall units, bedroom furniture, dining sets, anteroom furniture, bathroom furniture, occasional tables etc. The production technology is similar to the one seen in "Meblo", Nova Gorica. Production lines are specialized for a certain product group. The products are sold both on the domestic and export markets.

Like many other furniture factories in Slovenia, "Alples" also has developed the production of some woodworking equipment such as: small circular saws, adjustable horizontal single-spindle drilling machines, vertical panel sizing machines, dowel making sets rounding machines etc. Most of these machines are very suitable for the Korean conditions.

LIP, Bled, furniture factory in Bohinjska Bistrica

This is a medium size factory which produces table tops and solid wood furniture, mainly for export. The furniture factory is equipped with multi-purpose machines which makes it very flexible and also interesting for the study tour participants.

The development of factories of this size and type could be a realistic goal for the Korean furniture industry in the near future.

Here, the study tour participants had a chance to visit a very modern and highly automated sawmill. All the raw materials for the secondary wood processing is produced in this sawmill. On the same location, the company produces three layer forms for concrete shutter work. These forms are made of thin coniferous sawn boards. The surfaces are finished with special water-proof films. The entire production of these forms is exported to the German market.

In other factories, LIP. Bled produces kitchen and dining-room furniture as well as doors and windows.

Kovinoplastika, Loz

Kovinoplastika is a modern factory producing two million pieces of joinery fittings, 400,000 pieces of stainless steel kitchen sinks, roof windows and various other products made of metal and plastic. Almost 90 percent of the output is exported, mainly to the western countries. The production process is highly automated and the products are of a very high quality. The Korean participants showed a very high interest for this production because such products are not yet available on their market. It would be a good idea to establish a joint venture company between the DPR of Korea and Kovinoplastika, because Korea has both the resources and the market for such products.

Lama, Dekani

Lama is a well-known producer of furniture hardware, ranging among the largest producers of this kind of products in Europe. A large assortment of this factory consists of various items of furniture hardware made of metal, plastic and in combination metal-plastic. These are various hinges, jointers, locks, handles, shelf-holders, latches, castors etc.

This huge factory is equipped with modern machinery for moulding and processing lines for finishing products.

The Korean participants showed an exceptional interest for the production process and the products of this factory. They obtained samples of the most interesting items. It seems they have a serious intention to initiate the production of this kind of hardware in the DPR of Korea. It would be very reasonable to establish some kind of cooperation with Lama, even a joint venture company.

Visits to producers of woodworking equipment

There are two groups of factories manufacturing woodworking machines in Slovenia: one developed within wood processing enterprises, and the other which is only specialized for production of woodworking equipment. Most of the factories of the first group were visited during visits to the furniture factories of the same companies. Visits were organized also to some other producers of machines.

Kovind, Unec pri Rakeku is a producer of various conveyors and other internal transport equipment for both primary and secondary wood processing industries. Its product line comprises also cross-cutting and multi-blade circular saws. The cross-cutting circular saws, with automatic selection of lengths to be cut, are very interesting, because the required specification of components can be obtained from the minimum quantity of wood cut. All the equipment produced by this factory is suitable for Korean conditions.

Nastro, Ljubljana has a long tradition and a good reputation in manufacturing high speed routers, single spindle moulders, revolving (carousel) moulders, panel sizing saws with one and two circular saw blades etc. Both the quality and the prices of the machines made by this company are very competitive and could be very interesting for the development of the Korean furniture industry.

SOP, Krsko is a producer of surface finishing equipment, including automatic finishing lines, wood drying equipment, dust extraction and air conditioning equipment etc. Besides the wood processing industry, this company serves the other industries making metal finishing lines, various products for the food and beer industry etc.

At the request of the Korean participants, the company made an offer for a small finishing line consisting of two spray booths and a lacquer drying tunnel with conveyor. Such a combination would be very suitable for the Pilot Furniture Plant and for other medium-size furniture factories in Korea.

Lestro, Maribor is known as a producer of good four-side planers, parquet lines, wide two-side planing machines and multi-blade circular saws.

A new machine which is a combination of a heavy two-side planer and a wide belt sander was demonstrated at the LESMA woodworking machines Fair in Ljubljana, showing good results. It is designed for large-scale mass production.

LESMA, Woodworking Machines Fair, Ljubljana

The one day visit to this exhibition was a good chance for the Korean participants to see the variety of products available for the wood processing industry made in Slovenia, Italy, Germany, Japan, the Taiwan Province of China and other countries.

A selection of woodworking tools, pneumatic powered tools, tool grinding wheels, sanding belts etc. were also presented. The Korean participants showed interest for woodworking tools made by TRO, Prevalje in Slovenia.

This visit to the Fair was very useful because the study tour participants had a first hand opportunity to see many woodworking machines, including those with CNC controls.

Technical Middle School for Wood Processing, Nova Gorica

This was an excellent opportunity for the Korean participants to visit a well-organized school combining theoretical teaching and practical training for the education of carpenters and technicians.

Furniture Testing Institute at the University, Ljubljana

The Institute carries out various tests in order to compare durability and other quality characteristics of furniture products with standard requirements.

By simulating conditions under which a product may be used and by measuring changes, conclusions about the product's quality are made and a quality certificate is issued.

Testing data are used to control the product's characteristics, to improve construction and for commercial purposes. A similar institute would be desirable in Korea once its furniture industry has developed further.

CONCLUSIONS

The study tour in Slovenia was very successful and the participants learned a lot on what a well-organized and efficient furniture factory looks like.

It was important that the study tour programme was not limited to furniture factories only, but included other products that a successful production of furniture depends on, such as sawnwood, woodbased panels, woodworking equipment, hardware for furniture products etc. The programme was even wider, showing an educational institute, a quality control institute and a woodworking equipment fair.

This study tour will have a positive impact on the development of the furniture industry in the DPR of Korea, because information, catalogues,

samples and other facts and ideas collected during the stay in Slovenia, will be well utilized in making strategic and operative decisions.

An excellent organization of the study tour and the very friendly receptions in all the factories and institutions visited contributed to the full satisfaction of the study tour participants.

ANNEX IV

SPECIFICATION OF WOODWORKING TOOLS AND MACHINE SPARE PARTS TO BE ORDERED FOR PURCHASE

A. Woodworking tools:

1. Reciprocating slot mortise bits, left rotation.
Leitz catalogue: WB 510-0

Pieces	Ident No.	D (mm)	GL (mm)	Shank (mm)	Quality
5	037020	6	90	13x40	HSS
5	037022	8	95	13x40	HSS
5	037023	9	100	13x40	HSS
5	037024	10	105	13x40	HSS

2. Slot mortise bits, left rotation,
Leitz catalogue: WB 401-0

Pieces	Ident No.	D (mm)	GL (mm)	Shank (mm)	Quality
5	037140	6	120	13x50	SP
5	037142	8	130	13x50	SP
5	037144	10	140	13x50	SP
3	037149	15	165	13x50	SP

3. Twist drills, right hand rotation, shank 8 x 30 mm.
Leitz catalogue: WB 120-0-05

Pieces	Ident No.	D (mm)	GL (mm)	Quality
5	035852	3	70	HSS
5	035853	4	80	HSS
5	035854	5	90	HSS
5	035857	8	120	HSS
5	035859	10	140	HSS
5	035861	12	155	HSS

4. Twist drills, right hand rotation, shank 8 x 30 mm.
Leitz catalogue: WB 120-0-06

Pieces	Ident No.	D (mm)	GL (mm)	Quality
5	035980	8	95	SP
5	035982	10	94	SP
3	035983	12	93.5	SP
3	035985	16	92.5	SP

5. Countersink, right hand rotation.
Leitz catalogue: WB 701-0-01

Pieces	Ident No.	d (mm)	D (mm)	Shank (mm)	Quality
2	036250	3	16	10 x 30	SP
2	036251	4	16	10 x 30	SP
2	036252	5	16	10 x 30	SP
2	036253	6	16	10 x 30	SP

12 Pieces Allen Screws M 6 x 5, Ident. No. 005836, and
4 Allen keys

6. Eccentric router chuck, No. II Morse taper shank with M 30 x 1.5 mm retaining thread (MK2),
Leitz catalogue: PM 420-0

Pieces	Ident. No.	Shank (mm)	Chuck No.	Dimensions
1	037353	Ø 9.5	2	
1	037356	Ø 9.5	4	
1	037382	Ø 12	6	
1	037386	Ø 12	10	
10	005869	Allen screws		M 8 x 10
4	005436	Allen keys		
10	005803	Balancing screws		8 x 6

7. Router cutter Z1 for eccentric chuck.
Leitz catalogue: Wo 100-1-02

Pieces	Ident. No.	D (mm)	NL (mm)	GL (mm)	Shank (mm)	Quality
5	037602	4	13	46	9.5 X 20	HSS
5	037606	6	15	48	9.5 X 20	HSS
3	037610	8	24	55	9.5 X 20	HSS
3	037614	10	30	60	9.5 X 20	HSS
3	037620	15	35	65	12 X 20	HSS
5	037624	20	38	70	12 X 20	HSS

8. Collet chuck for concentric router cutters. shank Morse taper No. 2 (MK2) with M 30 x 1.5 mm retaining thread.
Leitz catalogue: PM 350-0-02

Pieces	Ident. No.	
1	037466	With collet chuck 10 mm
1	037451	With collet chuck 12 mm

9. Router cutter Z2 for concentric chuck,
Leitz catalogue: WO 120-1-01

Pieces	Ident. No.	D (mm)	NL (mm)	GL (mm)	Shank (mm)	Quality
5	038000	6	8	41	9.5 x 20	HSS
5	038004	10	26	53	9.5 x 20	HSS
3	038006	12	32	54	12 x 20	HSS
3	038010	20	38	60	12 x 20	HSS

10. Universal profile router cutterhead Z2.
Leitz catalogue: WP 520-1/WP 522-1

Pieces	Ident. No.	Type	B (mm)	PT (mm)	Diameter of guide (mm)	Quality
1	029192	WP 520-I	40	15	--	HSS
1	029190	WP 522-I	40	15	67.4	HSS
1	009700	Spare bearing with guide and screw for WP 522-1, dimensions 67.4 x 12				
10	0C6073	Allen screws M 8 x 14				

Pieces	Ident. No.	Type	B (mm)	PT (mm)	Diameter of guide (mm)	Quality
4	005445	Allen keys S4				
8	007111	Straight rebating knives. TM 105-1. SP. B=40				
4	005602	Straight limiters. TA 300-1. B=40 mm				

11. Standard profiled knives LEN-profiles
Leitz catalogue: TM 135-1

Pieces	LEN profile
2	5
2	7
2	12
2	13
2	14
2	15
2	16
2	18
2	19
2	20
2	24
2	26
2	36

12. Balancing roll for Morse taper shank No. II, complete with wooden box
Leitz catalogue: VM 799-0

1 Piece Ident. No. 037420

13. Universal safety cutterhead Z2 for spindle moulder
Leitz catalogue: WM 510-1-01

Pieces	Ident. No.	D (mm) square knives	B (mm)	d (mm)	Z	Quality
1	025659	128	40	40	2	SP

14. Grooving cutter without spurs
Leitz catalogue: WF 100-2

Pieces	Ident. No.	D (mm) square knives	B (mm)	d (mm)	Z	Quality
1	020072	160	8	30	8	HSS
1	020073	160	10	30	8	HSS

15. Spur type grooving cutter
Leitz catalogue: WF 102-2-01

Pieces	Ident. No.	D (mm)	B (mm)	d (mm)	Z/V	Tipped
2	020488	140	10	30	3/6	HSS

16. Adjustable grooving cutter,
Leitz catalogue: SF 501-1

Pieces	Idnet. No.	D (mm)	B (mm)	d (mm)	Z/V	Max. grooving depth (mm)	Tipped
1	020632	150	7.5-14.5	35	4/4	32	TCT

17. Coffering cutter set Z2 for wood thickness 24 to 28 mm
Leitz catalogue: SF 640-1-04

2 pieces, Ident. No. 022300, complete cutter set, d=35 mm

18. Grooving saw
Leitz catalogue: WK 100-2-03

2 pieces, Ident. No. 020170, TCT, Z-18, D 150 mm, B 4 mm, d 30 mm.

19. Planer head
Leitz catalogue: WM 200-2-03/VN 265-0

Pieces	Ident. No.	Quality	Z	d (mm)	B (mm)	D (mm)
2	029752	HSS	4	40	130	125
2	029753	HSS	4	40	180	125
1	029755		Setting device VN 265-0			
16	006825	HSS	Knife 130 x 30 x 3 mm			
16	006826	HSS	Knife 180 x 30 x 3 mm			
8	009269		Clamping wedge with screws, B-130			
8	009270		Clamping wedge with screws, B-180			

20. Dovetailing cutter for single spindle dovetailing machine, type OMEC 750/1992
5 pieces: Shank 12 x 30 mm, NL-23mm, GL - 60 mm

21. Cutterhead with hogging unit, knives and spurs for tenoner for rounded end tenons, Model: TSU, PADE, Italy/1992

Quantity	Description	D (mm)	B (mm)	d (mm)
1 piece	Cutterhead	40	90	80
1 piece	Hogging unit	80	30	130
2 sets	Knives for cutterhead			
2 sets	Knives for hogging unit			
2 sets	Spurs for cutterhead and hogging unit			

22. Wood turning knives for wood turning lathe, Model: TC 1200, Centauro, Italy 1992.
6 pieces Spare part catalogue, Tavola 2, No. 17
10 pieces Triangular grinding stones for grinding turning knives L-150 mm, a-15 mm.

23. Bandsaw blades for log sawing bandsaw
5 pieces, 6000 x 100 x 1.0 mm, PV teeth: t-35 mm, h-12 mm.

24 Hand swaging device for swaging bandsaw teeth (one piece).

25. Airless spray gun Model FM 57 S, Falcioni, Italy with adjustable TITAN TIP (without pump) (one piece)

26. Pneumatic couplings for connecting pneumatic tools and machines to hoses with compressed air.
15 pieces, Ø 1/2" (inner diameter of the part which fits on the tool attachment).

B. Spare parts

1. Spare parts for tenoner for end rounded tenons (model: TSU, PADE, Italy 1992) (Based on producer's spare parts catalogue)

- 2 pcs. toothed flat belt type 600H100, B-25 mm, L-1500 mm
- 2 pcs. ballbearings: No. 6206 TBP 63
- 2 pcs. " No. 6206
- 2 pcs. " No. 6015
- 2 pcs. " No. 6015 2PS
- 1 pc. programmable controller PLC SYMAC C 28H
- 1 pc. Sealings: DIS.N.7: pos. 5
  1 pc. pos. 11
  1 pc. pos. 12
  1 pc. pos. 13
  1 pc. DIS.N.8: pos. 8

1 pc.	pos. 11
1 pc.	pos. 15
1 pc.	DIS.N.9: pos. 3
1 pc.	pos. 4
1 pc.	pos. 12

2. Spare parts for slot mortiser. Model MSO. PADE. Italy, 1992. (based on producer's catalogue of spares).

- 2 pcs. belts: DIS.N.4	pos. 2 flat belt HEVALOID 1905x50
	pos. 5 V-belt A-48, 1300 mm, W-12 mm
- 2 pcs. ball bearings	No. 6207
2 pcs	No. 6204 2RS
1 pc.	No. 6206 TP6
1 pc.	No. 6305 TP6
- 1 pc. sealings:	DIS.N.10 pos. 7
1 pc.	pos. 8
1 pc.	pos. 9
1 pc.	DIS.N.11 pos. 7
1 pc.	pos. 11
1 pc.	pos. 15
- 1 pc. Pneumatic components:	DIS.N.12 pos. 2
1 pc.	pos. 4
1 pc.	pos. 5

3. Spare parts for Universal saw grinding machine, model: CANA/E, Vollmer, Germany 1992

- 2 pcs V-belts	10 x 725 mm
2 pcs	10 x 600 mm
2 pcs	10 x 800 mm

4. Spare parts for drum/brush sander. Model: CW-001. Chun Weii. Taiwan Province of China, 1992

- 2 pcs. pneumatic drum Ø11-, L=230 mm

5. Flexible pipes for dust extraction

- 5 m	Ø 100 mm
- 10 m	Ø 120 mm
- 20 m	Ø 150 mm

6. Various oils:

- 200 l hydraulic oil BP-HLP-68
- 200 l hydraulic oil BP-HLP-32
- 100 l lubrication oil Mobil B-30

ANNEX V

LIST OF TRAINEES

Training course	Name of trainees	Sex
Cross-cutting and ripping sawn timber	1. Kim Gi Un	M
	2. La Do Il	M
	3. An Yong Jun	M
	4. Kim Sung Lyol	M
Planing and thicknessing	1. Kim Gi Un	M
	2. Li Chol Sun	M
	3. Kim Gyong Ho	M
Moulding and routing	1. Kim Gi Un	M
	2. Li Gil San	M
Tenoning, mortising and drilling	1. Li Ae Sun	F
	2. Choe Gum Hwa	F
Sanding and surface finishing	1. Pak Yong Hui	F
	2. Kim Sun Yong	F
	3. Mun Gye Hwang	F

ANNEX VI

SUBSTANTIVE OFFICER'S COMMENTS

The Chief Technical Adviser has continued his useful and down-to-earth work. It is to be hoped that, as the project is coming to an end, the raw material situation will improve to the point where continuous production of a series can be assured, so as to make possible the completion of this objective. This would also call for the complete installation of the dust extraction ducts and compressed air lines. In the meantime, requisitions for the tooling and spare parts have been placed.

It is to be hoped that in future missions larger numbers of machine operators will be trained.