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ASSISTANCE IN THE ESTABLISHMENT OF A PILOT FURNITURE PLANT

DP/DRK/86/011

DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA

Technical report: Assistance in tool maintenance training*

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 G. A. Woods
Sawdoctoring and tool maintenance expert

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* This document has not been edited.

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1. INTRODUCTION

1.1 Geoffrey A. Woods a sawdoctoring expert undertook a three-month mission to DPR Korea from 14th August to 13th November 1989 under the UNDP/UNIDO project - Establishment of a Pilot Furniture Plant (DP/DRK/86/011) as Expert in Tool Maintenance.

His brief was to commission the Tool and Cutter Grinding Machine purchased as part of the equipment supplied by the UNDP input and installed at the Pyongyang Wood Complex and train Government counterpart staff in its use and in the correct maintenance of all cutting agents to be used in the pilot furniture plant. In addition to prepare a manual on the use of the Tool and Cutter Grinding Machine and the correct sharpening of the cutting agents used.

Mr. Yu Sang Gil from the General Bureau of Building Materials acted as guide and Mr. Cha Chol Ho, teacher from the Pyongyang University of Foreign Studies acted as interpreter. Mr. Li Chun Gyu, Head of the Technical Department and his Assistant Mr. Li Si Gu worked with and greatly assisted the expert in overcoming practical problems encountered within the factory. Mr. K. Malis the CTA of the project returned during the expert's mission and so was able to act immediately to the request for additional items of equipment for the toolroom although none of the equipment ordered will arrive before the expert leaves. The expert would like to thank all the above together with the numerous workers at the Factory and UNDP staff who helped in any way with the work of the assignment.

1.2 Although the expert's brief was mainly concerned with the maintenance of tooling in the Pilot Furniture Plant several reasons made it necessary to look at other maintenance problems throughout the Complex. These were as follows:

(a) None of the machines in the Pilot Plant were working and so had not Blunted any tools for sharpening;

(b) Very few of the machines in the Pilot Plant use tools which need sharpening there being only a few Router bits, Drills and T.C.T. circular saw blades apart from the Spindle moulding machine for which no tools had arrived; and

(c) Very serious problems existed in other parts of the Complex which could not be ignored and in any case served as training examples for the counterpart staff and provided much needed tooling to be sharpened.

EXPERT'S FINDINGS

2. The Pyongyang Wood Complex

2.1 The Pyongyang Wood Complex is quite large and is spread over a large area in many separate buildings with each building housing different activities with what appears to be little co-ordination between the various sections. There may be some logical explanation for this if one looked back into the history of the Complex but the expert does feel that perhaps it is an appropriate time with new investments in equipment being envisaged to look at the factory as a WHOLE and see if improvements could be made in the utilization of the existing machinery which is often duplicated in the various sections and is seldom seen to be fully occupied.

2.2 Most of the machinery is old and needs either replacing or thoroughly re-conditioning and this would be much easier to carry out if some of the sections could be brought together and the best equipment selected for use whilst other items could be re-conditioned and some possibly scrapped or kept for spares.

2.3 This rationalization of equipment is especially appropriate in the sphere of saw and tool maintenance which, with perhaps the exception of one large Knife Grinding Machine for the long guillotine knives for veneer peeling in the plywood factory, could benefit, enormously from CENTRALISING under one roof somewhere near the sawmill which uses the largest blades with all other blades and tooling being easily transported to the central toolroom.

2.4 The Pyongyang Wood Complex is extremely fortunate in having a well equipped engineering section quite capable of re-conditioning their own machinery and even manufacturing new simple machines and accessories, which is one of the reasons why the expert has made the previous suggestions of improved utilization and re-conditioning of existing machinery.

2.5 The expert made extensive use of these facilities during his assignment and in fact would have made little progress without them and this section should be congratulated on their willingness to help and on the items manufactured.

3. EXISTING CUTTING AGENTS

3.1 For several days the expert had a peculiar feeling that each workshop visited were hiding their tools away, for machines such as vertical spindle moulders, routers and drills

never seemed to have any cutters attached to their spindles and when asked where the tools were no-one volunteered an answer. Eventually cupboards and storerooms were found with some tooling but in most cases these tools were HOMEMADE i.e. within the Complex, and what is worse were sharpened FREEHAND even though TWO tool and cutter grinding machines existed before the new project machine was purchased.

3.2 Two or three T.C.T. circular saw blades were found all with their tips damaged and one almost new expensive ninety tooth blade had ALL its tips broken and they will all have to be replaced.

3.3 Ordinary circular plate blades are used extensively throughout the complex and these blades are locally made and the quality is not very good with most blades showing thin patches where surface grinding has not been able to clean up the entire surface. In addition, variation in hardness is suspected although this could not be tested. All blades were sharpened by freehand grinding.

3.4 The standard of cutting agents in the Complex is extremely poor since most of them are manufactured in the complex's own workshops. Whilst trying to be self-reliant is very praiseworthy the standard will have to be improved or tooling imported because the existing tools are giving poor results and what is more serious are damaging bearings on the machines with the vibration set up at the high speeds used in wood machining because the tools are not balanced.

4. EXISTING TOOLROOM MACHINERY AND EQUIPMENT

4.1 There are now four separate toolrooms and one sawdoctors workshop in the Complex plus a separate knife grinding machine in the plywood factory. Most of the equipment is old but by selecting the best items and re-conditioning as necessary most of the equipment for one good toolroom exists.

4.2 The only modern piece of machinery is a large capacity Japanese Tool and Cutter Grinding Machine which together with the new Italian machine supplied by the project will more than cope with all the tools in the Complex. A few additional accessories are required for these two machines, mainly mounting arbors to cope with at least five different spindle sizes on machines within the Complex.

4.3 There are four wide bandsaw blade (W.B.B.) tensioning rollers in four separate workshops yet one would easily cope with all the blades in the Complex. The best machine is in the workshop which does not really need it since they only use narrow

bandsaw blades (N.B.B.) which are not normally tensioned and the worst machine is in the sawdoctors workshop which needs one more than any other workshop. Furthermore, the capacity of this machine is only for 150mm wide blades yet 180mm blades are used in the sawmill.

4.4 There is one automatic circular saw blade (C.S.B.) sharpening machine of Russian manufacture but it is quite ancient and has parts missing and is not worth re-conditioning. This machine needs replacing urgently to cope with the many C.S.B. which are used throughout the Complex and to help maintain/manufacture T.C.T. circular saw to blades.

4.5 There are three automatic W.B.B. sharpening machines all ancient designs and need replacing with one modern machine which would cope easily with all the blades in the Complex.

4.6 With just two weeks remaining of the assignment the expert discovered yet another toolroom making a total of FIVE if we include the sawdoctors workshop.

4.7 Two extremely useful machines were amongst the equipment found both of German manufacture and of good quality. One was a W.B.B. Tensioning Roller which appears to be in excellent condition having had very little use in the past thirty years and the other machine is a W.B.B. "IDEAL" Butt Welding Machine with a capacity of joining 150mm wide blades. All the instruction plates were covered up with a thick layer of paint, it was clear from this that the staff did not know what the machine was and in fact were using it to BRAZE join NARROW bandsaw blades. If the machine is still in working order the expert hopes to be able to demonstrate how it should be used although he suspects that a much heavier electric supply cable will be needed to supply the 60 Amps required.

5. SAWMILL MACHINERY

5.1 The sawmilling machinery i.e. Log Bandmills, Band Resaws and Vertical Framesaws are all quite old and need replacing or re-conditioning. During the expert's stay very little solid wood was cut and logs were extremely small. It could be that a much smaller modern sawmill could cope but a separate study would be needed.

5.2 The main Log Bandmill is in very poor condition having a HOMEMADE top pulley to replace the original pulley twisted during a fire. Both pulleys desperately need re-grinding but the special grinding machine is not available. These worn pulleys together with incorrect tensioning of the W.B.B. are causing severe cracking.

5.3 Many other smaller faults exist with guides, shear boards etc., completely missing and it is amazing that the blades cut as well as they do but of course production is very low and logs extremely small.

EXPERT'S RECOMMENDATIONS

6. PILOT FURNITURE PLANT

6.1 As stated earlier the machines in the Pilot Furniture Plant do not use many re-sharpenable cutting agents therefore with the new Tool and Cutter Grinder and the additional equipment made in the Complex together with the further items recently ordered the staff trained by the expert should be able to cope with the sharpening needs when the plant starts production.

6.2 Obviously expendable items such as Tungsten Carbide Tips (T.C.T.), grinding wheels etc., will have to be renewed from time to time. In addition, a supply of 'EasyFlow' brazing paste or its equivalent should be ordered to make T.C.T. replacement more easy to carry out and ensure that the material used for this work is correct, the materials available for training were poor and of unknown specification. The correct materials for this work cannot be over emphasized for if tips come off during use this can be extremely dangerous since operators often stand in front and in line with the revolving blade. In addition, if one tip comes off and sticks in the wood it can damage and even rip off all the other tips on the blade.

6.3 Lighting in the toolroom of the Pilot Plant needs to be improved. The one 25 Watt fluorescent light, which seldom worked, needs replacing with FOUR 100 Watt tubes for no-one can do precision work in the dark.

7. CENTRALIZED TOOLROOM AND SAWDOCTORS WORKSHOP

7.1 It has already been suggested that a Centralized Toolroom/Sawdoctors Workshop using the best machines from the existing separate workshops and the new machines and equipment recently installed and those items recommended for the future would be far more efficient. The existing system is extremely wasteful of both machinery and manpower and it is very difficult to control the various cutting agents used which could be much better utilized if they came into one centre for sharpening and distribution. There is simply no-way anyone can justify FIVE sets at toolroom machinery and equipment and a planned changeover to one centralized toolroom is strongly recommended.

7.2 An alterative scheme would be to leave the Sawdoctors Workshop as a separate unit within the sawmill which would service ALL W.B.B. and Standard Circular Plate Blades for the Complex, however, this is only suggested as an alternative on the grounds of convenience of location for this solution would mean duplicating some machinery unnecessarily.

7.3 The newly discovered German W.B.B. Tensioning Roller is now the best in the Complex and looks as though it does not even need its rollers re-grinding. This machine should used for tensioning all the W.B.B. in the Complex with the next best machine being re-conditioned and set-up on a separate tensioning bench for the Framesaw blades. This bench is a different design to the one used for W.B.B. not needing rollers above and below the work table but also the height of the bottom roller instead of being level with the bench should be higher by the thickness of the framesaw blade tabs i.e. about 3 millimeters.

7.4 If the recommendation for a Central Toolroom is taken up it should be in a position to have windows on all sides, for good natural light is very important. In addition, for winter use there should be installed plenty of artificial lighting in the form of fluorescent tubes. If possible the floor should be of wooden construction or covered in a wood based material such as exterior grade plywood or particle board. This is essential for protecting W.B.B. teeth as they are often placed on the floor during servicing and will protect other tooling from severe damage if accidentally dropped.

8. ADDITIONAL MACHINERY AND EQUIPMENT

8.1 The most urgent equipment needed is a set of lightweight Oxy-Acetylene welding equipment which is needed for use in replacing T.C.T. on circular saw blades and other tooling and also for the repair of cracks in W.B.B. which at present can only be temporarily stopped by punching eventually having to be cut out by braze re-joining, this is a lot of work and a poor solution to the problem. The basic welding equipment is one of the items already requisitioned but a W.B.B. welding clamp will have to be made for which the expert has provided drawings. This has now been accomplished and training given in welding techniques.

8.2 Next most urgent are tool mounting mandrels for the Japanese 'HEIAN' tool and cutter grinding machine. These should be 200mm long and main diameters are 30mm, 35mm and 40mm, all with No.4 Morse taper ends.

8.3 A fully automatic C.S.B. sharpening machine comes next in priority. This is needed to sharpen properly the numerous circular plate blades used throughout the Complex but also needed for reforming the teeth on T.C.T., C.S.B before re-toothing and again to relieve the tops of teeth behind the tungsten carbide as the carbide tip is sharpened away. The same machine could also sharpen N.B.B. if necessary with an attachment which could be made in the Complex.

8.4 A new W.B.B. Automatic Sharpening Machine is also recommended to cope with the blades from the sawmill and other re-saws in the Complex.

8.5 The tooth PITCH of all bandsaw teeth should be increased to 45mm minimum and perhaps 50mm for the log bandmill blades.

8.6 As stated earlier a separate study is needed for the sawmill if it is to be modernized and coupled with this is the future of the Framesaw Machinery which it is suspected would not be retained. However, as the sawmill is at present, an attachment to sharpen the blades ought to considered. They come in various stages of sophistication and the basic form to fit the Vollmer C.S.B. sharpener would cope with the few blades in use.

8.7 The W.B.B. cracking problem will not be solved until the pulleys are ground on ALL the bandsawing machines. It may be that there is such a machine available elsewhere in the country, if so, it should be arranged to borrow it since they are only used for a few hours a year. If not, the machine is not too expensive and could be utilized in other government sawmills.

8.8 The existing W.B.B. Swaging Tools are very poor and need replacing together with Side Dressing Tools which they do not have to carry out the whole process properly.

8.9. Finally several small items of ancillary equipment are required but do not need explanation here. All the items recommended are shown in APPENDIX 1.

9. CARE AND USE OF T.C.T. CUTTING AGENTS

9.1 Both management and workers need to realize that T.C.T. saw blades and tools are a new technology which needs NEW techniques if any benefit is to be derived from the additional cost of such tools, to-date the high cost of the saw blades purchased would seem to have been a waste of money since they have in the main been damaged rather than worn away with production and sharpening.

9.2 The first lesson to get over to workers is that although T.C.T. is extremely hard it is also extremely BRITTLE and DELICATE and therefore needs EXTREME CARE when handling as the slightest knock against steel, concrete etc. will chip the carbide tip often so severely that it will need replacing. In some factories they realize the importance of this and make wooden boxes to keep the tools in during storage and transferring from toolroom to the machine it is to be used on.

9.3 Next the fit of C.S.B.on their spindle must be PERFECT with no play at all for any gap at the spindle will be doubled at the cutting edge, for example, a 0.2mm loose fit will mean that the teeth run out of true by 0.4mm which could mean that only a few of the teeth do any work since each tooth's bite may be less than this 0.4mm.

9.4 Under the right conditions T.C.T., C.S.B. can produce a surface finish almost as good as a planing machine, certainly good enough for glued jointing without any additional planing. This advantage comes about with the use of T.C.T. blades by the fact that the carbide tips are ground so accurately, certainly within 0.1mm. This excellent feature of T.C.T. blades is completely lost if the mounting collars which hold the blades in the machine run out of true. All collars should be checked with a dial gauge and corrected if not running within 0.1mm. We did repair one blade and decided to test it on the machine. The worker removed the other blade by using a hammer to loosen the securing nut instead of a spanner and it was not surprising to find that the teeth ran out of true by approximately 3mm. T.C.T., C.S.B. should not be run on machines like this until the collars have been trued up on their own spindle in a lathe.

9.5 The practice of using a hammer to tighten and loosen securing nuts MUST be stopped. This will damage bearings, may bend spindles which in turn will make cutting agents run out of true causing vibration which in turn will cause further damage to bearings and even cutting agents if T.C. tipped.

9.6 The tooth pattern of T.C.T., C.S.B. supplied from Japan is quite unsuitable for the sharpening facilities in the Complex. The alternate face bevels grind half the tip away before it has been used and the square faced raker tooth in the pattern complicates the sharpening tremendously. A much simpler pattern is recommended having no face bevels, a standard top clearance angle of 12 degrees with alternate top bevel of 10 degrees. Blades for ripping solid wood should have 25 degrees hook angle reduced to 10 degrees for blades used for cross-cutting solid wood or for cutting sheet materials such as plywood, blockboard and particle board. This much simplified pattern will cut quite satisfactorily, stay sharp longer and be much easier to sharpen.

10. TOOLROOM STAFF TRAINING

10.1 There was a few changes in the staff who came for training and some who did not always turn up. This was understandable since it was impossible to maintain their interest when we only had one machine on which to train and worse still, very few cutting agents to sharpen. In addition to this, the expert had to spend a lot of time in the engineers workshop far away from the toolroom supervising the making of equipment which was necessary to have in order to carry out the training.

10.2 The other Japanese Tool and Cutter Grinder would have helped considerably but this was in another building some distance away making it impossible to supervise the two machines at the same time.

10.3 In retrospect the three-month mission would have been better split in two with a short survey period by the expert undertaken at the beginning when the much needed equipment for training could have been purchased and other items manufactured in the Complex's engineers workshop in advanced of the second phase. It might even have been possible to have persuaded management to have centralized the Toolroom or at least to have moved the other good Japanese Tool and Cutter Grinder into the project's Toolroom for training purposes. Had this been done an awful lot of time which has been wasted would have been avoided and the amount and variation in training greatly improved.

10.4 Two of the trainees did attend regularly and proved very interested and quite capable. These were **Mr. Pak Hung Rok** who attended from the beginning and in the expert's opinion ought to be placed in charge of the Pilot Plant's Toolroom and **Mr. Kim Ho Son** a young man from the sawmill's sawdoctors workshop who would make an excellent assistant. Together these two could easily cope with the cutting agents from the Pilot Plant and could also sharpen other cutting agents from other workshops within the Complex.

10.5 The expert went through the process of setting up all the new unused cutters for the Pilot Plant but without actually sharpening them. Trainees were asked to record all the various angles and workhead positions used so that when production commences and cutters are blunted they should be able to cope fairly easily.

10.6 The damaged 90-tooth T.C.T., C.S.B. was completely re-conditioned including re-forming the teeth to receive the tips which had been altered in shape by free-hand grinding. The recommended simplified tooth pattern was used when sharpening so there should be no misunderstanding what is required.

10.7 An entirely new T.C.T. blade was made using a blank plate made in the Complex. Only 24 teeth were put on to demonstrate the square topped T.C.T. tip as recommended for ripping purposes.

10.8 As many other cutting agents were sharpened as could be found to give as much training as possible and it is felt that the two trainees mentioned earlier have acquired a good basic knowledge of tool and cutter grinding and the repair of T.C.T. tools.

10.9 The expert demonstrated crack welding of W.B.B. which stirred up a lot of interest in the sawmill where cracking of blades is a big problem. This led to a welding clamp to the expert's design being made so that he could train staff before he left. With the clamp made he also was able to train staff on the process of weld joining of W.B.B. which is superior to the now generally obsolete method of braze joining as being used in the Complex.

10.10 All in all quite a lot of training was accomplished despite the lack of equipment at the beginning for it was found that many of the staff of the Complex were quite skilful in their own way and could assimilate what was taught quite quickly.

11. EQUIPMENT MADE OR RECONDITIONED

11.1 Unfortunately when the expert arrived at the beginning of the mission he had almost no tools to work with and after PRETENDING to sharpen the few NEW cutters purchased for the Pilot Plant had to look around for other things to do. Each new idea he came up with proved to need some tool or equipment not available so there was nothing else for it but to design and have made the items required. This wasted a lot of time, for the expert nearly always had to supervise the work, however, the trainees were involved whenever possible and can now, for example, make their own straight edges and simple gauges plus grind the faces of the special sawdoctors tensioning hammers to the correct shapes, the hammers having been made in the Complex.

11.2 One of the W.B.B. Tensioning Machines was reconditioned and the expert re-ground the hardened steel rollers on the lathe in the engineers shop. Again staff watched and assisted so some training was achieved even if it was way out on the periphery of what we were supposed to be doing. This machine actually proved beyond satisfactory repair, as the expert expected it would be, but at least the engineering staff should have confidence enough to re-grind the other two better machines which also need doing.

11.3 A large C.S.B. tensioning anvil and a set of special hammers were made in the engineers workshop the anvil is of good quality steel cut from a huge shaft weighing about 2 tons but it really needs the working curved face HARDENING, this may be fully hardened and tempered or may be CASE-HARDENED i.e. just a thin layer on the working face by heating in a furnace for a long period covered with a carbon hardening compound.

11.4 A jig for locating accurately the T.C. tips when brazing them onto the circular saw blades was also made and proved very useful for training and the repair of several blades including the 90-tooth blade mentioned earlier and the new blade entirely made in the Complex.

11.5 A cutter balancing stand was designed and made to train staff on this important aspect. Previously staff in the Complex were under the wrong impression that if cutters weighed the same they would be balanced. This is NOT necessarily so for it is possible to have two cutters weighing the same but of different shapes and therefore having centres of gravity in different places.

11.6 A list of items is shown in **APPENDIX 11**

12. UNIVERSAL TOOL AND CUTTER GRINDER TRAINING MANUAL

12.1 To write a training manual during a three month mission is quite a task when each day is taken up in the factory carrying out practical work, however it did help to fill in the evenings and weekends and was completed during the first month as far as the English text was concerned. In fact, some of the text was handed in for translation after the first two weeks. The traslation proved difficult and in the end **Mr. Cha Chol Ho**, the official interpreter for the expert worked evenings and weekends to get the work done which was completed by approximately the seventh week leaving a month for the drawings to be re-draughted and the manual printed.

12.2 **Mr. Hwang Se Yong** of the UNDP Office did a marvellous job of typing the English text and setting out the half page arrangement ready to receive the Korean text. He even got us out of trouble when the English printed words on the drawings proved difficult for the draughtswoman by setting the titles and information out on the computer in nice lettering so that the drawings could be stuck on to the ready printed sheets. It is nice to meet such talent in a situation where many things prove so difficult.

12.3 The draughtswoman who re-drew the expert's sketchs also did a very good job considering the poor equipment she had to work with. If more training manuals are needed in the future then a set of proper drawing pens and lettering stencils should be bought for the project's use. The up-grading of the technical drawing, the expert feels, is equally as useful a training aspect as the practical work.

APPENDIX 1

RECOMMENDED NEW MACHINERY AND EQUIPMENT

		Estimated Cost (U.S. Dollars)
1.	Lightweight Welding Equipment Complete	650
2.	Narrow Bandsaw Blade Butt Welding Machine and Shears	2,950
3.	Two Lightweight Angle Grinders with Discs	500
4.	Two Double Ended Bench Grinding Machine plus Wheels	560
5.	Diamond Dressing Tool and Stand for Tool and Cutter Grinder	150
6.	Precision Drill Chuck for Tool and Cutter Grinder	100
7.	Automatic C.S.B. Sharpening Machine Vollmer Cana/e	15,000
8.	Automatic W.B.B. Sharpening Machine Loroch JLMV	12,000
9.	Various Mandrels and Accessories for Japanese Tool and Cutter Grinder	800
10.	Dial Gauge with Magnetic Stand Reading in Metric	75
11.	Electric Engraving Tool with Tungsten Carbide Tip	40
12.	W.B.B. Swaging and Side Dressing Tools	1,000
13.	Bandsaw Machine Pulley Grinding Machine with Motorized Head	1,500
14.	W.B.B. Shears with 200mm Capacity	500
15.	Set of Four 75mm-Diameter Rubber or Nylon Swivelling Wheels for Welding Trolley	50
	T O T A L :	35,875

Note: First 6 items already requisitioned. Other items will need specifications if funds are approved.

APPENDIX 11

ANCILLARY EQUIPMENT MANUFACTURED IN THE COMPLEX

1. Tungsten Carbide Tip Brazing Jig
2. Circular Saw Blade Tensioning Anvil
3. Set of Tensioning Hammers
4. Set of Tensioning Straight Edges
5. Centre Height Gauge for New Tool & Cutter Grinder
6. Cutter Balancing Stand
7. Cutter Setting Stand 30mm Arbor
8. Grinding Wheel Arbor for Japanese Tool & Cutter Grinder
9. Reconditioned W.B.B. Tensioning Roller Machine
10. Wide Bandsaw Blade Welding Clamp
11. Wide Bandsaw Blade Swaging Vice