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**EXPERT SERVICES
IN SAW DOCTORING,
TIMBER PREFAB
TECHNOLOGY
AND CHIPBOARD
TECHNOLOGY,**

DP/SRL/73/020

SRI LANKA,

**Technical report:
FURNITURE DESIGN AND PRODUCTION**

**Prepared for the Government of Sri Lanka by the
United Nations Industrial Development Organization,
executing agency for the
United Nations Development Programme**



United Nations Industrial Development Organization

United Nations Development Programme

EXPERT SERVICES IN SAW DOCTORING, TIMBER PREFAB
TECHNOLOGY AND CHIPBOARD TECHNOLOGY

IP/SRL/73/020

SRI LANKA

Technical report: Furniture design and production

Prepared for the Government of Sri Lanka
by the United Nations Industrial Development Organization,
executing agency for the United Nations Development Programme

Based on the work of Desmond P. Cody, furniture technologist

United Nations Industrial Development Organization
Vienna, 1977

Explanatory notes

References to dollars (\$) are to United States dollars.

The monetary unit in Sri Lanka is the Rupee (SRs). During the period covered by the report, the value of the rupee in relation to the United States dollar was \$1 = SRs 8.80.

A full stop (.) is used to indicate decimals.

A comma (,) is used to distinguish thousands and millions.

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ABSTRACT

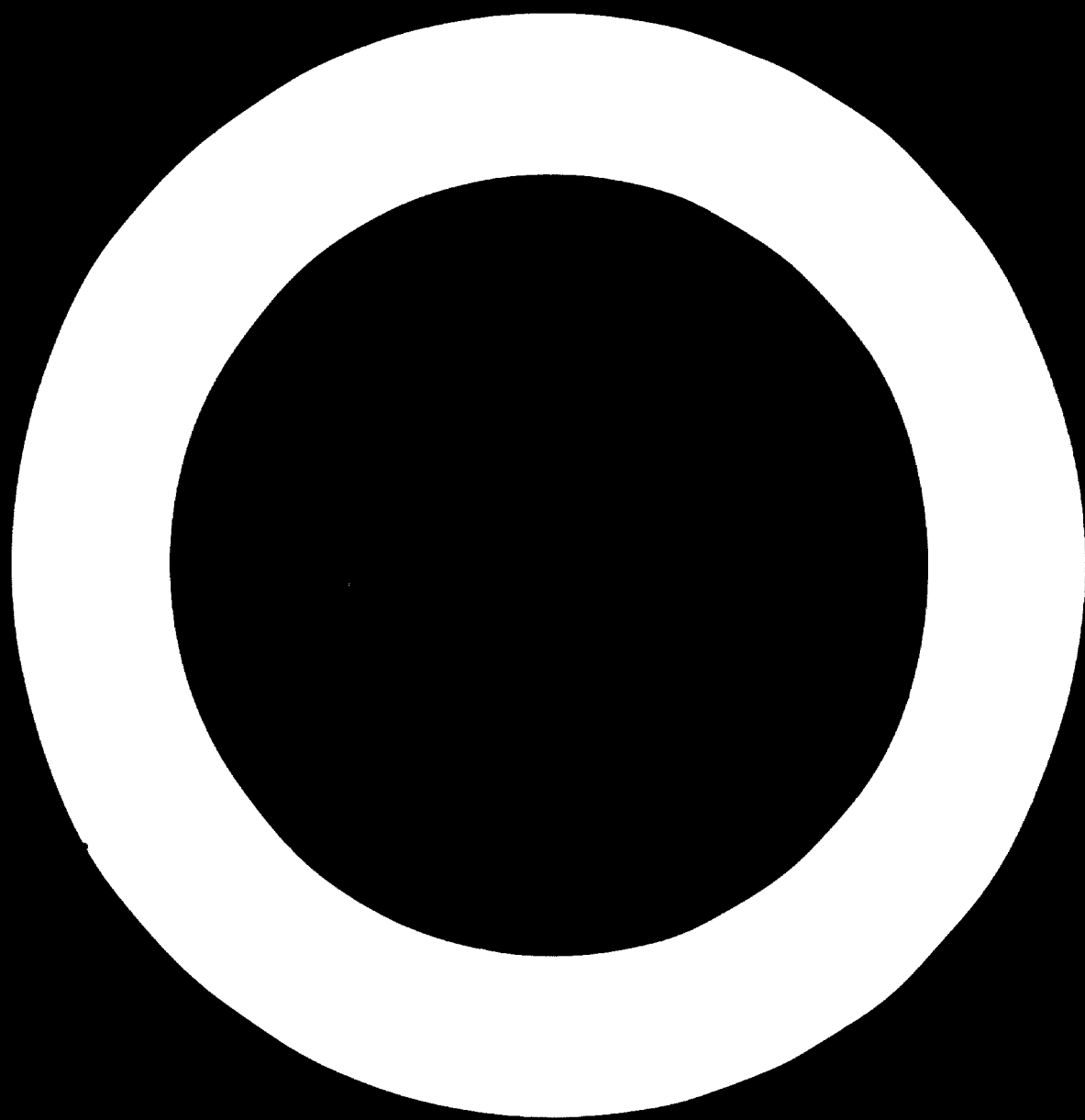
In response to a request by the Government of Sri Lanka to the United Nations Development Programme (UNDP), an expert in the design and production of furniture was sent on a six-month mission to advise the management of the Ceylon Plywoods Corporation on improving the design and production technology, on rationalizing production methods and on introducing new materials for use in domestic and contract furniture production. His assignment, which was part of the project entitled "Expert Services in Saw Doodoring, Timber Prefab Tehnology and Chipboard Tehnology" (DP/SRL/73/020) began on 3 September 1976 and ended on 2 April 1977. The United Nations Industrial Development Organization (UNIDO) was the exeouting agency. The government agency oo-ordinating the project was the Ministry of Industries and Soientific Affairs.

The chief objective of the mission was to identify the major shortoomings of the Corporation's furniture plant at Salawa, Kosgama, and to suggest how they could be rectified.^{1/} These shortoomings may be summarized as follows:

- (a) Absenoe of a produot polioy related to the speoifio needs of the Sri Lanka market and to the manufacturing potential of the various furniture plants under the aegis of the Corporation;
- (b) Low standard of design of the produots manufactured;
- (c) Continuous and severe shortages of essential raw materials and poor quality of those available;
- (d) Inadequate manufacturing faoilities and low levels of production technology;
- (e) Absenoe of suitable speoifioations and prooeedures for quality control;
- (f) Absenoe of an in-company training programme;
- (g) Inadequate prooeedures for production planning and oontrol;
- (h) Poor labour/management relations, resulting in ohronio absenteeism, bad timekeeping and general indisoipline;
- (i) Low levels of tehnioal and operative skills;
- (j) Low productivity;
- (k) Untrained and inexperienced management;
- (l) Laok of a good marketing polioy for Sri Lanka and for attracting export markets.

Each of these aspects is analysed in terms of the Corporation's needs, with empahsis on the requirements of both home and export markets.

^{1/} See also the technical reports "Specifications for domestic furniture production" (DP/ID/SER.A/91) and "Technology of furniture and joinery production" (DP/ID/SER.A/92).



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INTRODUCTION

The Ceylon Plywoods Corporation whose administration and sales headquarters are situated at 420, Bauddhaloka Mawatha, Colombo 7, has an integrated wood-working complex at Salawa, Kosgama, near Avissawella, 26 miles from Colombo. The complex, which was a turnkey operation, was designed and commissioned by a group of Romanian and Czechoslovak consultants. It comprises a sawmill, a particle board plant, a plywood plant and a furniture plant. Data on the Corporation's manufacturing activities are given in annex I.

The furniture plant, the reorganization and development of which are the subject of this report, was the particular responsibility of the Romanian consultants. It was planned in order to optimize the production of furniture and joinery manufactured from solid wood, veneered particle board and plywood for both the Sri Lanka and overseas markets. It has a nominal output capacity valued at SRs 12,000,000 per annum, but since its inception it has achieved little more than 25 per cent of this figure. Most of the processing equipment is of Romanian origin and its installation and commissioning were completed in 1971.

Subsequently, a Romanian production engineer and a technician started up the plant; this work included establishing a range of products, training the work-force, and achieving an acceptable level of productivity. Since August 1975 the plant has been operated by the Corporation's staff.

After a period of operation it became evident that further training was necessary, specifically in relation to product design and technology, productivity, production planning and control, quality control and management procedures, in order to achieve the level of output for which the plant was originally designed.

A formal request was made by the Government of Sri Lanka on 11 April 1973 to the United Nations Development Programme (UNDP) for the provision of technical advice and assistance for the Salawa complex, and the project "Expert Services in Saw Doctoring, Timber Prefab Technology and Chipboard Technology" (DP/SRL/73/020) was approved in October 1973. The assistance in furniture design and production began on 3 September 1976 and ended on 2 April 1977, after having been extended by one month. The United Nations Industrial Development Organization (UNIDO) was the executing agency. The Government agency co-ordinating the project was the Ministry of Industries. The expert's job description is given in annex II.

During a preliminary discussion which the expert had with senior officials of the Corporation at the outset, it was agreed to widen the scope of his assignment so that the Corporation's other furniture plants might benefit from his findings. Accordingly, he visited the other factories, assessed their manufacturing capacities and made recommendations with a view to integrating their production programme with the Corporation's furniture manufacturing activities as a whole.

It was also agreed to include among the expert's activities the training of design draughtsmen and training in the technology of furniture production, marketing and sales.^{1/} It was further decided to arrange a public exhibition of the new production range at Colombo before the end of the expert's stay, with the object of promoting sales and acquainting the public with the new designs.

A summary of the expert's major activities is given in annex III. The following personnel were concerned with the project: C. de Silva, initially engineer in wood technology and at present Plant Manager; H. Hm Jayasekera, Plant Manager, furniture factory; V. M. Allis, acting Production Manager; L. Abeywickrema, Senior Assistant Production Superintendent.

Also associated with the project were: G. Weeraratna, Chairman/Managing Director, Ceylon Plywoods Corporation, and E. M. P. Goonetilleke, General Manager, Ceylon Plywoods Corporation.

^{1/} See also the technical reports on "Specifications for domestic furniture production" (DP/ID/SER.A/91) and "Technology of furniture and joinery production" (DP/ID/SER.A/92).

I. FINDINGS

General observations

The furniture plant was commissioned by October 1973, and limited production began under the direction of a Romanian engineer assisted by a technician. Initial emphasis, apart from on-the-job training, was placed on the production of a range of office furniture intended for use by the various ministries and the other state corporations, school and domestic furniture, and flush doors and door frames.

The original contract for the establishment of the Complex, including the furniture plant, envisaged a period of training for selected personnel in Romanian woodworking factories, but this never took place. Consequently, all the training of line management and workers was carried out in the factory during the period when it was being directed by the Romanian consultants. Those who appear to have benefitted most from this training were workers who were engaged in prototype-making and product development of models introduced at that time, and the woodworking machinists who got a good grounding in machining operations. Much less attention was paid to the sections of the plant dealing with assembly, wood finishing and upholstery; the personnel in these sections have remained the least skilled in the work-force.

The experience of practically all managers, supervisors and workers in furniture making and joinery is confined to that obtained at Salawa. Most have never worked anywhere else, and their knowledge of the industry is therefore extremely limited. The Complex was intended to be self-sufficient in the sawmilling and kiln drying of timber as well as in the production of particle board, veneer and plywood for furniture and joinery and tea chests. Continued and increasing shortages in the supply of timber in log form have, however, created a stop-go situation which has done little to create the right tempo of production or to establish and maintain an acceptable level of productivity. The work-force, which is largely undisciplined, poorly trained and difficult to direct, is represented by six rival unions all of which appear to be highly sensitive to external as well as internal pressures. The Complex has had a history of disputes which have disrupted production, sometimes very seriously, and have led to a situation in which normal management/worker partnership no longer functions. Unhappily, the only evidence of integration is the solidarity of the workers in endeavouring to do as little work as they possibly can. Management is equally inactive in dealing with this situation.

At the root of the problem was the failure of management at the time the Complex was being established to introduce and maintain a code of operation and discipline that would have withstood the tests of time and the growth of the Complex. Furthermore, the Complex was directed mainly from the headquarters of the Corporation at Colombo, 26 miles away, and decisions were expected to be implemented by very junior and inexperienced management. It is not surprising, therefore, that the Complex never achieved genuine integration, which would have been an important and rewarding feature.

It may not, therefore, be unreasonable to ask if in the circumstances there is any real future for the Complex. The answer lies as much with the future of all the plants in the Complex because one cannot be regarded independently of the others. Elsewhere in this report the shortcomings of the furniture plant are highlighted, and recommendations are put forward on how they may best be overcome. These suggestions mainly concern matters over which the furniture plant should have control. Even if all the recommendations were successfully carried out, however, the furniture plant would still founder without the support of the sawmill, the plywood plant and the particle-board plant. The three latter plants must themselves operate and be managed as efficiently as the furniture plant ought to be managed for the Complex to achieve an integrated character.

In attempting then to deal with the problems of the furniture plant, the wider implications of the Complex as a whole must naturally be taken into consideration. For example, there is little point in attempting to introduce and maintain a code of discipline in the furniture plant and at the same time to ignore an identical need in the sawmill or plywood plant. This observation would also apply in the case of quality control, in-plant training, productivity, incentive bonus schemes, and almost all management procedures. Significantly, there appear to be no problems of interplant communication among workers when trade disputes threaten, but there is often a disastrous lack of it when there is a uniform intervention on the part of management.

It should be emphasized, nevertheless, that there was nothing fundamentally wrong in the original planning of the Complex; its suitability with regard to the current level of industrial consciousness in Sri Lanka, however, remains very much open to question. This approach to woodwork manufacturing is regarded, even in fully developed economies, as one of the best possible solutions to the present-day development of the industry. With a few exceptions,

the Complex has all the manufacturing facilities needed for efficient and profitable performance. What it lacks are clear-out policies governing its modus operandi and management with the professional approach to carry them out.

Product design

It is apparent that little planning went into the existing ranges of furniture models. They are extremely limited in scope, and in most other ways they reflect the absence of a product policy. Each item seems to have been produced on an ad hoc basis, as the need arose. The importance, for example, of developing in the designs a clearly discernible and interlinking set of characteristics seems either to have been ignored or considered unimportant. At all events, the models themselves bear little relationship to the principles of good design or to the precise needs of the market for which they are produced.

It is important, therefore, at the outset to define what is meant by design in relation to furniture. The elements that go into planning design are the production facilities of the plant, the skills of its work-force, an understanding of the nature and characteristics of the materials used, the form and colour of the article, its tactile beauty, its fitness for the purpose, and its acceptability to the consuming public. The result of ignoring the plant's production facilities and the skills, or lack of them, of the workers is plain to see, for example, in the existing range of office desking. This range is standard and is produced in varying dimensions and large batch sizes. All desks have veneered and edge-lipped particle-board gables, or ends, whose upper corners are radiused. By the simple expedient of leaving these corners square, at least six difficult processes would be disposed of, and production would be eased considerably without taking appreciably from the appearance or the function of the desk. (See annex VI.)

Present-day production, depending as it does in large measure on prefabricated materials, has tended to remove both management and worker from an intimate knowledge of the materials used. While this undoubtedly has facilitated production in quantity, it has resulted in a loss of understanding of the qualities of the materials and their scope in design. For example, in the manufacture of cabinet goods - wardrobes, dressing tables, storage units etc. - veneered particle board and plywood have largely replaced solid wood. These are excellent materials in their own right, but the method of their

treatment must differ fundamentally from that of treating traditional materials. Otherwise, the resultant piece of furniture will be a failure. In fitness for purpose, not only the Corporation's range of furniture, but also nearly all furniture produced by other manufacturers in Sri Lanka cannot be rated highly. Obviously, no one has undertaken the research to discover exactly the consumer needs in furniture.

The remedy, therefore, is to raise the general standard of design. As there are no trained furniture designers in Sri Lanka, however, nor any facilities for training designers, the provision of such facilities, even immediately, could hardly produce substantial results in less than a decade. It is thus all the more urgent that the problem be tackled now. The Corporation should request the co-operation and assistance of the appropriate ministry.

In the meantime, there exists a basis for improving the situation in the short and medium term, by continuing to rely on outside technical assistance in the fields of design and technology. Admittedly, most of the efforts must continue to be short term in improving the basic manufacturing techniques, as a precondition to undertaking more ambitious functions. In Salawa there are good draughting facilities and while they should never be confused with design, it would be possible to incorporate some element of design expertise into them. The senior draughtsman would benefit enormously, in this respect, by attendance at an appropriate furniture design course abroad, preferably in the United Kingdom where excellent courses are given in colleges like the London College of Furniture and the High Wycombe College of Further Education.

There are also good prototyping and product-development facilities at Salawa, but they are badly hampered by lack of working space and other poor working conditions. A special area should therefore be set aside as a new prototype and product development workshop, which should have all the facilities necessary for this work. Alongside it the design and drawing office should be relocated, so that the two could work hand in hand in developing new designs and in preparing the various production aids for their successful manufacture. When the new workshop and drawing office are fully equipped and organized, they should be able to provide not only for the needs at Salawa, but also for those of the other factories and workshops owned by the Corporation.

As a further short-term means of solving its design problem, the Corporation should consider the negotiation of licensing arrangements with foreign

manufacturers. Such arrangements can offer many advantages in terms of technical know-how in addition to a well-developed product or product range. The same basic criteria must, however, be applied in assessing the prospects for a licensing arrangement as in analysing alternative product development strategies. These criteria should include production costs, likely sales, future competition and profit projections. At the same time, it must be stressed that the arrangement should be regarded only as a short-term expedient; it is no real substitute for soundly based and developed home design.

Annex VI provides details of the design ranges which were developed and produced during the current project. They conform to the criteria outlined in previous paragraphs and were manufactured almost totally from raw materials produced in the other plants in the Complex. Other considerations included common structural elements and processes, interchangeability of components and uniform standards of quality and performance. The expert wishes to stress, however, that this range should be regarded as the first of a number of design-integrated systems, which as they are being developed will reflect accurately an anticipated growth in skills and expertise in the plant.

Raw materials

In 1975, raw materials for the Complex as a whole accounted for over 70 per cent of the total cost of production of furniture and joinery, and are therefore of paramount importance in both design and production considerations. The major problems experienced by the plant concerned suitability, availability and quality, particularly in relation to the supply of veneers, particle board, plywood and solid wood. There is no shortage of materials specifications since an almost over-elaborate system of quality control is in operation. This does not prevent the supply of substandard materials much of which are rejected at far too late a stage in the production cycle.

Of a more serious nature, however, is the problem of supply which has bedevilled not only the furniture plant, but the Complex as a whole since its commencement. Whatever the system operated by the central supplies office in Colombo, it is patently inadequate to the needs of the Complex. For one thing, such long-distance control could not possibly efficiently provide a manufacturing series of units which between them consume 600,000 cubic feet of timber annually. For another, it is evident that a supply system operated from outside the Complex cannot be expected either to anticipate or to deal promptly with the problems that arise daily because of the nature of the raw materials.

The only real solution would be to ensure that the supply of vital raw materials shall be within the competence and under the direct control of the Complex itself. One individual with the necessary experience and qualifications should take over this responsibility, and he should be provided with whatever facilities are necessary to carry it out effectively. He should organize and plan incoming supplies so that at least two months of buffer stocks are permanently maintained. He should establish a proper inspection system at the point of entry and ensure that timber during subsequent storage, air-drying, and conversion shall not suffer from degradation or deterioration. For example, a vast amount of wastage occurs annually because suitable sheds are not available for storage during air-drying. He should provide liaison between the various plants within the Complex and ensure that supplies not only of raw timber, but also of particle board, plywood, door skins etc. shall always be available well in advance of their use. The individual plants should co-operate by keeping him informed of their needs, and the managers, together with the supplies manager, should meet at least weekly to review and to co-ordinate their material requisition programmes. The commercial management should remember that there is never any justification for a plant slow-down, and that in the absence of a directive from them, the local manager must be free to decide for himself how best to convert timber dimensionally rather than to allow his plant to be idle. Supplies of other raw materials such as adhesives and surface coatings are satisfactory, but it is important that the technical representatives of the manufacturers of these materials should visit the plant frequently in order to ensure trouble-free use and to keep the management informed of new technical developments.

There remains the question of furniture fittings and accessories. Those currently available in Sri Lanka are totally unsuited to the production and quality standards required of modern furniture, and their use should be discontinued. Suitable fittings must be imported, and since they are essential items of production, they should not be subject to import restrictions or excessive tariffs. To enhance the plant's potential for exports it is even more imperative to obtain suitable fittings. If the Corporation does not have access to the same sources and quality of fittings as its competitors abroad, it is unlikely that it will make an impact on overseas markets.

The technical report "Technology of furniture and joinery production" (DP/ID/SER.A/92) gives some details of raw materials used in the furniture industry. Included are illustrations, technical information and the names of manufacturers of current ranges of furniture fittings.

Production

Productivity in the furniture plant, by any standards, is abysmally low, and is matched to a greater or lesser extent by that in the other plants in the Complex. (See annex I.) Output per worker does not cover the basic costs of production and should be increased tenfold before the current level of investment in the plant would be justified. This is not meant to suggest that workers are expected to work ten times as hard, although far greater effort on their part would certainly be necessary. Of greater importance is the extent to which all the production facilities of the plant, i.e. buildings, machinery and equipment, and skills, are exploited. The ways in which personnel are expected to contribute are discussed later in this chapter. The technical aspects of production and productivity are dealt with here.

Buildings

The Salawa furniture plant is housed in a building which was specifically designed for that purpose. It is spacious and has been kept in good repair. Some modifications were necessary in the layout of machinery and equipment, but generally it conforms well to the principles of good work flow and efficient use of space. There is, however, a serious problem regarding through ventilation which causes the atmosphere to remain humid and oppressive with resultant debilitating effects on the work-force. Considerably more effort than usual is required for most kinds of work. Such conditions are unnecessarily tiring, and the building section of the Corporation should investigate and remedy this condition which also exists in the other plants of the Complex.

Lighting throughout the plant is unsatisfactory. The result is a gloomy and depressing interior which tends to diminish alertness and concentration. On the other hand, when the lighting is adequate, the surroundings immediately become more cheerful, pleasant and conducive to work. The nature of the work generally determines the intensity of the light that is needed; in the case of furniture manufacturing this is quite considerable. In particular, it applies to woodworking machines because the machinist must have an immediate and full appreciation of the nature of the timber so that he can adjust the feed to obtain smooth cutting. When the direction of the cut is not predetermined by a fence or jig, he must be able to control the workpiece easily and accurately to follow the desired line.

At present there is no natural lighting in the plant. This is a pity since Sri Lanka enjoys a very high and consistent level of natural lighting.

All that is required is to replace about 10 per cent of the roofing sheets by sheets of transparent plastic material similarly corrugated. The result would be adequate and uniform natural lighting which would cut costs and would not be subject to the frequent power failures which occur in the area. A further help would be to whiten the interior walls and to clean regularly the lighting fittings. Apart from considerations of productivity and quality control inherent in a good lighting system, there is also the matter of safety. The present system uses fluorescent tubes and care should therefore be taken to avoid the stroboscopic effects associated with this lighting, particularly when it is used to illuminate fast-running machines. This illumination is intermittent and coincides with the peaks of the voltage waves. While the fluctuations are far too rapid to be visible to the human eye, they may correspond to, or even be sub-multiples of, high-speed cutter revolutions. If the fluctuations correspond with the cutter revolutions, the cutter will be seen in the same position at each periodic illumination and will appear to be stationary even when running at full speed. If the fluctuations do not correspond exactly with the speed of revolution, the cutter will appear to be travelling very slowly either in a forward or reverse direction. Router cutters revolve at very high speeds (18,000 - 24,000 r.p.m.) and 80,000 circular saw teeth may pass a fixed spot in a minute; a stroboscopic effect will occur when running up to speed or when slowing down, whenever the speed is an exact multiple of the lighting fluctuations. This effect can be prevented by dividing the discharge lamps between the different phases of the supply, or by using incandescent lamps in combination with discharge lamps.

"Shadow line" lighting should be used to indicate the line of the cut on circular and band saws. A filament is stretched below a light source and casts a fine shadow on the workpiece or the table of the machine to coincide with the line of the cut and thus guide the machinist, even though the cutting point is hidden.

Machinery and equipment

The machinery and equipment available for furniture production is, in the main, adequate to immediate needs. Much of it is Romanian in origin and this poses considerable problems in the supply of spares and special tools. There are some notable exceptions, amounting in all to about six machines, and these for one reason or another have never been used. One, for example a curtain-coating machine, was manufactured in Italy and it was thought at

the start of the project that it could be used in conjunction with the finishing system. There was no literature available on the operation of the machine so that the Italian manufacturers were requested to provide the relevant technical information and operating manual. In their reply the manufacturers stated that they no longer manufactured curtain-coating machines, and in fact they had not produced a model similar to the one in the plant in over 10 years. The finishing system subsequently developed during the project did not involve the use of this machine.

Despite the fact that all the machines required for wood processing are available, the capacity of some is extremely limited. Even before the expected increase in productivity, they pose serious bottle-necks in the production cycle, in particular the group of edge-veneering and edge-lipping machines which are operated on either a low-voltage or radio-frequency system. All veneered and edge-treated panels must be processed at these machines, and even though there are four of them and they are in continuous operation, they are a constant source of disruption and delay to the work-flow. Furthermore, the heating coils, or elements, for these machines must be supplied from Romania or be made laboriously by hand in the Complex workshops. The machines are operated manually, handle only one process, namely the setting under pressure of the adhesive used, and require three operators per machine.

Annex IV, item 7, gives an outline specification for a single-sided edge-banding machine now commonly used by the industry. This machine will not only set the adhesive, but it will also end-trim and edge-sand all in one pass. No more than two operators are required, and it has a capacity far in excess of the combined capacities of the four machines which it should replace.

Observations of a similar nature apply in the case of the other machines listed in the annex. For example, successful volume and varied production of dining-room chairs are related to items 1, 5 and 6, while the speedy and accurate production of cabinet furniture will need augmentation of the present multiple-boring machine by item 2. Good veneer-jointing facilities do not exist; hence the inclusion of item 3. Finally, an essential additional purchase is item 4, not only for accurate sanding of flat components, but of even greater importance for calibration of particle board so that it has uniformity of thickness throughout its plane before flat veneering.

Mention was made earlier of some redundant machines which include a hydraulic pendulum saw (1-M1A), a bandsaw (12-M5A), a knot remover (19-M7A),

a surface-planer (24-M80), a lock mortiser (32-M5A), a chain mortiser (48-M21A), a belt sanding machine (90-M46) and at least two of the L.V. edge-banding presses. These machines, as they are no longer of value to the Corporation, could be used in part payment for the machines recommended. The prices quoted are for new machines and would be reduced by about one half in the event of the purchase of guaranteed reconditioned machines.

An essential adjunct to the efficient and accurate use of machines is the development of appropriate gauges, jigs and formers. These should be designed and made up at the product development stage and should be the result of the combined expertise of the draughtsman and prototype makers. The new design programme has provided an opportunity to develop many of these.

The attention of management is also drawn to the recommendations regarding the efficient machining operations, assembling and finishing, which are contained in DP/ID/SER.A/92.

Assembly procedures

Some additional observations are called for in the assembly section since it has proved to be the most recalcitrant and therefore the most difficult part of the plant to organize and to make more productive. Comment has already been made about the little attention that had been paid to this section in the past, and about the consequences of that omission. The workers are literally work-shy and respond indifferently to both demonstration and direction. They need not only to be trained, but also to be supervised so that gradually, and possibly over a prolonged period, their morale, which is now low, would be improved and they would regain interest in, if not enthusiasm for, their work.

A start has already been made by providing them with the basic requisites of their trade, namely hand tools, work benches with vices and job platforms. Work should be planned for them so that they have no excuse to be idle, and however long it takes, they should learn to become craft workers with a natural feel for wood and an appreciation of the importance in their work of attention to detail. Management must not only give, but be seen to give, particular attention to this section. It is by far the weakest link in the whole chain of production, but it is just as essential as the others.

Management

General

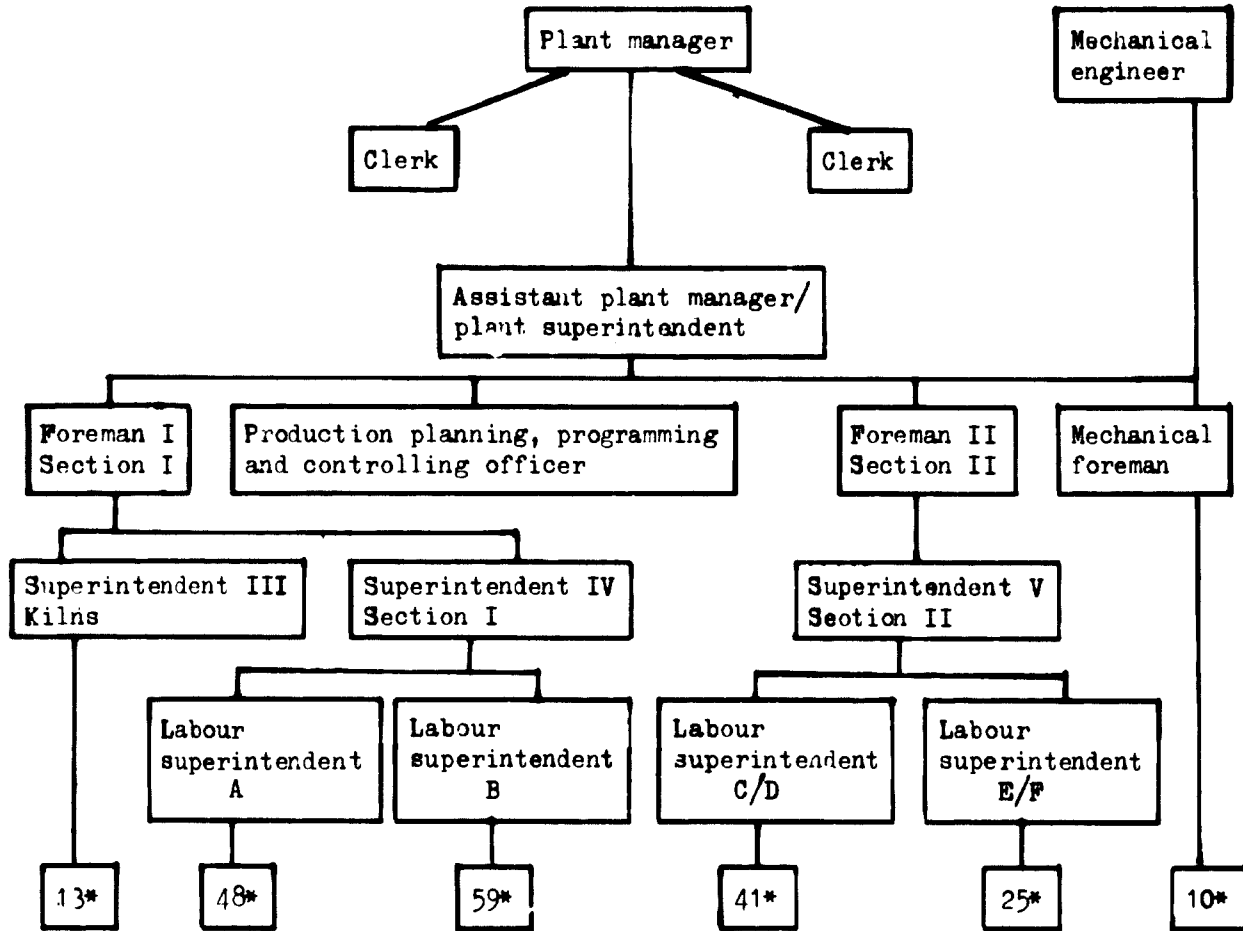
The existing management structure illustrated in the organization chart indicates the various levels of line management in operation. This conforms to the requirements of a plant of this size and does not need to be altered appreciably.

The quality of the management has been weighed against the task set it in making both the furniture plant and the Complex as a whole efficient and profitable. This, as in any management situation, requires an acceptable level of expertise in the fields of administration, finance, production, personnel and supervision.

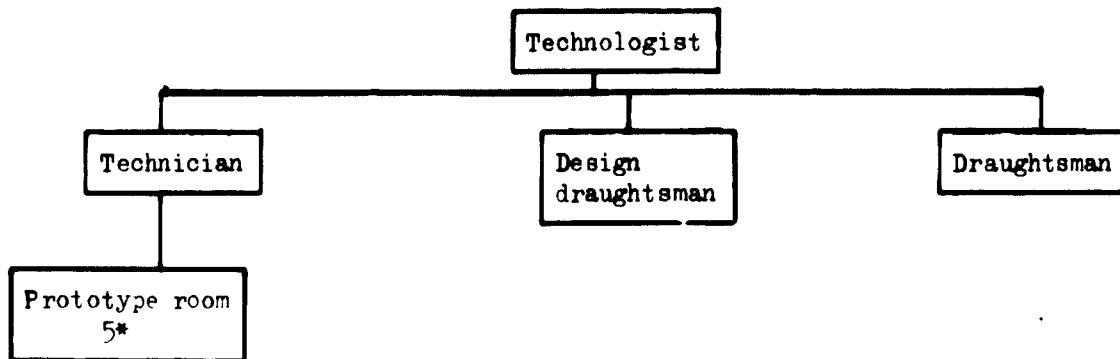
At any rate, the general manager of the Complex, the production manager and the various plant managers have the right kind of academic qualifications on which to build good management skills. They are all, however, young and inexperienced. The average age is 32 and none have worked anywhere else. Some have received additional technical training abroad, but only one has been trained specifically in the production of furniture and joinery. None had received any management training prior to taking up an assignment in the Complex, and few have received further training. It is not surprising, therefore, that they lack the management techniques, technical knowledge, and in the case of the furniture plant, the aesthetic training needed if the plant is to fulfil its purpose satisfactorily. This reflects the attitude of top management towards management at the local level, that the latter is apparently expected on appointment to be practically inspired to lead and to direct without any preparation or training whatsoever. Only in very exceptional circumstances does this approach prove workable and the situation in Salawa is clearly not one of them.

While making allowances for the special difficulties associated with the establishment of the Complex, the expert feels that most of its present ills can be laid at its own doorstep, and that these deficiencies can in the main be traced to poor management. Furthermore, the primary responsibility for improving the situation rests with the Corporation, which should act before the situation deteriorates to a stage beyond redemption. What is called for, initially, is a reappraisal of the whole management structure and function not only at Salawa but throughout the entire Corporation, and the creation of a framework around which all management policy, including

Figure I. Organization chart - Furniture factory
Production staff



Technological department



* Number of workers

- Key:**
- A. Timber Processing Section
 - B. Veneer/Plywood/Chipboard Processing Section
 - C. Sanding Section
 - D. Lacquering and Polishing Section
 - E. Assembling Section
 - F. Upholstery Section

job specifications, function, responsibility, performance and training, would be uniformly built. It may well be necessary to obtain outside assistance in this task, but there is no doubt that its successful outcome would avoid repetition of the mismanagement of the past.

In the meantime, there exists a basis for improving the situation at the furniture plant in the short and medium term. The plant manager and most of his supervisory staff have much of the background and the potential to become effective managers. As regards the current project, they have shown a remarkable willingness to learn, and they co-operated fully with the expert in seeking to achieve its objectives. The project itself was designed to make use of most management techniques associated with the successful running of a furniture plant and these are now standard practice.

Production planning and control

Chief among the techniques of production planning and control is the establishment of the principle of setting specific and periodic performance or output objectives, the achievement of which could be monitored daily. This would automatically take account of all production-planning procedures including product design, preparation of working drawings and specifications, batch sizes, raw materials availability, gearing up of all production facilities, work load, quality control and costing. A card concerned with the time measurement of every process or operation is in use so that in conjunction with a materials specification card, information will be automatically available to provide realistic costing information and to measure production performance. In this connection, it will be necessary for the accounts section to assist in monitoring output by continuing to provide such financial information as unit costs for materials, hourly rates per grade of worker, overhead rate, break-even point for the plant and profit projections. It will also be necessary to provide management with further training in these procedures, possibly with the assistance of the National Institute of Management. In particular, they should be given a thorough grounding in the financial implications of running a plant of this nature, and of its relevance to productivity.

Technical control

Management is felt to be weakest in the area of technology, and this is probably one of the reasons why supervision is so ineffective. In giving technical or other directions to workers the supervisor should indicate his

conviction that such procedures are appropriate and relevant. Any hesitancy on his part is quickly detected by the worker who, if he wishes, may turn the situation to his own advantage. Chief among the causes for this lack of technology lies in the absence of a training policy from the inception of the Complex. It was then virgin territory without any tradition in manufacturing, much less in furniture production. Therefore, careful development with appropriate instruction and demonstration was required. Only one supervisor had received the right kind of technical training and, oddly enough, he was relegated to a very minor role in the management of the factory. This obviously scarce talent should not be dissipated in this manner, and this man, who is at present occupying a position as foreman, should immediately be appointed to the position of assistant manager with special responsibility for production. His special knowledge would enable him not only to supervise every aspect of production, but also to pursue and check on progress with authority. The capabilities of the remaining management personnel should be reassessed as already suggested, their deficiency in technology made good by further training, and at least two of them should be removed from supervisory posts for which they are clearly unsuited.

The nature of the training required should be related to the following:

- (a) Furniture plant layout and design. Problems in industrial plant design as applied to furniture manufacturing, building structures, equipment location, space utilization, power utilization, light, heat, ventilation, and safety are among the subjects covered as well as materials handling and maintenance;
- (b) Woodworking equipment. Study of production woodworking equipment for cutting, shaping, sanding, veneering and assembly operations; capabilities and limitations of machines; theory and practice of cutting and sanding wood; low-cost mechanization; pneumatics, electrical and hydraulics;
- (c) Wood processes. Processes of drying, gluing and finishing wood; reconstituting wood as fibreboard, hardboard and particle board;
- (d) Engineering economy. Study of criteria and techniques for management decisions in relation to economy of design, selection and operation; effects of depreciation policies and machine replacement;
- (e) Furniture design and construction. Detailed drawings and bills of materials from samples and designers' sketches. In construction, emphasis is placed on good performance under variable atmospheric moisture, on adequate strength and rigidity, and on low cost;
- (f) Furniture manufacturing and processing. Study of production methods in the furniture industry, including production procedures from the yard through all operations, and shipping;
- (g) Manufacturing controls. Development of principles and procedures for control of materials, manpower and costs, with special attention to production and inventory control, equipment utilization, wage classification and cost reduction programmes;

(h) Quality control. Economic balance between cost of quality and value of quality; statistical theory and analyses as applied to sampling, control charts, tolerance determination, acceptance procedures and control of production.

Technical information

The other remaining and urgent need is for the provision of a good technical information system, which would enable management to remain abreast of technical and other developments in the industry. This could best be done by establishing a small technical information centre at the Complex, by furnishing it with appropriate books, journals and publications and by making this material available to the management and supervisory staff. Annex V provides a list of publications which are readily available at low cost and which could form the basis for this requirement.

Supervision

Many references have already been made to the need for informed and sustained supervision of the work-force. In the case of Salawa, this is a particular requisite for good productivity, and there is no substitute for it. Again it requires training in human relations, work allocation and quality control. Above all, it calls for personal qualities of leadership and integrity which alone will win and sustain the respect and loyalty of the workers, and encourage them to learn and to do their best. It should be manifest in fairmindedness and a meticulous observance of the regulations of the plant, whether these are concerned with discipline, punctuality or productivity. Procedures for the effective supervision of each section of the plant are given in DP/ID/SER.A/92.

Labour

Labour relations in the Complex are not harmonious. There is a long history of differences between some of the unions concerned and an equally long history of differences between the Corporation management and the unions which have taken the form of strikes, go-slows, lock-outs and restrictive practices. One of the chief difficulties on the Corporation's side has been that very often it has had to negotiate with separate unions and even if it reached agreement with all six unions, this agreement might subsequently be repudiated by one or more individual unions.

Many such agreements have also been negotiated too hastily and without the proper research or testing period, and have later proved disastrous, thus adding further to the differences. A particularly painful example is the current incentive bonus scheme which becomes absurd when, as result, workers can achieve the bonus without the concomitant output. On the workers' side, it is evident that they do not fully appreciate that by their persistent lack of co-operation they are harming themselves since no manufacturing organization can sustain indefinitely constant and often unnecessary disruptions, which ultimately are reflected in continued and severe losses.

Even if the patience of the long-suffering home market does not wear thin, there can be no doubt that such tactics will not be appreciated in export markets where delivery schedules will be expected to be fully adhered to and non-conformity with these schedules will lead to cancellations.

It is essential for the progressive development of the Complex that this situation be resolved as speedily as possible. Management must reappraise its whole approach to labour relations and ensure that all future negotiations shall be carried out against a background of well-informed opinion about the immediate issues. It is particularly important that procedures for dealing with potential troubles be established and adhered to so that confrontations will be avoided at all costs. The formation of works committees, made up of representatives of management and unions and meeting frequently, would do much towards anticipating and dealing with probable areas of complaint and disagreement.

It may be Utopian to suggest that a single union could look after the interests of all the workers but there is no question that the number of unions involved could be reduced with advantage to all. At all events, it is necessary to impress upon both management and the unions that the Corporation has reached a crossroads; whatever path it takes from now on it is on its own. Elsewhere in this report recommendations are made which will, if followed, point the way to expansion and prosperity for the Corporation. The persistence by both management and labour in attitudes that are relevant only to the past can do the Corporation nothing but harm; there is a good chance that it could frustrate many of the recommendations. A new approach to labour relations is overdue and will be essential if the Corporation is to develop.

Training

Throughout this report, stress is laid repeatedly on the need for training if the efficiency of the work-force is to be raised to an acceptable standard. Training is an essential tool of management which if planned and implemented systematically can reduce labour turnover, improve output and quality, reduce wastage, lower the number of accidents and improve morale and job satisfaction. Furthermore, use of the right method can reduce learning times dramatically, enabling workers to improve earnings and increasing production capacity.

Training should be based on the commercial needs of the Corporation, thus helping it to become more efficient and profitable. This means that its overall effectiveness must be appraised and plans made for the future. To make these appraisals and planning processes more effective, it will be necessary to define specifically those areas in which effort must be concentrated. These may include finance and profitability, labour productivity, marketing and sales. In this way training is linked closely to the whole business process. If it is to pay off, the Corporation must ask itself:

How well do we perform?

What are our main areas of weakness?

How well equipped are we to carry out our plans and achieve our targets?

Only then can it ask:

What training should we give individuals to carry out our plans and achieve our targets?

The first and essential stage in the establishment of a training programme is the appointment of a full-time training officer. The man chosen must have the qualifications and background experience to carry out training within the Corporation effectively. Ideally, he will be found among the existing personnel, and since his task will be exacting, he will need to receive appropriate training himself. Excellent courses for training officers exist particularly in England where they are organized by the Furniture and Timber Industry Training Board. The course, which usually lasts for about three months, includes sawmilling and the production of particle board, plywood, furniture and joinery. The training officer will then identify precisely the training needs of the Corporation, draw up a training programme and supervise its implementation. What has to be taught will be found by comparing what the employees need to know for effective performance and the knowledge of the job they are likely to possess as potential trainees.

The basic steps of a training programme would be:

- (a) To describe the job, what it is and why it is done (job description);
- (b) To break the job down into suitable items of content for the purposes of instruction (job analysis);
- (c) To define the standards to be reached in each element of the job. At this stage a statement of the knowledge and skills required can be prepared (job specifications);
- (d) To prepare a detailed statement of what the trainee is to be taught and how (syllabus) by making a comparison between this specification and the existing knowledge and skills of the trainee;
- (e) To gauge the time required to cover each part of the syllabus;
- (f) To prepare a logical and progressive timetable;
- (g) To prepare the lesson plans.

At this stage the instructor is ready to teach his trainees and to maintain records of their progress.

Quality control

General

The quality of a product may be defined as the sum total of that product's essential characteristics which determine its degree of suitability for a concrete purpose. The quality programme of any manufacturing organization should extend into every contributing function of the organization; the quality of the efforts of each function should become part of measurable administrative entities.

Within this framework, the role of the quality control section of the Corporation is to provide and co-ordinate a system which ensures that it will produce an optimum quality product at minimum product cost. The responsibilities of those charged with quality control are to define, plan, co-ordinate and measure the quality efforts of the Corporation, as well as to perform those activities normally associated with quality control. Quality itself cannot be ensured by inspecting a product, but should be designed and built into it. Quality control entails not only inspection or testing for the acceptance or rejection of parts; it is also concerned with the provision of rapid, accurate and usable information about product and process quality which would give guidance for process control and control of product quality.

Quality control is effective if it is exercised in conjunction with standard specifications that apply to every aspect of the product. These standard specifications are now recognized internationally and are applied uniformly. Their application in terms of quality nearly always proves the decisive factor in successful export.

Quality control at Salawa

There are 21 people engaged in quality control in the Complex of which 5 work in the furniture plant. Most of them were initially employed as laboratory attendants and were subsequently promoted to become quality control officers. Only those working in the plywood plant received training in quality control and this consisted of six lectures over a period of three weeks. The most senior quality control and research officer attended a quality-control training course sponsored by UNIDO and held in Sweden in 1976.

Judged by the standard of the end product, the system of quality control cannot be called effective. Furthermore, it is difficult to see how the situation could be otherwise, since most of the personnel exercising it are themselves unaware of what it really means. In the furniture plant, for example, so many evident lapses of quality escape the notice not only of the quality controller, but also of the production supervisors and workers, that it is hard to escape the conclusion that there is no alternative to discontinuing the system altogether. At all events, it should be thoroughly overhauled and should not be reintroduced until it is capable of achieving the purposes for which it was intended.

The technical report on "Specifications for domestic furniture production" (DP/ID/SER.A/91) contains standard specifications which should be applied throughout the plant. Before being introduced, however, it should be studied and be fully understood by all quality control personnel. They should also realize that over and above the specifications laid down in the standards a sense of quality is required, especially for furniture, which might best be described in practice as complete attention to detail. This cannot be attained overnight; it will come only after many months and perhaps years of interest and application.

Those responsible should also realize that quality control begins and ends with the worker, whose responsibility to exercise it in terms of his craft cannot be transferred elsewhere. They should discontinue the futile practice of peering over a worker's shoulder while he is doing his job. Unless the latter is totally insensitive, which is unlikely, it will have the opposite effect to the one intended. At best, it will make him nervous and awkward and, at worst, resentful. Either way quality suffers.

It should also be remembered that quality control is best carried out in a well-organized and well-disciplined plant where everyone makes the right kind of contribution whether he is a cleaner or a production manager. It should be uniform and consistent in character because standards which fluctuate from time to time, whether in terms of raw materials, processes or finished goods, are no longer standards but further manifestations of poor management.

Marketing

It is one thing to produce furniture efficiently and profitably and quite another to market and sell it. As for the production of good design, an important condition is the acceptability of the product to the consumer. Therefore, ideally much of the marketing in the sense of identifying consumer trends and preferences should have been completed before the design is put into full production. In this way guesswork, inspired or otherwise, is avoided and the financial risk involved in the development of a new product is reduced to a minimum. There is still, however, much to be done before the agreed sales targets are achieved and maintained.

With regard to the Corporation's activities in this field, expertise, particularly in relation to marketing management, is lacking and little attempt is made to create a dynamic and aggressive marketing policy. Perhaps ambition in this direction has been dulled because of the Corporation's well-earned reputation for tardiness in delivery and in dealing with consumer complaints. Whatever the reason, it should in future ensure that its selling and promotional techniques are updated to the point where they match those of potential competitors abroad.

Market planning, the definition of the market segment at which the Corporation's products are directed, the establishment of sales targets, more investment in quality sales literature, sales representation, point-of-sale display material and brand advertising are all areas in which the products must compete effectively. In addition, the Corporation should promote an image of good-quality Sri Lankan furniture and joinery on the home market.

There is little doubt that the Salawa plant has the potential of exporting furniture successfully provided it manufactures on the basis of design and quality. However, the precise nature of the products to be sold in any given market can only be ascertained from an analysis of the market itself. This analysis would disclose such important considerations as living standards and conditions, climate, consumer preferences, price trends and competitor

information. In general, the products must be manufactured with at least the same types of raw materials as those available to competitors, particularly in relation to timber, plywood and particle board, adhesives, lacquers and furniture fittings.

Again the need for training is paramount if the required degree of professionalism in marketing is to be achieved. The expert has been informed that special training courses for those engaged in marketing and selling are being conducted by the Export Promotion Secretariat of the Ministry of Planning and Economic Affairs. Corporation personnel engaged in this function should participate in these courses.

With regard to the development of a satisfactory marketing policy, the following factors should be taken into consideration:

1. Nature of the market of Sri Lanka (all sectors)

Growth rate in past 10 years

Per capita consumption of furniture

Consumption of other consumer durables (e.g., radios, domestic electrical equipment, automobiles etc.)

Special characteristics of market

Retail selling: types of outlet, promotion, pricing structure, mark up by retailers, stocking, promotion of imported furniture

Future markets: changes or improvements in consumer tastes

Marketing management

Sales promotion

Advertising

Furniture fairs

Service/delivering

Direct selling

Factory showrooms

Market planning and distribution

Import competition

Co-operation in the industry

2. Considerations for Ceylon Plywoods Corporation

(a) The product

Trends in sales volume

Competition advantages

Gross margins per product/model

Completeness of line
Price structure
Product classification
Quality
Design and styling
Identification

(b) The market

Data on present customers: who buys, location, volume of sales for each, profitability, size of orders, method of delivery
Seasonal or cyclical characteristics
Market potentials: determination of sales volume by product, territory and customer
Customer purchasing habits and buying preferences (field surveys)
Competitive activity
Technical advance (affecting demand)

(c) Distribution

Selection and training of salesmen
Selection of channels of distribution and methods of sale
Determination of sales quotas per product per customer per salesman
Routing of salesman/sales territories
Advertising and sales promotion
Salesman's compensation (incentives)
Price policies
Other sales policies including those regarding returns and allowances, entertainment, use of corporation cars, terms of sales, hire purchase and direct selling
Distribution costs: by salesmen and territories, by product, costs per call; delivery equalization per area: by functions such as storage handling, credit and collections, packagings, order handling

II. CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Plant facilities

1. All the furniture manufacturing activities located at the Corporation's Woodworking Complex at Salawa are housed in good buildings which were planned and laid out for that purpose.

(a) All working and storage areas are artificially lighted, but since about 50 per cent of the light fittings are usually out of order, the level of illumination is far below that required for furniture manufacturing. Ventilation is poor, making working conditions within the factory unpleasant and tiring.

(b) Layout of primary and secondary machining areas is good but could be improved upon by relating it more closely to the most logical flow of work and to better use of storage and working areas. Better attention should be paid to the layout of the assembly and finishing sections which need to be replanned completely.

(c) Materials handling, arrangements throughout the plant, with the exception of the finishing section, are good.

2. The plant was designed to provide a reasonable balance between mechanization and the need to use as large a labour force as possible. There are, nevertheless, some serious omissions among essential items of machinery and equipment. Most of the machines are Romanian in origin and pose considerable problems in relation to the provision of essential tools and spares. Some machines, for this reason, cannot be operated. Machines are well maintained and there is a good dust and waste extraction system.

Management

3. Production management is weak, and such techniques as production planning, method study, design of production aids, quality control, work flow, design of work stations, materials inspection, materials handling and good housekeeping, need to be made effective.

4. General management in relation to the Complex as a whole is not good. Those responsible for the administrative and technical direction of the furniture plant are inexperienced and largely untrained in the production of furniture.

Design

5. The plant's deficiencies are most apparent in the field of design, the meaning and function of which are not fully understood.
6. Design and product development are not sufficiently co-ordinated.

Raw materials

7. Arrangements for the continued supply of essential raw materials are completely unsatisfactory. When materials are available they are often inadequate and therefore wasteful.

Production technology

8. The technology of modern furniture and joinery production consistent with a plant of this scope and magnitude is largely unknown. This is particularly the case with regard to a satisfactory understanding and use of most materials used by the industry, the design and structural details of furniture construction, furniture finishing and upholstery.
9. No arrangements exist for the provision of up-to-date technical information and literature relating to furniture production.

Labour

10. There is no provision for in-plant training by the Corporation. This is urgently required for operatives, technicians, production supervisors and design staff.
11. Levels of skill throughout the plant are low and clearly reflect the absence of adequate training and supervision.
12. Productivity is very low. Causes, other than a dearth of raw materials, include absenteeism, bad timekeeping, indiscipline and lack of strict supervision. To this may be added the absence of the support of top management whenever line managers attempt to deal with these occurrences.
13. There is considerable scope for improvement in the field of labour relations. This has caused serious difficulties since the establishment of the Complex.

Quality control

14. Quality control is not effective because those responsible for exercising it do not understand what it means in the context of furniture production.
15. The plant is large enough to have its own product-testing facilities.

Marketing

16. Export prospects for the plant are not good, given the present state of management and the poor supply system of essential raw materials.
17. The future of the plant appears to lie in the manufacture of medium-priced, good-quality, modern furniture produced according to established procedures and on a repetitive semi-mechanized basis.
18. Marketing and selling are not sufficiently well organized or co-ordinated to generate an acceptable level of sales, or to make a good impact on the Sri Lankan market. This market appears to have considerable potential.

Recommendations

Product design

1. The Corporation must evolve a design and product policy consistent with the needs of the Sri Lankan market and with the production capabilities of the plants at Salawa and elsewhere.
2. The design standards of all items manufactured need to be raised. In addition, new designs should be introduced as quickly as possible.
3. As there is a scarcity of competent furniture designers in Sri Lanka, the Corporation must ensure that it provides for its own needs in this respect. A beginning could be made by arranging for the attendance by the senior draughtsman at an appropriate design course abroad, possibly with the aid of a UNIDO fellowship.
4. The Corporation should also consider, as an interim measure and particularly in relation to exports, the manufacture under licence of an internationally established range of furniture designs.

Product development

5. Since there must always be close collaboration between the drawing office and the prototype workshop, the two should be relocated in adjoining areas in the factory.
6. All the Corporation's design and prototyping facilities should be centralized so that an effective and co-ordinated design and prototyping service may be provided for all the Corporation's furniture plants.
7. Prototyping should also include the design and production of all processing aids such as master parts, formers, jigs, measurement gauges and fixtures.

Raw materials

8. The raw materials supply system for the Complex as a whole requires much greater direction and co-ordination in order to ensure that adequate stock levels of appropriate quality shall be maintained at all times for each of its constituent parts. One man with suitable experience and knowledge of materials, especially timber, should be appointed to take charge of this function.
9. The standard of metal and plastic fittings, e.g., hinges, locks and handles currently manufactured in Sri Lanka, is not sufficiently high for the production of furniture made largely from veneered particle board. These fittings should be imported from abroad, particularly from the Federal Republic of Germany, the United Kingdom and Scandinavia where there are established manufacturers of such fittings.
10. Close liaison between management and manufacturers of other materials such as wood finishes and adhesives should be maintained. The latter's technical representatives should be encouraged to visit the plant regularly and to keep management informed of new developments.

Production and productivity

11. In order to achieve an acceptable level of productivity, specific production targets, based on capacity and known performance, should be set monthly in advance, and output should be monitored daily.
12. Greater attention should be paid to work planning, layout, production flow, machine loading, production control and method study.

13. Lighting throughout the plant should be improved and this improvement should be maintained. The most satisfactory long-term solution is to replace about 10 per cent of the existing roof sheeting with filtered transparent sheeting.

14. While there is a superfluity of some machines, other essential machines are missing and should be obtained immediately. Meanwhile it will be necessary to introduce shift work on certain machines in order to avoid serious bottle-necks in production.

15. Greater use should be made of such production aids as go and no-go gauges, patterns and templates, jigs and formers, locating and boring aids.

16. The daily rate of production should not vary according to the availability of raw materials. In the event of a shortage, the plant should close down until normal supplies are resumed.

17. A considerable increase in productivity, i.e. output per worker, is necessary. This will be achieved only by the management's ensuring adequate production facilities (machines, raw materials, skills) as well as strict and informed supervision throughout the plant.

18. All workers in the assembly section should be provided with a set of tools, a work-bench with vice and a job platform.

19. All assembled furniture should be loaded on flat rubber-wheeled trolleys for transfer to the finishing section. Many of the trolleys originally intended for use in conjunction with the now obsolete curtain-coating machine can be adopted for this purpose. These trolleys should be used by the assembly and finishing sections only.

20. The roofs of each of the spray booths should be raised in order to accommodate the finishing of wardrobes and other tall objects, and additional flame-proof lighting should be incorporated in the walls and roofs of each booth. Turntables should be installed in the centre of each booth for easy handling while spraying.

21. A new finishing system should be introduced incorporating the use of polyurethane stains and lacquers. Existing spray guns, all of which are defective, should be immediately replaced by more modern guns which have adequate capacity.

22. Good housekeeping is required throughout the plant. Floors should be kept clean, gangways kept clear and waste bins provided where waste or off-cuts normally accumulate.

Management

23. Job specifications and responsibility levels should be clearly defined for all management and supervisory personnel.

24. Before taking up a particular management appointment, all personnel should undergo a period of induction and training.

25. Regulations regarding supervision and discipline should be uniform throughout the plant, and all personnel should be made fully aware of them. A special booklet on this should be prepared and issued to every employee.

26. There should be weekly co-ordinating meetings between the managers of the Complex and the various plant managers. There should also be weekly meetings between the plant managers and their supervisors at which all aspects of production, including raw materials supplies, and progress on achieving monthly targets would be discussed.

27. Managers should get the full support and backing of the General Manager, Chairman and Board of Directors in ensuring that Corporation regulations are carried out effectively.

28. All appointments and promotions should be made on the basis of qualifications, appropriate experience and general suitability. No appointment should be confirmed until a trial period of at least six months has elapsed.

29. Managers concerned should always be consulted before any particular appointment is made.

30. Bonus incentive schemes should not be introduced until it is demonstrated that they clearly help to accomplish the required level of productivity. The application of such schemes should be uniform throughout the Complex.

31. Managers should understand and apply such techniques as works study, production planning, production controlling, quality control, work programming and machine loading. Those who have received training abroad should make use of that training in their daily work.

32. Managers and supervisors should realize that there is no substitute for direct and personal supervision. They should therefore spend the major part of their day on the factory floor. This is particularly important while attempts are being made to establish good discipline.

Labour

33. The level of skills should be upgraded by the application of strict supervision and quality control.

34. There should be established procedures for dealing with disputes and other difficulties which arise from time to time in the plant, and management should insist on their being observed at all times.

35. A works committee made up of representatives of management and workers should be established. This committee should meet weekly in order to discuss all aspects of the day-to-day operation of the plant.

36. Bad timekeeping and indiscriminate absenteeism should be discouraged, and management should provide the lead in this respect.

37. There should be no restrictive practices in operation in the plant. All workers should do whatever work is required of them including being moved to other departments when necessary.

Training

38. In-plant training programmes should be immediately established as a matter of policy for all plants and all grades of management and workers employed by the Corporation.

39. A full-time training officer should be appointed to prepare and implement all such training programmes. The training officer should attend a full-time training programme abroad concerned with industrial training in the woodworking industry. This might be sponsored by UNDP.

40. Training programmes for line management should include attendance by relevant personnel at part-time and full-time courses conducted by the Sri Lanka Institute of Management.

41. Selected personnel should continue to attend UNIDO-sponsored courses on woodworking technology.

42. A technical information centre should be established at Salawa, and the Corporation should arrange for the purchase for it of books, periodicals and other publications concerned with technology and production in the wood industries. UNDP assistance might be sought towards this end.

Quality control

43. Quality control should be substantially improved. Specific procedures and standard specifications for the implementation of quality control should be laid down and strictly adhered to.
44. Those directing quality control in the plant should themselves be fully familiar with its requirements and applications.
45. The plant should have its own performance testing equipment and those responsible for quality control should be trained in its use.
46. Management should realize that quality control is everyone's responsibility and that it should be applied particularly by all craft workers.

Marketing

47. The marketing and sales organization of the Corporation should do much more in promoting and developing sales of its range of products. Greater attention should be paid to the techniques of marketing in order to advise the Corporation on its product policy and the requirements of the various sectors of the market.
48. Since the Corporation enjoys a virtual monopoly in certain sectors of the market, e.g., the supply of furniture to state and semi-state agencies, this should be more fully exploited to the Corporation's advantage.
49. The promotion of furniture should be made more effective by improving the presentation of sales literature and adopting a brand name.
50. The Corporation should open its own show-room at Colombo and other show-rooms later at the major centres of distribution.
51. Use should also be made of press and cinema advertising.
52. Exports should not be seriously contemplated until products are well established on the home market. This, however, should not prevent the exercise of careful market research of potential markets abroad.

Communications

53. An internal telephone system should be installed immediately, and the external system should be improved.
54. Relevant sections of this report should be translated into Sinhala and issued to the appropriate managers and supervisors.

Annex I

DATA ON CEYLON PLYWOODS CORPORATION

<u>Total capital employed (1975)</u>	<u>Rupees</u> 142,000,000
<u>Total turnover (1975)</u>	95,000,000
	<u>Number of units</u>
<u>Total manufacturing units</u>	13
Salawa/Kosgama Complex	
Sawmill	1
Plywood factory	1
Particle board factory	1
Furniture and joinery factory	1
Gintota plywood factory	
Carpentry divisions: factories at Velona, Kandy, Amparam, Koggala, Bandarawela, Jaffna, Batticaloa	7
Timber project (KIN)	1
	<u>Number of persons</u>
<u>Total employment</u>	4,150
Gintota	1,200
Salawa/Kosgama	1,250
Head office	200
KIN project	385
Carpentry division	1,115
<u>Employment: Salawa/Kosgama Complex</u>	
Log yard	40
Sawmill	65
Particle board factory	110
Plywood factory	580
Furniture and joinery	210
Transport	90
Boiler maintenance	160
<u>Value of production, Salawa, 1975</u>	<u>Rupees</u>
Sawmill	1,724,000
Particle board factory	4,605,000
Plywood factory	28,433,000
Furniture and joinery	3,819,000

Productivity, Salawa /Kosgama, 1975

Rupees/person

Sawmill	26,500
Particle board factory	41,800
Plywood	49,700
Furniture and joinery	18,200
<u>Exports, Salawa /Kosgama, 1976</u>	<u>Rupees</u>
	207,800

Annex II

JOB DESCRIPTION
(DP/SRL/73/020/11-03/03)

Post title: Furniture Technologist

Duration: Six months

Date required: As soon as possible

Duty station: Salawa, Kosgama

Purpose of Project: To upgrade the furniture production technology to enable the Ceylon Plywoods Corporation to improve the quality and competitiveness of its products and, eventually, to enter world markets.

Duties: The expert will be assigned to the Ceylon Plywoods Corporation and will be expected to advise the management of the Corporation's furniture plants on the introduction of modern production technology, design practice and process and quality control. Specifically, the expert will be expected to advise on:

- (a) Maintenance of cutting tools, equipment and machines;
- (b) Streamlining of production methods;
- (c) Introduction of modern production planning, control and quality control procedures;
- (d) Selection of machinery, plant layout and low-cost automation;
- (e) Selection of timber and its seasoning;
- (f) Gluing, surface finishing and upholstery techniques;
- (g) Safety in industry;
- (h) Cost accounting and inventory control;
- (i) Training of factory personnel.

Qualifications: Wood technologist or engineer with considerable experience in the production of furniture at the policy-making level. Experience in design and on developing countries desirable.

Language: English

Background
information:

The Ceylon Plywoods Corporation has established an integrated woodworking complex at Salawa, Kosgama, comprising a sawmill, a plywood mill, a particle board plant as well as a joinery and furniture plant. Assistance under this project has already been given to the particle board plant as well as to the sawmills (in the field of saw doctoring).

Annex III

SUMMARY OF MAJOR ACTIVITIES OF PROJECT

The following is a list of the main project activities:

- (a) Plant survey and preparation of work programme;
- (b) Design of range of domestic storage furniture and seating; redesigning of existing range of office desks;
- (c) Preparation of working drawings for new designs;
- (d) Prototyping of new designs and making of appropriate production aids, e.g., jigs, fixtures and formers' gauges;
- (e) Preparation of materials specifications for all items;
- (f) Design of production planning and control system including sequence processing, routing, time measurement, materials cost and utilization and other relevant production information;
- (g) Preparation of handbook on the technology of furniture production including design, materials, machines and processes and management;
- (h) Preparation of handbooks on standards specifications for furniture and joinery, quality-control procedures and test methods;
- (i) Improvement of all manufacturing facilities related to buildings, machinery, equipment selection and layout, production flow, waste reduction and methods study;
- (j) Improvement in supply and quality of all raw materials;
- (k) Training of management and labour in the implementation of new procedures, techniques and skills;
- (l) Assessing market potential and advising on promotion and sales;
- (m) Planning, preparing and executing a furniture exhibition at Colombo;
- (n) Preparation of technical report.

Annex IV

SPECIFICATIONS FOR ADDITIONAL MACHINERY TO BE PURCHASED

1. Semi-automatic copying lathe

Maximum distance between centre	1,050 mm
Maximum turning diameter	140 mm
Fitted with copying saddle and mechanical centering device	
Approximate price including spares for two years	14,200 DM

2. Universal dowel-hole boring machine

Working table	1270 x 750 mm
Vertical and horizontal adjustable unit	
Boring spindle bar with 19 mm spindles, 32 mm spacing 576 mm maximum centre distance	
Approximate price including spares for two years	20,000 DM

3. Veneer guillotine jointing machine

Cutting length	3,230 mm
Insertion height	100 mm
Fitted with light barrier safety device	
Approximate price including spares for two years	40,000 DM

4. Combined drum and thickness sander

Fitted with two rollers	
Motor for infinitely variable feed speed	
Capacity (width)	1,100 mm
Approximate price including spares for two years	47,000 DM

5. Semi-automatic slot mortiser

Table dimensions	430 x 440 mm
Diameter of maximum work piece	30 mm
Maximum depth of hole	100 mm
Maximum length of slot	120 mm
Spindle speed	5,000/10,000 r.p.m.
Approximate price including spares for two years	15,500 DM

6. Semi-automatic high-duty tenoner

Table dimensions	360 x 340 mm
Cutter head	5,600 r.p.m.
Maximum tenon length	90 mm
Maximum tenon width	170 mm
Suotion hood above cutter head	
Approximate price including spares for two years	18,000 DM

7. Single-sided edge-banding machine

Fitted with end-trimming, edge-trimming and edge-sanding units	
Automatic strip feed magazine (solid wood and veneer)	
Coil feed magazine	
Flush cutting unit	
Dust extraaction unit with middle pressure ventilator	
Approximate price including spares for two years	20,000 DM

Annex V

LITERATURE ON FURNITURE

Journals

Furniture Manufacturer (monthly)

Magnum Publications Ltd, 110/112 Station Road East
Oxted, Surrey, England

Cabinetmaker (weekly)

Woodworking Industry (monthly)

Benn Brothers Ltd, 25 New Street Square
London EC4A 3JA, England

Wood and Equipment News (monthly)

Westbourne Journals Ltd, Crown House, London Road
Morden, Surrey SM4 5ER, England

Books and pamphlets published by the Furniture
Industry Research Association (FIRA)

Maxwell Road, Stevenage, Hertfordshire, England

FIRA bulletins

FIRA research notes

FIRA technical reports

Furniture literature

Management accounting

Methods engineering

The furniture standards handbook

Publications issued by the United Nations

New York, N.Y. 10017, USA

Production of panels from agricultural residues.
Report of the expert working group meeting, Vienna, 14-18 December 1970
(ID/WG.83/15 - ID/79)

Sales No.: 72.11.B.4

Production of prefabricated wooden houses.

Sales No.: 71.II.B.13

Production techniques for the use of wood in housing under conditions prevailing in developing countries.

Report of study group, Vienna, 17-21 November 1969 (ID/WG.49/10 - ID/10)

Sales No.: 70.II.B.32

Wood as a packaging material in the developing countries (ID/72)

Sales No.: 72.II.B.12

Publications issued by the United Nations Industrial Development Organization

P.O. Box 707, A-1011 Vienna, Austria

Furniture and joinery industries for developing countries.
(Raw material inputs, pt. 1; Processing technology, pt. 2;
Management considerations, pt.3)
(ID/108/Rev.1)

Information sources on the furniture and joinery industry
(UNIDO/LIB/SER.D/4/Rev.1)

Information sources on industrial quality control
(UNIDO/LIB/SER.D/6)

Information sources on the building board industry based on wood and other fibrous materials (UNIDO/LIB/SER.D/9)

Information sources on the paint and varnish industry
(UNIDO/LIB/SER.D/18 - ID/150)

Selection of woodworking machinery. Report of a technical meeting, Vienna, 19-23 November 1973 (ID/WG.151/38/Rev.1 - ID/133)

Low-cost automation for the furniture and joinery industry (ID/154)

Wood processing for developing countries. Report of a workshop, Vienna, 3-7 November 1975 (ID/WG.200/14/Rev.1 - ID/180)

Annex VI

DESIGN AND MANUFACTURING PROGRAMME

The design programme described here was prepared and the prototypes were produced in batch sizes during the course of the project. Its aim was to provide the Corporation with a basis for the establishment of a sound product policy which would enable it to develop further ranges as management expertise and skills were perfected and demand was increased. Factors which influenced the choice and designation of the models are enumerated in chapter I. These included common structural elements, a rationalized range of dimensions and a high degree of component interchangeability.

The programme covered manufacture of the following types of furniture (see figures II - XII):

- Living and dining-room chairs and seating
- Storage units for bedroom, dining-room and kitchen
- Office desks

The raw materials used were as follows:

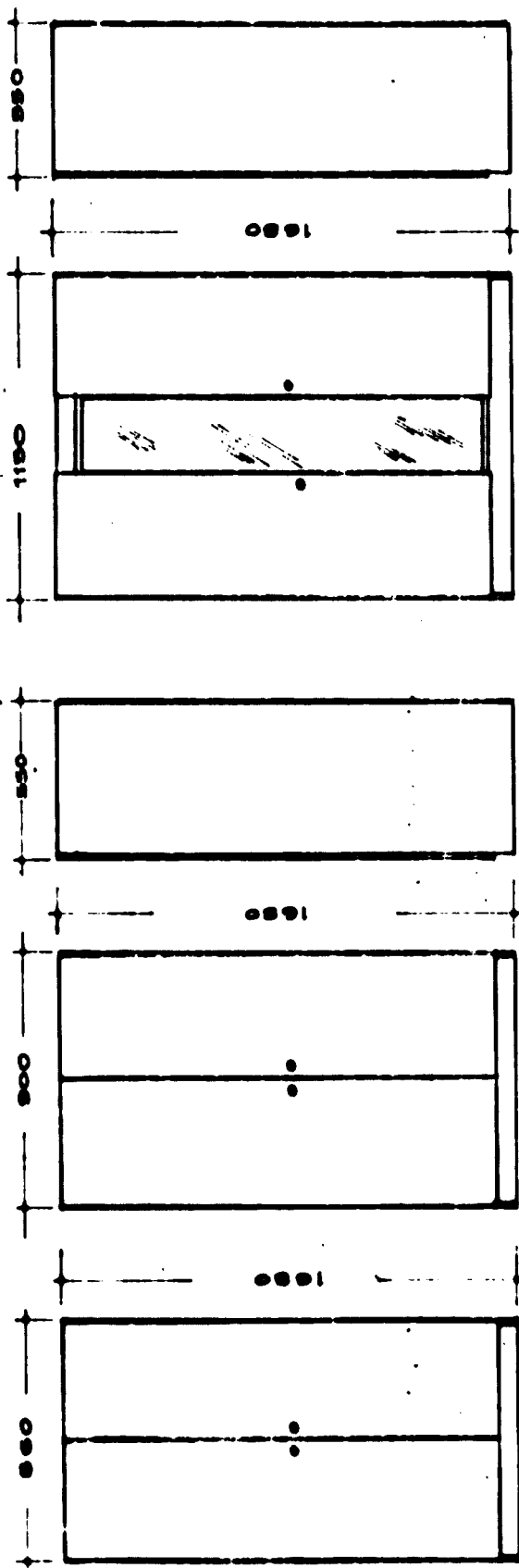
<u>Item</u>	<u>Raw material</u>
Chairs, frames and seating	Kirihembiliya, a locally grown hardwood available in sufficient quantities
Storage units	Veneered particle board and plywood
Office desks	Veneered particle board and plywood
Upholstery	Latex foam rubber and resilient webbing
Covering material	Good wearing fabrics and leather cloths
Lacquering	Nitro-cellulose and polyurethane lacquers
Fittings and accessories	Sri Lankan and imported from Europe

The main form of construction involves the use of dowels, mortise and tenon and housing joints, so that the furniture will be fully assembled on leaving the factory. Should the need arise to export the furniture in knock-down (KD) form, this could be done without difficulty by substituting the appropriate knock-down fittings for these joints. The fittings are illustrated in DP/ID/SER.A/92.

Manufacturing programme

The manufacturing programme is based on a projected output which is in excess of SRs 12 million per annum. It is subdivided into two major areas of activity, namely the production of flush doors and door frames, and the production of domestic furniture and office desks. Table 1 provides a break-down of this programme over a 12 month period and table 2 gives a quantity analysis of the timber and board requirements over the same period. Further analyses should be undertaken at a later stage to determine production values based on production units per shift and time per unit.

Figure II. Wardrobes



Unfitted

Fitted

Fitted with mirror

Item

Ends, doors, tops, bottoms, shelving

Top and bottom rails

Back

Finish

Material

Veneered, edge-lipped particle board

Solid wood

Plywood

Acid-catalysed and nitro-cellulose lacquers

Figure III. Bedroom furniture

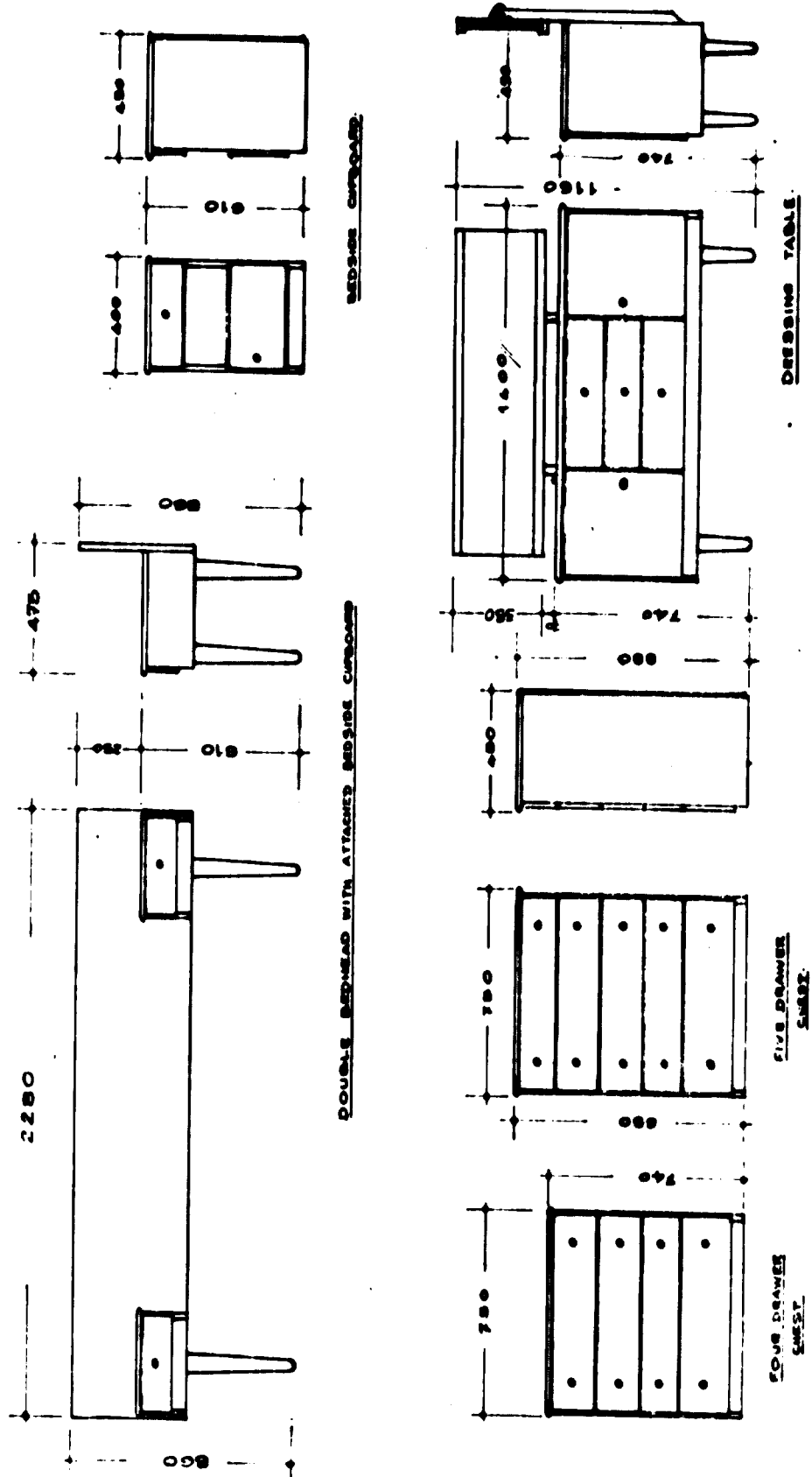


Figure IV. Dining-room furniture

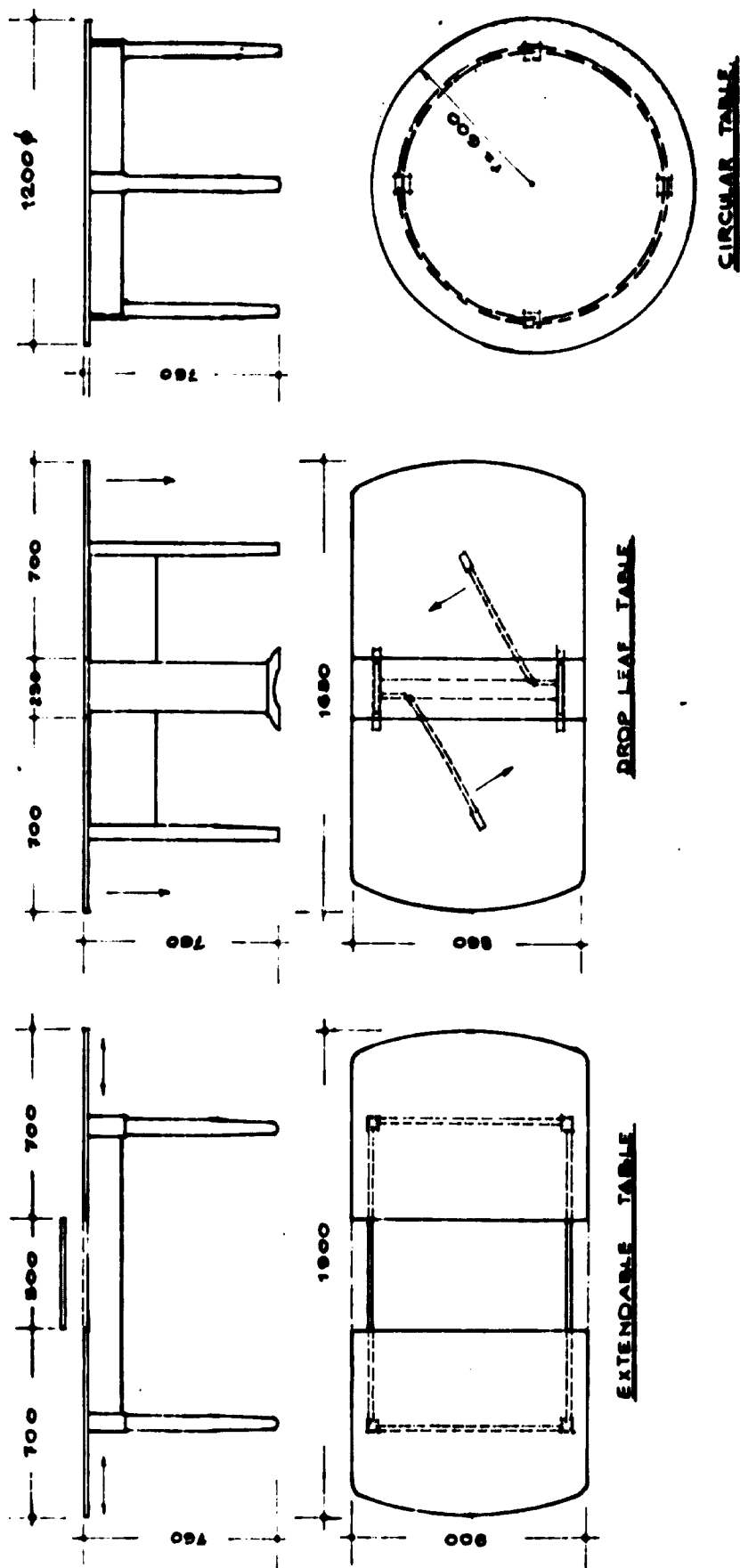


Figure 6. Cabinets

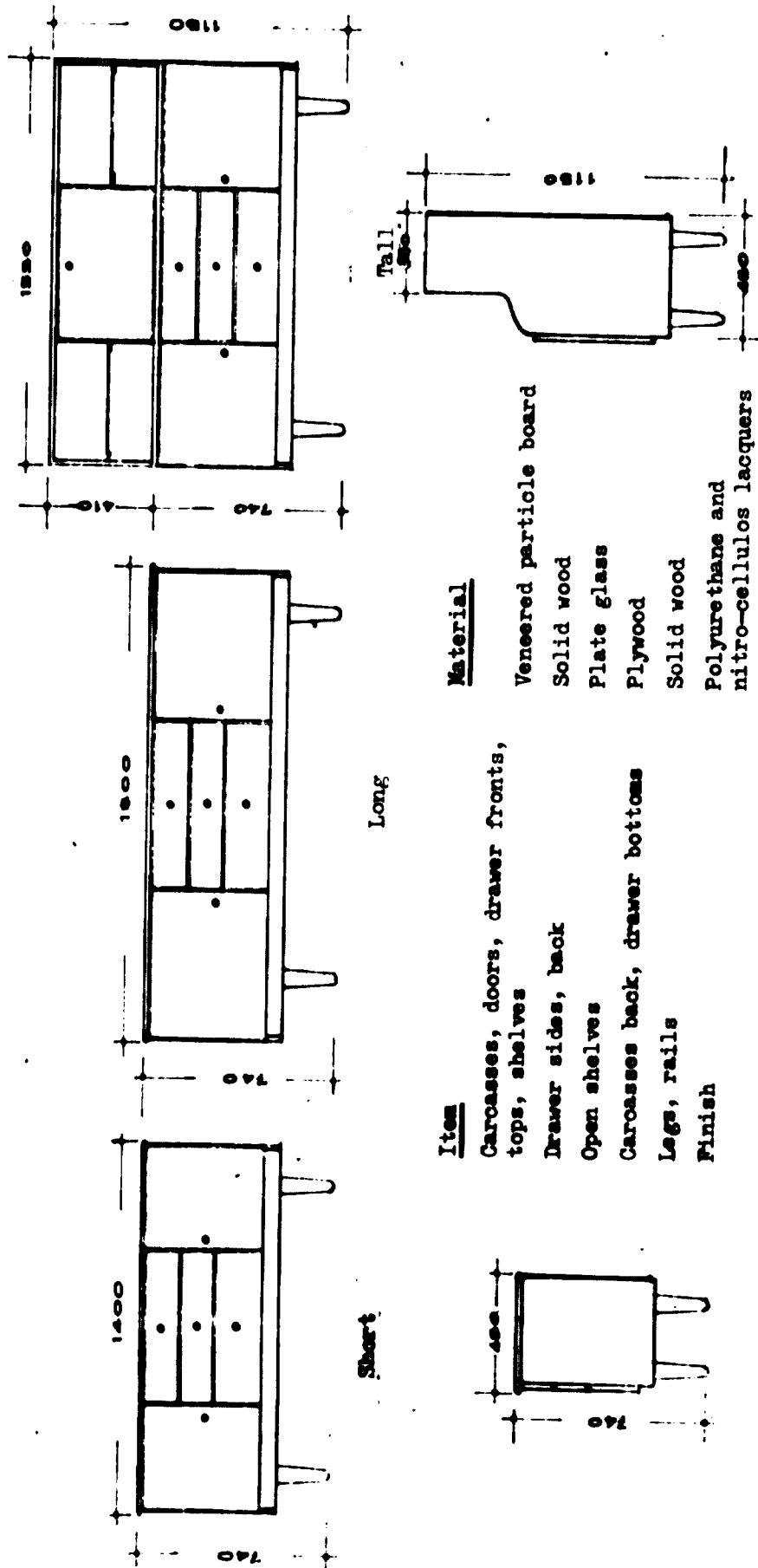
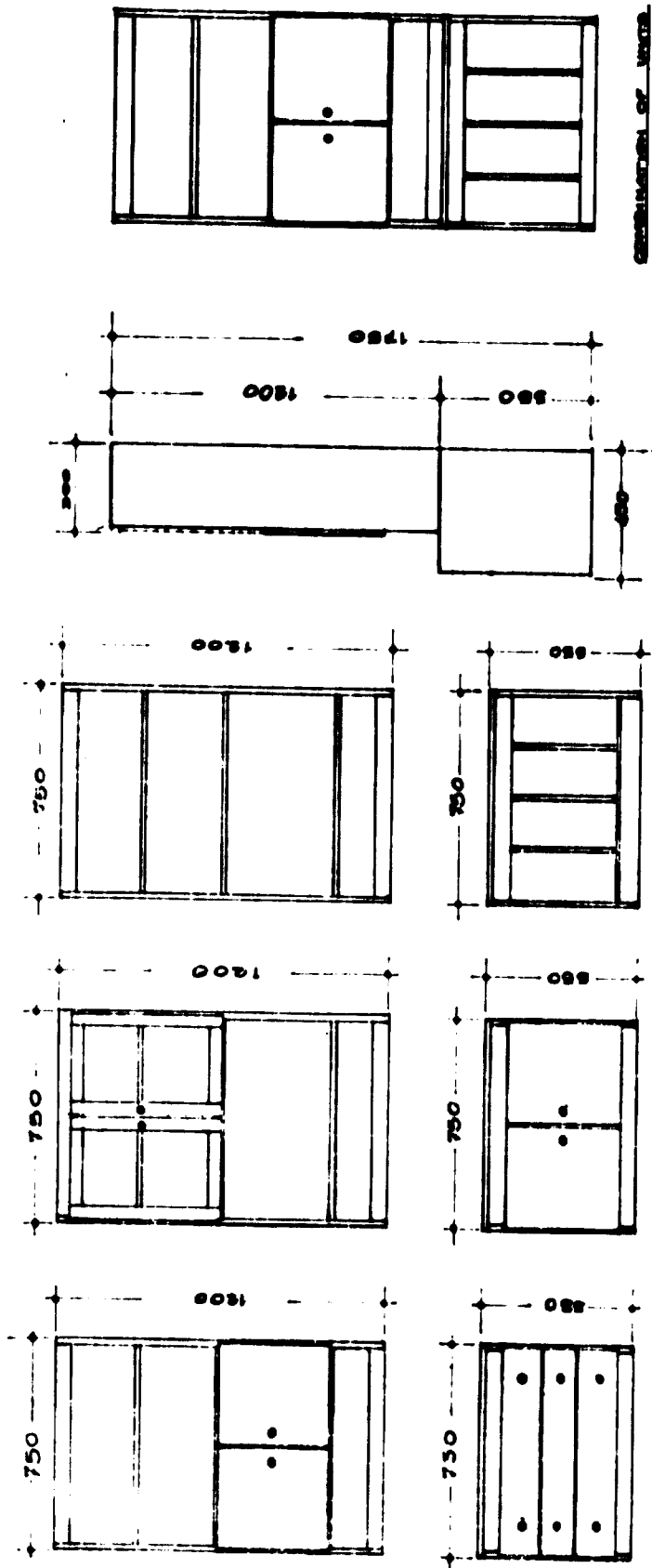


Figure VI. Living-room storage units



CONTINUATION OF WORK

Item

Carcasses, shelving, doors, divisions, drawer fronts Veneered particle board

Open backs Veneered plywood

Framed doors, rails Solid wood

Door panels Clear glass

Finish Acid-catalysed and nitro-cellulose lacquers

Material

Veneered particle board

Veneered plywood

Solid wood

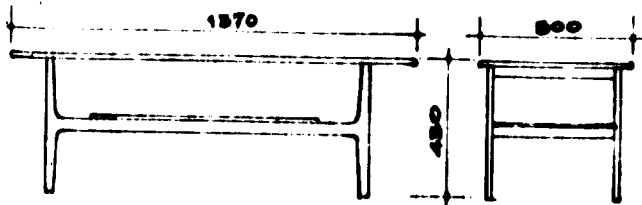
Clear glass

Acid-catalysed and nitro-cellulose lacquers

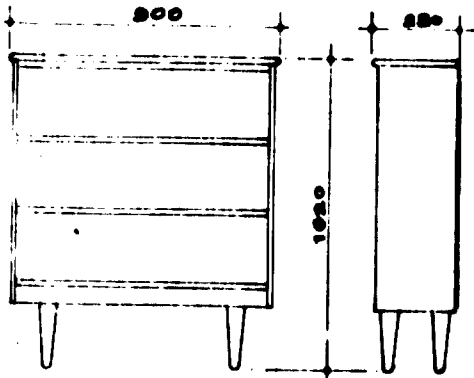
Figure VII. Occasional furniture



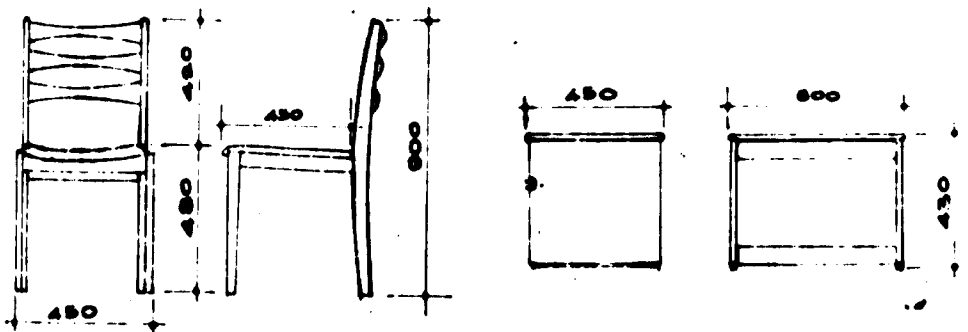
Nest of tables



Coffee table



Bookcase



Dining chair

Dressing stool

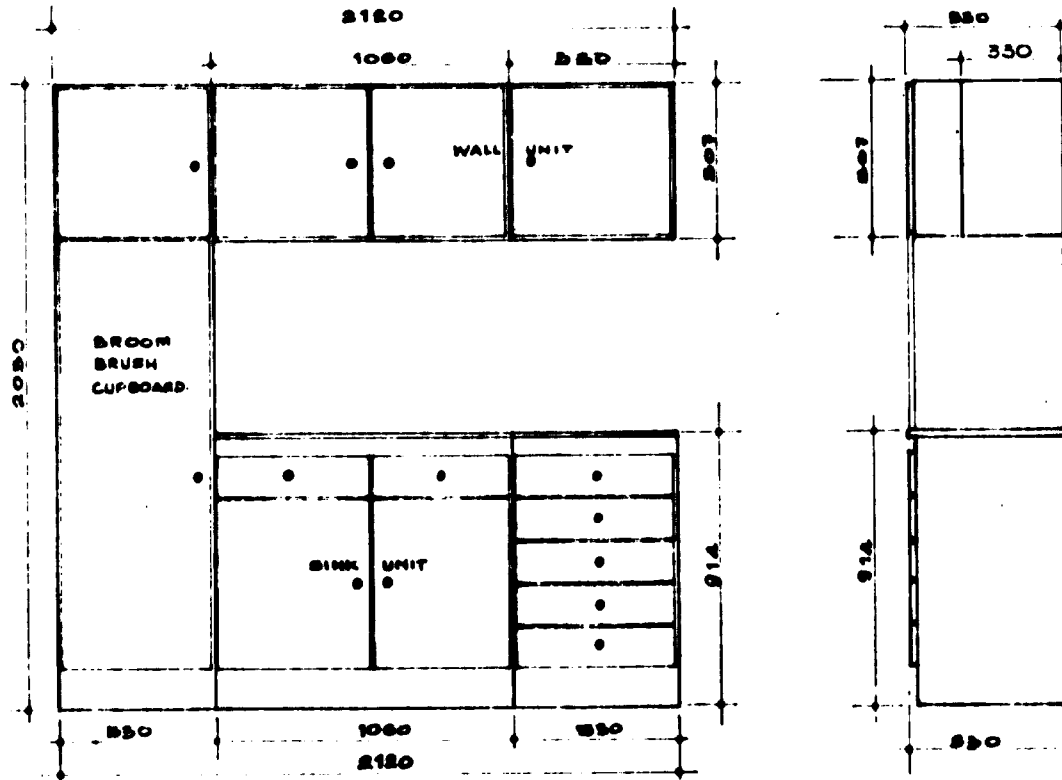
Item

Frames
Tops and shelving
Finish

Material

Solid wood
Veneered, edge-lipped particle board
Acid-catalysed and polyurethane lacquers

Figure VIII. Unit kitchen furniture



Item

Carcasses, doors, drawer front/bottoms, backs, shelves

Drawer sides/back, rails

Tops

Finish

Material

Plywood

Solid wood

Plastic laminate

Pigmented polyurethane lacquer

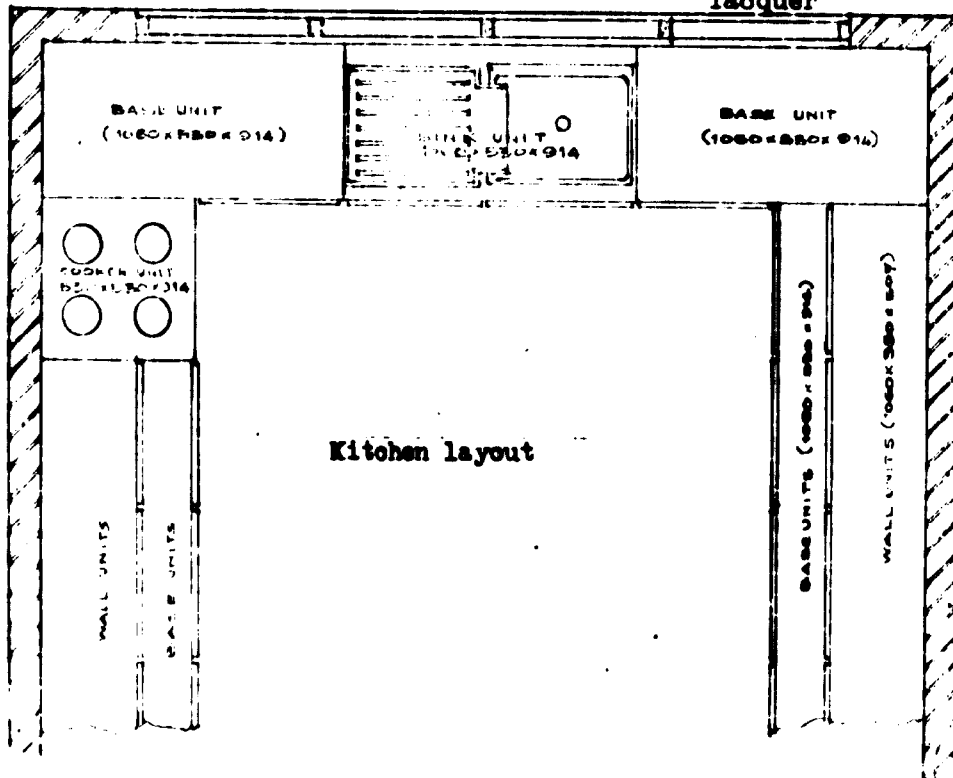
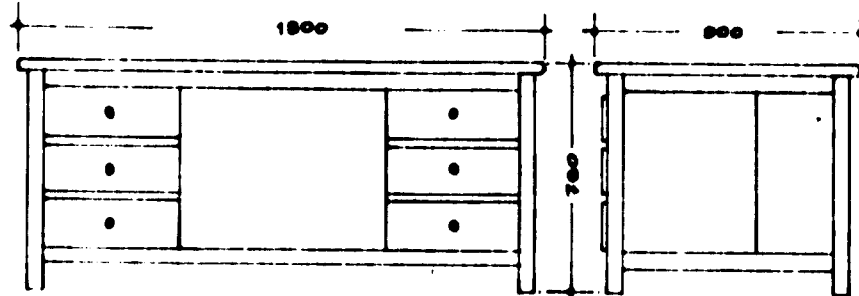
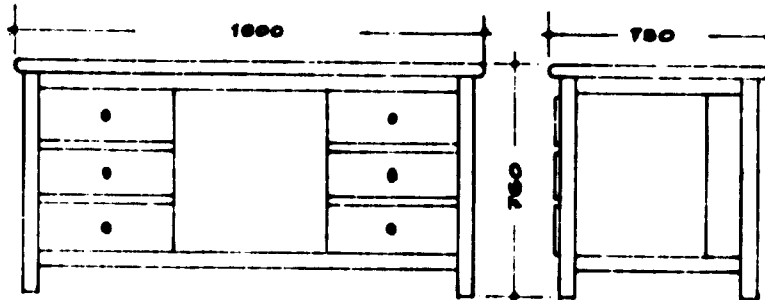


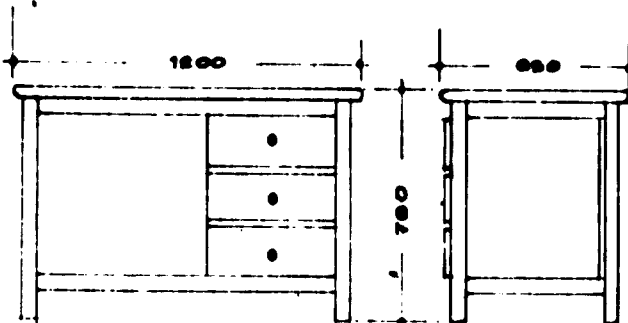
Figure IX. Office desks



Senior executive desk



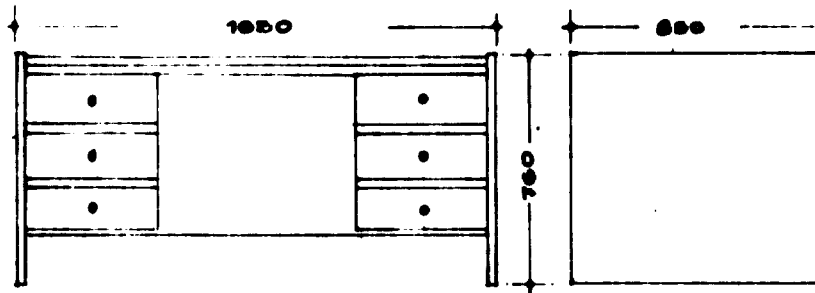
Junior executive desk



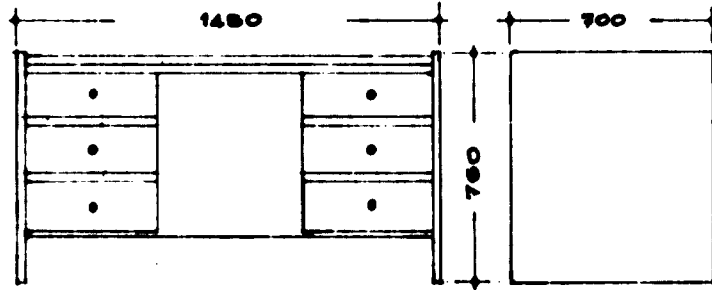
Clerk's desk

<u>Item</u>	<u>Material</u>
Frames, drawer sides/backs	Solid wood
Carcasses, tops, drawer, fronts	Veneered particle board
Drawer bottoms, carcass backs	Plywood
Finish	Acid-catalysed lacquer

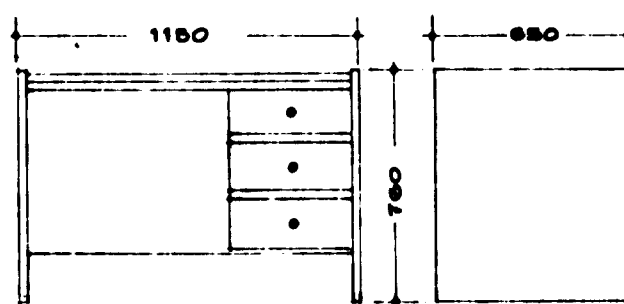
Figure X. Office desks



Senior executive desk



Junior executive desk



Clerk's desk

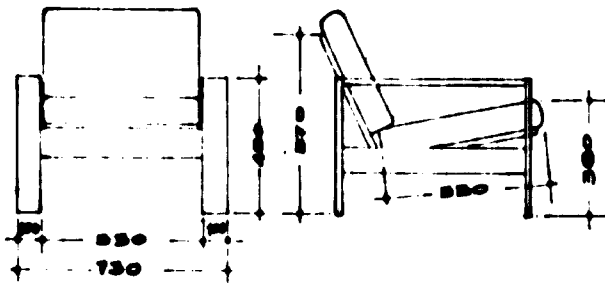
Item

Frames, drawer sides/backs
 Carcasses, tops, drawer, fronts
 Drawer bottoms, carcasses backs
 Finish

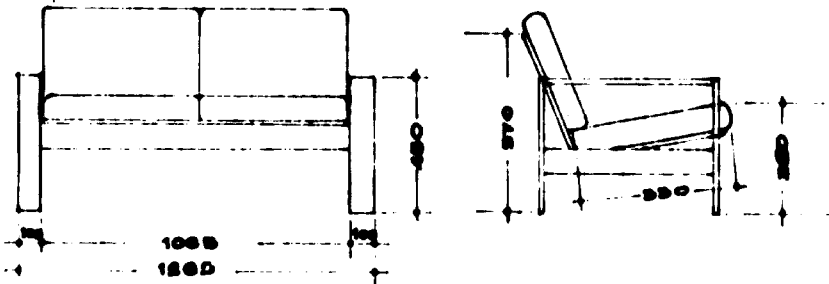
Material

Solid wood
 Veneered particle board
 Plywood
 Acid-catalysed lacquer

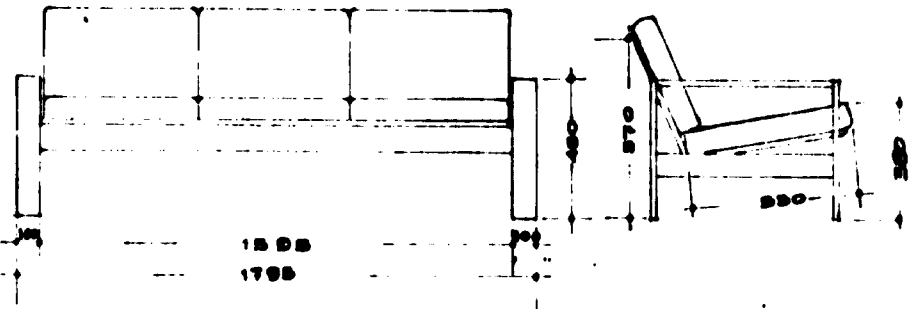
Figure XI. Living-room seating units



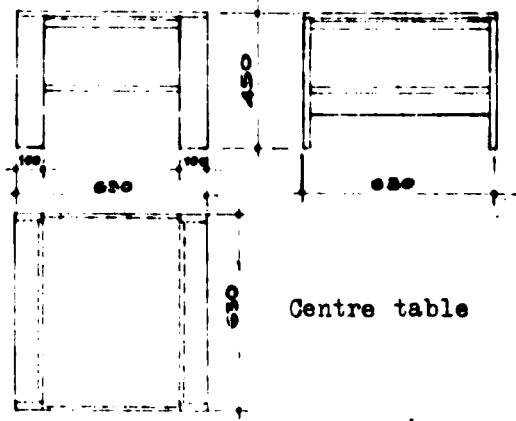
Easy chair



Two-seater settee



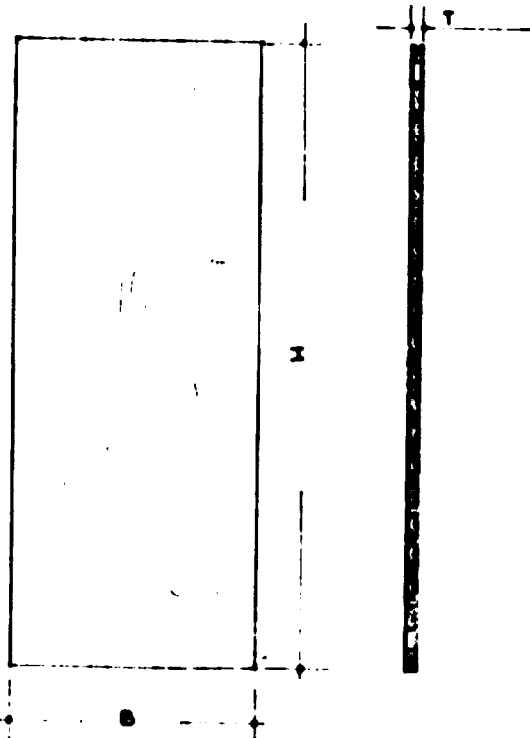
Three-seater settee



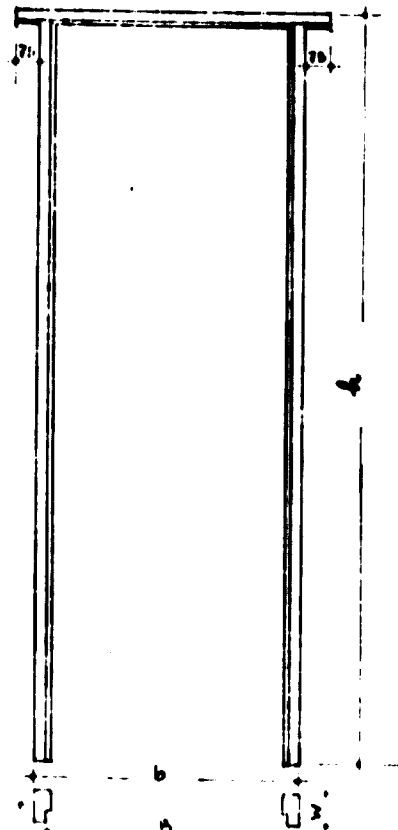
Centre table

<u>Item</u>	<u>Material</u>
Frames	Solid wood
Seat/back	Rattan
Cushions	Latex foam
Cover	Fabric
Finish	Acid-catalysed lacquer

Figure XII. Flush door and door frame



MODEL	LARGE DOOR	MEDIUM DOOR	SMALL DOOR
H	2060	2060	2060
B	1070	840	690
T	32	32	32



MODEL	LARGE FRAME	MEDIUM FRAME	SMALL FRAME
A	2095	2095	2095
B	1140	910	760
W	95	95	95

<u>Item</u>	<u>Material</u>
Frames	Solid wood
Door skins	Plywood
Door core	Plywood



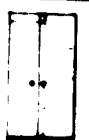






























Table 1. Production programme
(see figure XIII)

Model	Code No.	Batch size	Units/daily production
<u>Bedroom</u>			
Wardrobe 'A' (with mirror) (4604)	WRA	25	15
Wardrobe 'B' (fitted) (4606)	WRB	25	15
Wardrobe 'C' (unfitted) (4605)	WRC	25	15
Continental headboard (04504)	CHB	50	30
Dressing table 'B' (drawers and doors) (4650)	DTB	25	15
Dressing stool (27601)	DS	100	50
Dressing table 'A' (drawers only) (4640) ^{a/}	DPA	25	15
Five-drawer chest (5622)	CD 5	50	25
Four-drawer chest (4627)	CD 4	50	30
Bedside cabinet (4628)	BC	100	30
<u>Dining-room</u>			
Dining table 'A' (427)	DTA	25	10
Dining table 'B' (424)	DTB	25	10
Dining table 'C' (428)	DTC	25	10
Dining chair 'A' (438)	DCA	100	50
Sideboard 'A' (414)	SBA	25	15
Sideboard 'B' (413)	SBB	25	15
Sideboard 'T' (410)	SBT	25	12
<u>Living room</u>			
Three-seater settee	3S	50	20
Two-seater settee	2S	50	20
Easy chair	EC	100	20
Coffee table 'A'	CTA	50	25
Nest of tables	NT	50	15
Base unit 'A' (14211)	BUA	50	50
Base unit 'B' (14212)	BUB	50	50
Base unit 'C' (14213)	BUC	50	50

Model	Code No.	Batch size	Units/daily production
Top unit 'A' (14214)	TUA	50	50
Top unit 'B' (14215)	TUB	50	50
Top unit 'C' (14216)	TUC	50	50
Bookcase ^{a/}	BC	50	25
Unit occasional table ^{a/}	UT	50	30
<u>Kitchen</u>			
Floor unit 42" (42202)	FU 42	50	25
Floor unit 21" (42201)	FU 21	50	25
Floor unit 63" (42203) ^{a/}	FU 63	50	20
Wall unit 42" (42402)	WU 42	50	30
Wall unit 21" (42401)	WU 21	50	40
Wall unit 63" (42412) ^{a/}	WU 63	50	25
Broom cupboard	BCU	25	20

^{a/} Models not shown in figure XIII.

Figure XIII. Sinha Furniture range (Ceylon Plywoods Corporation)

BED ROOM				DINING ROOM.			
MODEL	CODE	DESCR: & DIMENSIONS	PRICE	MODEL	CODE	DESCR: & DIMENSIONS	PRICE.
	WRA	FITTED WARDROBE WITH MIRROR H: 168, L: 118, W: 55.			DTA	EXTENDING DINING - ROOM TABLE H: 76, L: 190, W: 90.	
	WRB	GENTS SINGLE WARDROBE H: 168, L: 90, W: 55			DTB	DROP-LEAF DINING TABLE H: 76, L: 168, W: 90.	
	WRC	LADIES SINGLE WARDROBE H: 168, L: 90, W: 55.			DTC	CIRCULAR DINING - ROOM TABLE H: 76, DIA: 120	
	CHB	CONTINENTAL HEADBOARD H: 88, L: 228, W: 48			DCB	DINING ROOM CHAIR H: 90, L: 46, W: 43	
	DTB	DRESSING TABLE H: 110, L: 140, W: 48.			SBA	LONG SIDEBOARD H: 74, L: 180, W: 45	
	DS	DRESSING TABLE STOOL H: 48, L: 60, W: 48.			SBB	SHORT SIDEBOARD H: 74, L: 140, W: 45	
	CD5	FIVE DRAWER CHEST H: 88, L: 78, W: 48.			SBT	TALL SIDEBOARD H: 118, L: 188, W: 48.	
	CD4	FOUR DRAWER CHEST H: 74, L: 78, W: 48.		LIVING ROOM.			
	BC	BEDSIDE LOCKER H: 81, L: 48, W: 48.			3S	THREE SEATER SETTEE. H: 87, L: 178, W: 88.	
KITCHEN UNITS.					2S	TWO SEATER SETTEE. H: 87, L: 128, W: 88.	
	FU42	42" FLOOR UNIT H: 91, L: 108, W: 55			EC	ARM CHAIR H: 87, L: 73, W: 83	
	FU21	21" FLOOR UNIT H: 91, L: 55, W: 55.			CTA	COFFEE TABLE H: 48, L: 157, W: 80.	
	FUD	21" DRAWER UNIT. H: 81, L: 55, W: 55.			NT	NEST OF TABLES H: 80, L: 70, W: 80	
	WU48	42" WALL UNIT. H: 80, L: 108, W: 55.			BUA	BASE UNIT WITH DRAWERS. H: 88, L: 78, W: 48.	
	WU21	21" WALL UNITS. H: 80, L: 55, W: 55.			BUB	CUPBOARD BASE UNIT. H: 88, L: 78, W: 48.	
	BCU	BROOM CUPBOARD. H: 208, L: 55, W: 55.			BUC	BASE STORAGE UNIT. H: 88, L: 78, W: 48.	
					TUA	TOP UNIT WITH DRINK CUPBOARD H: 120, L: 75, W: 50.	
					TUB	TOP UNIT WITH GLASS DOORS H: 120, L: 75, W: 50.	
					TUC	TOP UNIT WITH ALL OPEN SHELVES H: 180, L: 75, W: 80.	

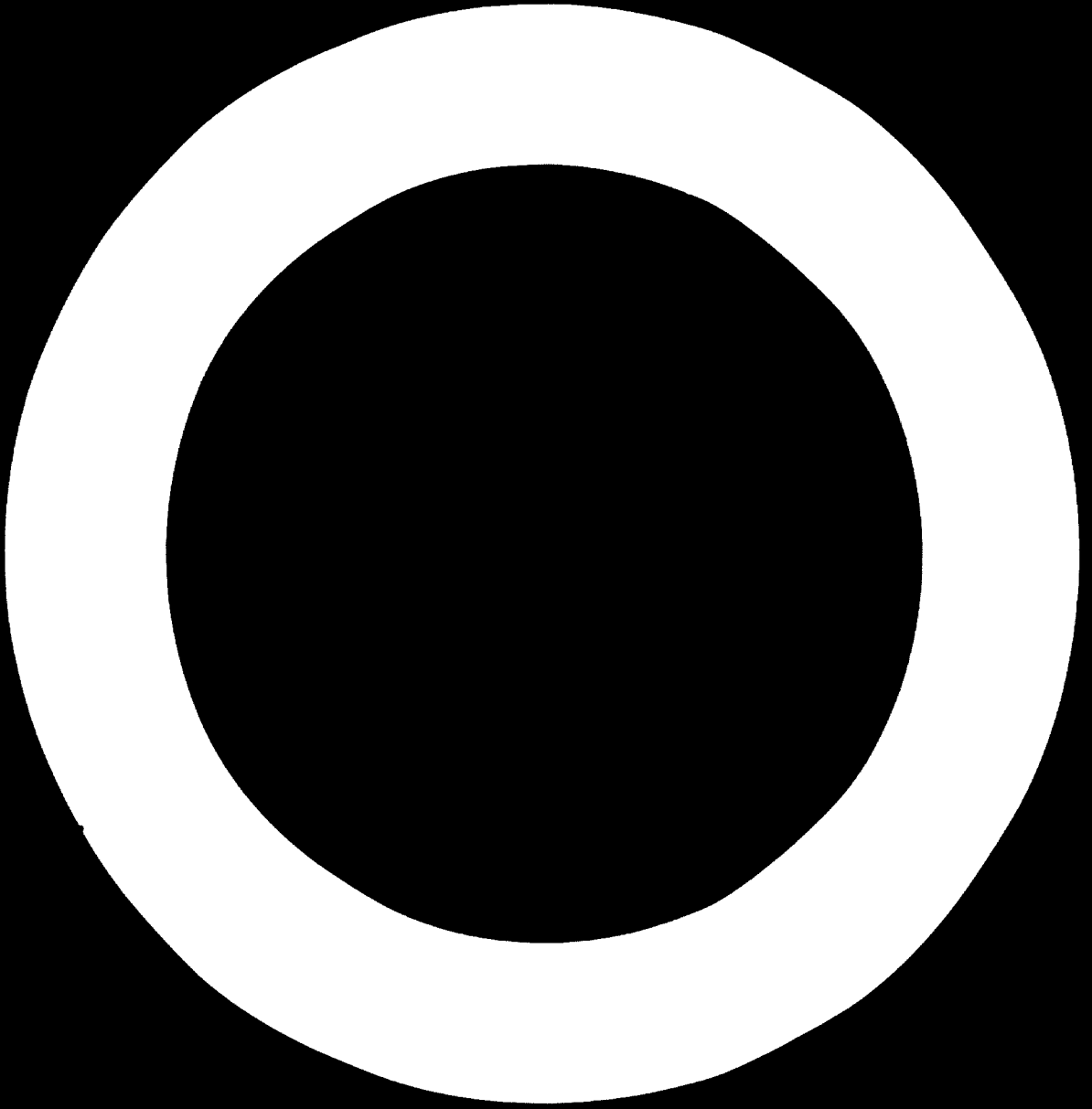


Table 2. Domestic furniture range - quantity analysis of raw material

Model	Solid wood - waste 6%								Chipboard - waste 15%			
	Thickness 18 mm (3/4 inch)		Thickness 16 mm (5/8 inch)		Thickness 25 mm (1 inch)		Thickness 32 mm (1 1/8 inch)		Thickness 18 mm (3/4 inch)		Thickness 16 mm (5/8 inch)	
	Input net	Input GROSS	Input net	Input GROSS	Input net	Input GROSS	Input net	Input GROSS	Input net	Input GROSS	Input net	Input GROSS
1. (a) Chest of drawers/5 drawers (drg. No. 290)	-	-	0.0004	0.0000	0.0004	0.0134	-	-	-	-	1.7004	1.0007
(b) Chest of drawers/4 drawers (drg. No. 290)	-	-	0.0130	0.0107	0.0070	0.0132	-	-	-	-	1.0100	1.7000
2. Dressing table (drg. No. 293)	-	-	0.0100	0.0100	0.0100	0.0100	0.0000	0.0000	0.0101	0.0000	2.0000	2.0100
3. Wardrobe ('B' fitted) (drg. 249)	0.0013	0.0000	-	-	0.0007	0.0000	-	-	-	-	2.0007	2.0000
4. LRF/base units (drg. No. 289)	0.0007	0.0011	0.0007	0.0100	0.0070	0.0112	-	-	-	-	2.0700	2.7710
5. LRF/top units (drg. No. 288)	0.0010	0.0000	0.0000	0.0000	0.0000	0.0000	-	-	-	-	1.0000	2.0000
6. LRF/wardrobe (drg. No. 252)	0.0000	0.0000	0.0000	0.0000	0.0007	0.0107	-	-	-	-	0.0010	0.0000
7. LRF/bedside cupboard (drg. 253)	-	-	0.0000	0.0000	0.0000	0.0001	-	-	-	-	1.0007	1.0010
8. LRF/bed head with fixed cupboard (drg. No. 254)	-	-	0.0000	0.0000	0.0000	0.0110	0.0000	0.0007	-	-	0.7000	0.0001
9. LRF/dining table extendable (drg. No. 287)	-	-	0.0007	0.0011	0.0100	0.0004	0.0000	0.0101	-	-	-	-
10. LRF/sideboard (drg. No. 256)	-	-	0.0111	0.0170	0.0100	0.0000	0.0007	0.0013	0.0000	0.0010	2.0000	2.0000
11. LRF/drop-leaf dining table (drg. No. 257)	0.0000	0.0000	-	-	0.0000	0.0000	-	-	-	-	-	-
12. LRF/circular dining table (drg. No. 258)	-	-	-	-	-	-	0.0070	0.0100	-	-	-	-
13. LRF/tall sideboard (drg. No. 285)	0.0011	0.0017	0.0112	0.0170	0.0000	0.0000	0.0000	0.0070	-	-	4.0004	0.0012
14. LRF/dressing stool (drg. No. 268)	-	-	0.0007	0.0011	0.0000	0.0000	-	-	-	-	0.0007	0.7000
15. Bookcase (drg. No. 262)	-	-	0.0000	0.0000	0.0000	0.0070	0.0000	0.0001	-	-	1.0000	1.0000
16. LRF/coffee table (drg. No. 263)	-	-	0.0000	0.0014	0.0071	0.0112	-	-	0.0001	0.0170	0.0000	0.7004
17. Nest of tables (drg. No. 275)	-	-	0.0000	0.0000	0.0000	0.0000	-	-	-	-	0.0070	0.0000
18. LRF/dining chair (drg. No. 266)	-	-	0.0000	0.0012	0.0000	0.0000	0.0110	0.0170	-	-	-	-
19. KF/kitchen cupboards/model 1 (drg. No. 268)	0.0010	0.0000	0.0100	0.0000	0.0000	0.0100	-	-	-	-	1.0000	2.1010
20. KF/kitchen cupboards/model 2, 3 (drg. No. 271)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-	-	-	-	2.0007	2.0000
21. KF/kitchen cupboards/model 4 (drg. No. 273)	-	-	0.0070	0.0101	0.0070	0.0110	-	-	0.0000	0.0000	2.0000	2.0000
22. KF/kitchen cupboards/model 5, 6 (drg. No. 274)	-	-	0.0070	0.0100	0.0070	0.0110	-	-	0.0000	0.0000	2.7000	2.1010
23. KF/wall cupboards/model 7, 8 (drg. No. 276)	-	-	0.0000	0.0000	0.0001	0.0000	-	-	0.0000	0.0000	2.0001	2.0000
24. KF/broom, brush, cupboard (drg. No. 277)	-	-	0.0000	0.0000	0.0012	0.0000	-	-	0.1000	0.1700	2.0100	4.0000
25. LRF/wardrobe with mirror (drg. No. 282)	-	-	-	-	0.0010	0.0010	-	-	-	-	1.0000	1.0000
26. Easy chair, 2 & 3 seater settee (drg. No. 299)	-	-	-	-	0.1100	0.1000	-	-	-	-	-	-
Total input (gross)		0.0100		0.2100		0.4211		0.0077		2.0010		20.0014
		7%		7%		7%		7%		7%		7%
		0.0000		7.4100		14.0000		2.0000		20.0000		244.4000

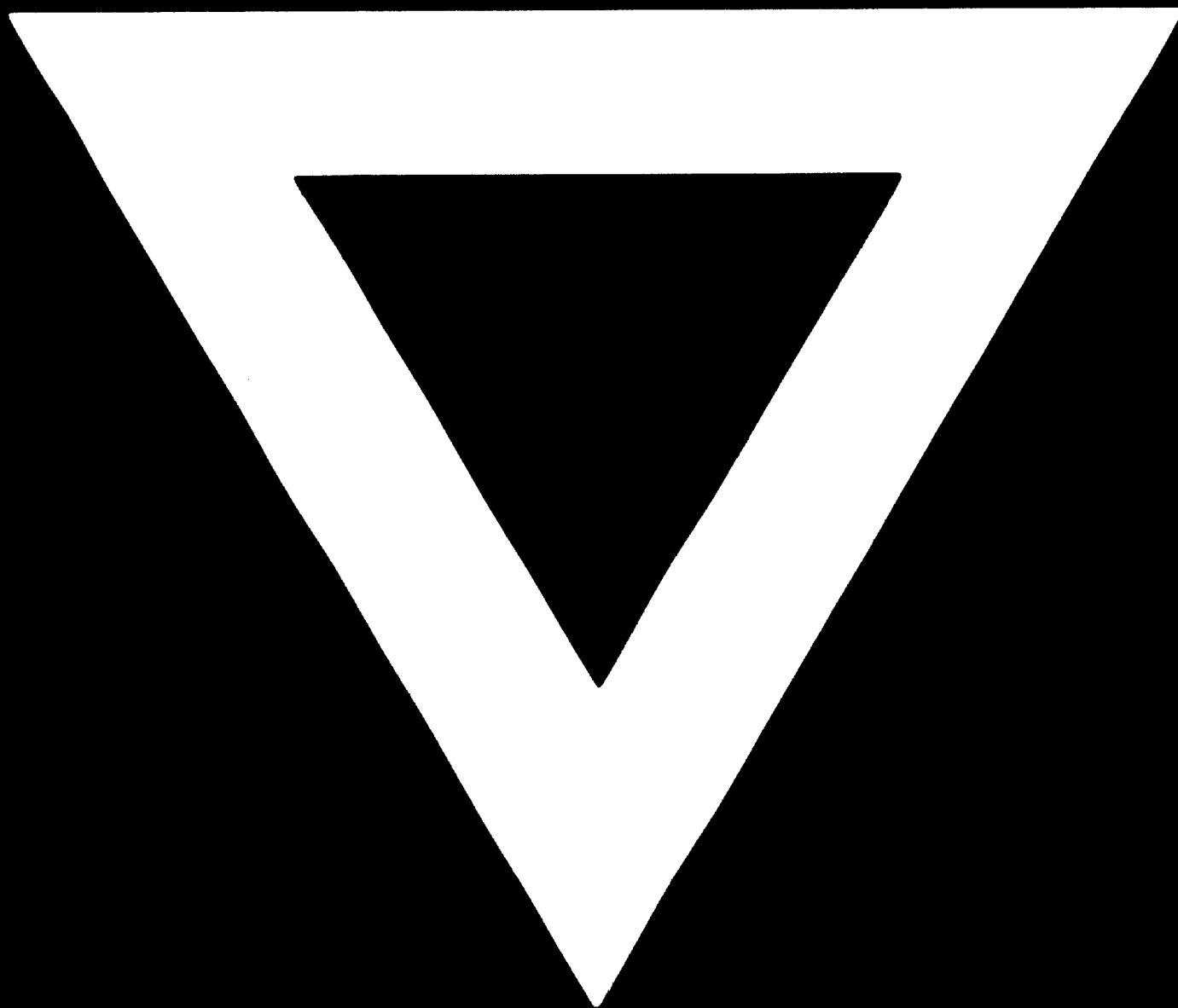
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Table 2. Domestic furniture range - quantity analysis of raw material

Item No.	Solid wood - waste 6%						Chipboard - waste 12%						Veneer - waste 12%				
	Thickness 10 mm (3/8 inch)		Thickness 25 mm (1 inch)		Thickness 35 mm (1 1/4 inch)		Thickness 12 mm (1/2 inch)		Thickness 16 mm (5/8 inch)		Thickness 18 mm (3/4 inch)		Face		Back		
	Input net	Input gross	Input net	Input gross	Input net	Input gross	Input net	Input gross	Input net	Input gross	Input net	Input gross	Input net	Input gross	Input net	Input gross	
	0.0004	0.0000	0.0000	0.0134	-	-	-	-	1.7004	1.0007	-	-	1.0000	0.1000	1.0000	1.0000	
	0.0122	0.0107	0.0070	0.0122	-	-	-	-	1.0100	1.7000	-	-	1.7000	1.0070	1.4001	1.0001	
	0.0100	0.0100	0.0100	0.0100	0.0000	0.0001	0.0104	0.0000	2.0000	2.0100	-	-	2.0001	2.0000	1.0000	2.2047	
0.0021	-	-	0.0007	0.0000	-	-	-	-	2.0007	2.0000	0.0070	0.0000	0.0040	0.0000	0.0000	0.1470	
1.0011	0.0007	0.0100	0.0070	0.0112	-	-	-	-	2.4700	2.7710	-	-	2.0100	2.0071	2.0000	2.4000	
0.0020	0.0000	0.0000	0.0000	0.0000	-	-	-	-	1.0000	2.0001	-	-	2.2000	2.0700	0.0004	2.2072	
0.0000	0.0000	0.0000	0.0007	0.0107	-	-	-	-	0.0010	0.0000	0.0070	2.0014	0.0000	7.7000	0.0044	7.1001	
	0.0000	2.0000	0.0000	0.0001	-	-	-	-	1.0077	1.1010	-	-	1.0000	1.1000	0.0700	1.1200	
	0.0033	0.0000	0.0000	0.0110	0.0000	0.0007	-	-	0.7000	0.0001	1.0000	1.1700	2.0704	0.0044	2.0000	2.0000	
	0.0007	0.0011	0.0100	0.0004	0.0000	0.0121	-	-	-	-	0.0701	1.0000	1.0000	1.0000	1.0000	1.0000	
	0.011	0.0170	0.0100	0.0000	0.0007	0.0040	0.0000	0.2012	2.0000	0.2004	-	-	4.0407	2.0007	4.0000	0.2700	
0.0040	-	-	0.0000	0.0000	-	-	-	-	-	-	1.0700	2.0000	1.0000	2.0000	1.0001	0.1170	
	-	-	-	-	0.0070	0.0120	-	-	-	-	1.0100	1.0000	0.2011	2.0077	0.1000	2.0700	
0.0017	0.0112	0.0170	0.0000	0.0000	0.0000	0.0070	-	-	4.0004	0.0012	-	-	0.0000	0.0707	0.0110	0.7000	
	0.0007	0.0011	0.0000	0.0000	-	-	-	-	0.0407	0.7000	-	-	0.7012	0.0100	0.7000	0.0700	
	0.0000	0.0001	0.0000	0.0070	0.0000	0.0041	-	-	1.0000	1.0000	-	-	1.0000	0.0707	1.7100	1.0000	
	0.0000	0.0014	0.0071	0.0110	-	-	0.2001	0.2170	0.0000	0.7004	-	-	1.1000	1.2000	1.0070	1.2012	
	0.0000	0.0000	0.0000	0.0000	-	-	-	-	0.0470	0.0400	-	-	0.0210	1.0700	0.0010	1.0700	
	0.0000	0.0012	0.0000	0.0040	0.0110	0.0170	-	-	-	-	-	-	-	-	-	-	
0.0020	0.0100	0.0000	0.0000	0.0100	-	-	-	-	1.0000	0.1010	-	-	0.4000	0.0000	2.1710	2.4070	
0.0000	0.0000	0.0000	0.0000	0.0040	-	-	-	-	0.0407	2.0000	-	-	0.0000	2.0000	2.2100	0.2012	
	0.0070	0.0121	0.0070	0.0110	-	-	0.4004	0.4700	2.0000	2.2700	-	-	2.7000	4.0000	0.4077	2.0000	
	0.0070	0.0120	0.0070	0.0110	-	-	0.0000	0.0400	2.7000	0.1010	-	-	2.0401	4.0012	0.4010	4.0000	
	0.0000	0.0000	0.0001	0.0000	-	-	0.4004	0.4700	2.0001	2.0000	-	-	2.0000	4.0000	2.0014	2.0112	
	0.0020	0.0001	0.0012	0.0010	-	-	0.1000	0.1700	2.0100	4.2700	-	-	4.7000	0.4000	4.4000	2.0000	
	-	-	0.0010	0.0010	-	-	-	-	1.0000	1.4000	2.0070	0.0000	0.2004	7.0000	0.0001	0.0000	
	-	-	0.1100	0.1000	-	-	-	-	-	-	-	-	-	-	-	-	
0.0100		0.2100		0.4011		0.0077		2.0410		20.4114			17.7100		00.0000		70.4004
Pt. 2		Pt. 3		Pt. 2		Pt. 3		Pt. 0		Pt. 0			Pt. 0		Pt. 2		Pt. 2
0.0000		7.4100		14.0000		0.2000		20.2000		044.4001			101.2700		000.0000		000.0000

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