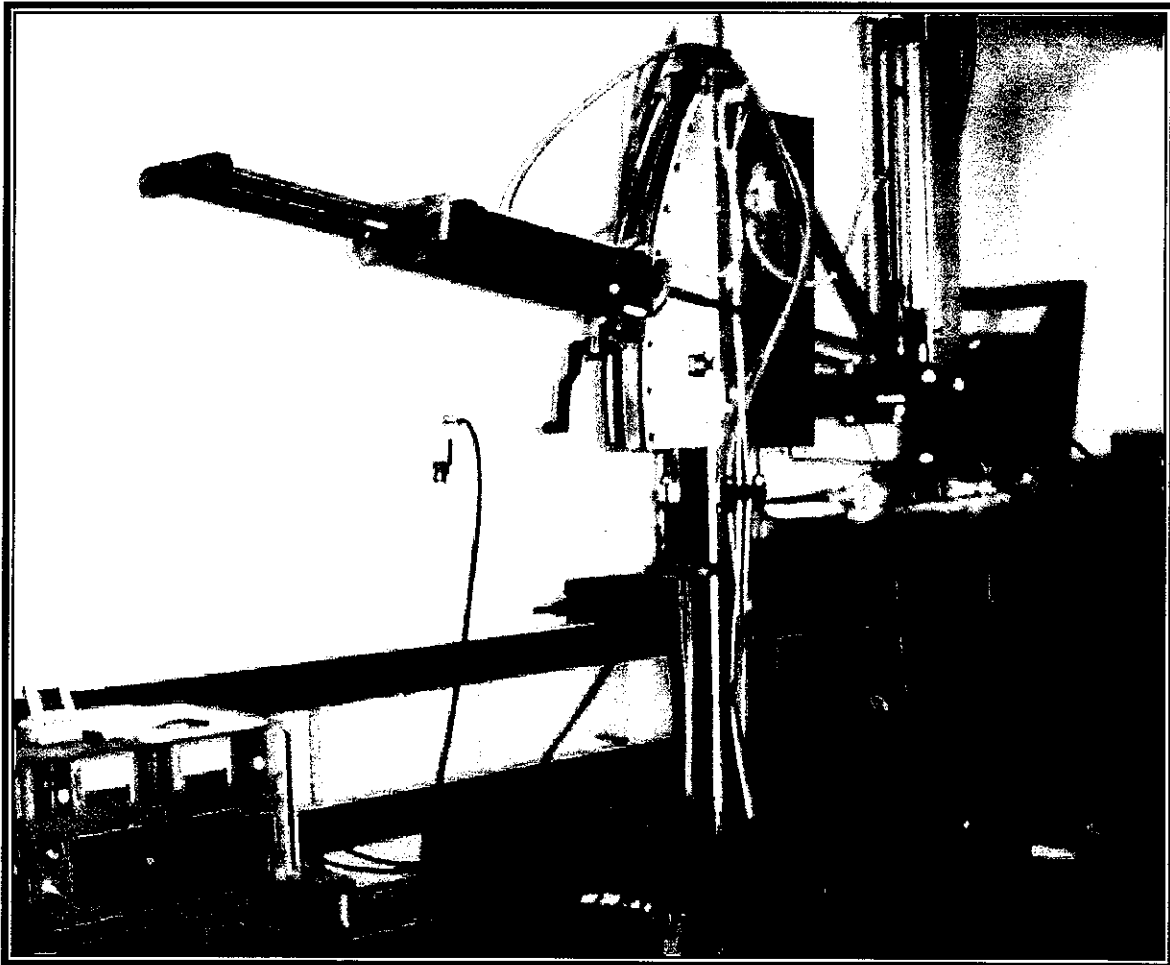


**Forest Products Research and Development Institute  
International Tropical Timber Organization**



**PROJECT COMPLETION REPORT  
ITTO PD 35/99 Rev. 4 (I)**

**PERFORMANCE EVALUATION OF EXPORT WOOD FURNITURE  
IN RELATION TO STRENGTH AND END-USE APPLICATIONS  
USING ESTABLISHED TEST STANDARDS**



**Los Baños, Laguna 4031, Philippines  
July 2004**

# PROJECT COMPLETION REPORT

## A. Project Identification

Title : Performance Evaluation of Export Wood Furniture  
in Relation to Strength and End-Use Applications  
Using Established Test Standards

Serial Number : PD 35/99 Rev. 4 (I)

Executing Agency : Forest Products Research and Development  
Institute (FPRDI)

Host Government : Philippine Government

Starting Date : 01 May 2002

Actual Duration : 18 Months (with extension)  
First Extension: November 01, 2003 - April 30, 2004  
Dissemination: May 01- October 31, 2004

Actual Project Cost : - - - - US \$ 367,899.00  
ITTO Counterpart - - - - - US \$ 139,999.00  
Released to the Project - - - - - US \$ 128,200.00  
Retained by ITTO for Monitoring  
and Evaluation and Administration Cost - - - - - US \$ 11,799.00

Fund Source : Government of Japan

Philippine Government Counterpart: - - - - - US \$ 227,900.00  
(in cash and in kind)

## **PART I. EXECUTIVE SUMMARY**

### **1. Background Information About the Project**

- 1.1 Before the Twentieth Session of the International Tropical Timber Council and Eighteenth Session of the Permanent Committee on Forest Industry, the Forest Products Research and Development Institute (FPRDI) submitted to the International Tropical Timber Organization (ITTO) a Project Proposal PD 14/96 (I) entitled "Technological Inputs for Upgrading and Modernization of the Furniture Industry in the Philippines" for evaluation by the Panel of Experts for Technical Appraisal of Project Proposals. As reflected on pages 15 and 16 of the project briefs of the Permanent Committee on Forest Industry (PCI) XXVIII/2, dated 13 March 1996, the Expert Panel made some relevant comments and recommendations for the improvement of the project. The Panel concluded that a reformulation of the proposal is essential and it will assess the reformulated project proposal before it can be commended to the committee for final appraisal.

In due regard to the comments and recommendations of the Panel, FPRDI contemplated and decided to submit instead this Project Proposal entitled "Performance Evaluation of Export Wood Furniture in Relation to Strength and End-Use Applications Using Established Test Standards" which is more specific problem oriented, similarly geared to upgrading of furniture, and more quantifiable output than the first project proposal PD 14/96 (I). Besides, the major objectives and component activities of PD 14/96 (I) is at present being undertaken in the regular S & T activities of FPRDI, thus we consider it more rational and important to submit this project proposal than revising PD 14/96 (I). The project as conceptualized and proposed will determine and evaluate the strength and performance of export wood furniture such as chairs, stools, tables, drawers and cabinet doors by the application of loads or forces simulating normal functional use, as well as acceptable mis-use, according to a graded scale of severity following established test standards. The test standards that will be used are the British Standards (BS), International Organization for Standardization (ISO) and the British-European Standard (BS-EN), which specifies performance requirements for domestic and contract furniture and/or office and educational furniture. The test will cover static, fatigue and impact strength of wood furniture under specified levels and rapid rates of loading that occur occasionally and under repeated movement or application of load occurring during daily use. Evaluation will include determination of initial damage, damage propagation and ability to withstand acceptable mis-use and demonstration of residual strength. Designs or innovations that will improve the strength and stability of furniture will be identified and disseminated to furniture manufacturers and the members of the Chamber of Furniture Industries of the Philippines. Through actual testing of prototype furniture using established standards and appropriate testing machines and knowing their actual performance would help enhance the growth and global competitiveness of furniture makers. As envisioned, the project output would help upgrade furniture products and would lead to the modernization of the furniture industry in the Philippines.

## **1.2 Key Problem Intended to Solve**

The project is addressed to the problem of the furniture producers, exporters and users on the poor and inadequate data and information on the performance of furniture in actual service, resulting to pre-mature failure and low product quality. This problem can be attributed to the lack of actual test on the strength and performance of prototype furniture being sold in the market. In the Philippines and some other furniture exporting countries, furniture are marketed without undergoing or passing any kind of test and evaluation particularly on their strength, durability and stability. The manufacturers, buyers and end-users have no idea or information on how long and stable a chair, a sala set, a table, drawer, a cabinet door would last in service. There is no specific guarantee or information that a piece of furniture could withstand the repeated operations, movement and applications of loads occurring during daily use.

## **1.3 Specific Objectives**

To test and evaluate the static, fatigue and impact strength of export wood furniture under high levels and rapid rates of loading that occur occasionally and under repeated movement or application of load occurring during daily use.

To determine initial damage and damage propagation and ability to withstand acceptable mis-use and demonstration of sufficient residual strength. Recommend design improvement to help upgrade the performance and quality of furniture products.

## **1.4 Specific Outputs**

After the completion of the project, the following have been accomplished:

Data and information on the static, fatigue and impact strength and performance of the individual prototype chairs, tables, stools, cabinet doors and table drawers from tropical timber generated and known.

Types of furniture damage identified. The extent of damage propagation known and evaluated for specific kind of furniture. Designs or innovations that would improve the strength and stability of furniture identified and recommended to manufacturers.

## **1.5 Strategy Adopted in Carrying Out the Project**

The strategy adopted in carrying out the project was primarily to ensure that it is executed smoothly based on the approved workplan or timetable for implementation. The strategies and measures were followed.

Identification and Designation of Project Staff and Personnel.

The Project Leader, National Expert acting as Assistant Project Leader and the International Consultant was done by the Executing Agency in consultation with the ITTO. Hiring of support personnel namely: Research Assistant, Computer

Operator, Machine Operator and Clerk/Bookkeeper was done also in consultation with the ITTO. They were informed and oriented of their duties and responsibilities and scope of work.

The Project Leader and National Expert made frequent dialogue with project personnel and emphasized the activities to be done and output to be attained. They take care/monitor of the day-to-day operation/implementation of the project. It confers with furniture manufacturers and exporters for the supply of prototype furniture to be tested. These firms are members of the Chamber of Furniture Industries of the Philippines (CFIP) and who are the target beneficiaries of the project. The International Consultant trained the project personnel on the methods and procedures employed in performing tests for wood furniture using the British-European Standard (BS-EN) and the equivalent ISO Standard.

Project funds are being transferred and deposited by ITTO to a Project Bank Account in a reputable local bank recommended by the Executing Agency. Procurement of supplies and materials for the project followed the standard operating procedure of the Philippine government and the ITTO Guidelines for Procurement and Payment of Service. Request for cash advance for travel by project personnel followed standard government procedure. All disbursements, vouchers, cheques and other related documents are being signed by the Project Leader, Deputy Director, Accountant and Cashier.

The Project Management regularly submits Bi-Annual Progress Reports to ITTO and provide relevant data and information on the status of project work/ accomplishments corresponding to the period covered in the implementation. The Project Monitoring Review and Evaluation Committee monitor and review the progress of project implementation and made some recommendations to led the project to successful completion and to bring the outputs at most to the target beneficiaries.

To promote the importance of project, it participated in two International Furniture Shows and Exhibitions in Angeles City and Cebu City. It presented posters and brochures to highlight the objectives, the testing facilities available and the services rendered to the furniture industry. The project likewise participated in the Fourteenth Annual Science and Technology Fair held at the Philippine Trade and Training Center in Manila. The participation in the technology fair help promote the importance of testing wood furniture using established standards and its role in improving their competitiveness in the world market.

## **1.6 The Project's Planned Duration and Planned Overall Costs**

The Project's planned duration was for one year and one half from May 01, 2002 to October 31, 2003. It was given an extension of six months to complete the testing activities of prototype furniture from November 01, 2003 to April 30, 2004 without additional funding. During the meeting of the Project Monitoring, Review and Evaluation Committee on January 21, 2004 held at FPRDI in Los Baños, Laguna, the Committee agreed and adopted the suggestion/

recommendation of the ITTO Representative Dr. Emmanuel Ze Meka, Assistant Director of Forest Industry that the output of the project be disseminated to the furniture manufacturers in the Philippines. The Committee likewise authorized the Project Staff to use the savings of the project in the dissemination process starting May 01, 2004 to October 31, 2004, subject to the preparation and submission of an addendum/amendment project proposal for the dissemination of the project outputs to target beneficiaries.

The planned overall cost of the project was US \$367,899. This included a grant proceeds of US \$139,999 from ITTO and a counterpart in kind resources (Testing machines and Laboratory facilities) from FPRDI amounting to US \$227,900. Out of the grant proceeds, the ITTO retained the amount of US \$11,799 to cover for monitoring and evaluation and administrative costs. The amount of funds managed by the project was US \$128,200.

### **Relevance to Regional and National Policies to which the Project Relates**

The Philippines is a member of the World Trade Organization (WTO), the Asia – Pacific Economic Cooperation (APEC) and the Asia Free Trade Area (AFTA). This compels the country to institute measures and adopt internationally established and accepted standards for product quality, performance or serviceability set by these organizations for Mutual Recognition Agreement (MRA) through harmonization of standards and accreditation of test facilities to remove discrimination against foreign products and ensure that obstacles to trade are eliminated.

In view of the above, the Philippines must produce furniture and other related products that conforms to the required quality standards to remain competitive and maintain a lead in the world market. Although producers are encouraged to implement good manufacturing practices to address the challenges of market globalization, the industry must be supported in terms of technical and managerial training and appropriate testing services. Hence, this project was conceptualized, proposed and implemented to address the vital problems of the furniture industry and likewise ensure that Philippine furniture meet the global standard quality and performance before they are marketed locally or exported.

## **2. Project Achievements**

### **Outputs Achieved**

Data and information on static, fatigue and impact strength on different kinds of furniture were generated. Using seat static load, back static load and balancing load of 1,300 Newtons (N), 560 N and 1,300 N respectively applied 10 times under test level 3 of the standard for chairs the performance of the individual prototype chairs from different furniture producers/manufacturers were obtained for information. The test standards used are ISO 7173, BS 4875 Part 1 and BS EN 1728.

The seat fatigue and back fatigue performance of prototype chairs using a seat load of 950 N and back load of 330 N with balancing load of 950 N were adopted in the test. Most of the chairs tested passed the 50,000 cycles without any sign of defect. Although in some chairs, slight defect start to develop after 10,000 to 25,000 cycles. These defects in the form of slight separation of the rear legs from the rails and loosening of the joints would increase in size at 30,000 to 40,000 cycles. The types of joints used in the construction of prototype chairs are mortise and tenon and dowel joints.

Impact performance of the seat and back of individual chairs were tested and evaluated using a drop height of 180 mm of the vertical impactor and applied 10 times for the seat and 210 mm height of pendulum hammer at an angle of 38 degrees and also applied 10 times to the back rest. Except for a few chairs most of the products survived or passed the drop test using test level 3 of BS 4875 Part 1 and 3 and ISO 7173. Specifically one chair passed the static, fatigue and vertical impact test but failed in horizontal impact and drop tests. Failure occurred at the backrest for impact test and at the joints between the front leg and armrest and also between the armrest and rear post in drop test.

For stools, similar tests parameters and machines were used with that of chairs in testing the static, fatigue and impact strength and performance when drop at specified height. Most of the stools tested passed the ISO 7173 and BS 4875 Part 1 standards.

For pivoted cabinet doors, the standards used were BS 4875 Part 7 and ISO 7170 both for strength determination. The machine used was the door cycling machine. Test results showed that the cabinet doors failed in durability test. Loosening of metal hinges occurred at 20,810 cycles. Test requires 40,000 cycles. The pivoted doors also failed in vertical load. The hinges were deformed when a weight of 25 kilograms was applied at 100 mm from the edge.

For drawers, similar standards were employed in testing cycling and slamming test. Results indicated that drawer performed satisfactorily. Test includes horizontal load movements of drawers and runners slam shut and open.

For table, it failed under vertical load test. It tilted after loading 53.3 kilogram force on one end. The minimum required is 61.6 kilogram force. The table however passed the horizontal impact test. Under strength and durability, the table passed the horizontal and vertical static and fatigue tests. It also passed the vertical impact and drop test.

### **Specific Objectives Achieved**

The first specific objective was to test and evaluate the static, fatigue and impact strength of export wood furniture under high and rapid rates of loading that occur occasionally and during daily use. This was achieved satisfactorily by testing and evaluating individual prototype chairs, stools, cabinet doors, drawers on their static, fatigue and impact strength using the required testing machines following British Standard (BS), British-European (BS-EN) and International Organization for Standardization (ISO). Since the furniture tested

is under the performance category of **delicate, careful domestic, general domestic** and **careful contract**, test level 3 of the standards was used with relative ease and success. Majority of the furniture tested passed the above tests with their corresponding specified number of load or force applications and cycles to attain. There were some few visible defects or damage that occurred during the actual testing. For some few chairs that failed during the test, failure occurred during the drop test and during back impact test.

The second objective was to determine the initial damage and damage propagation and withstand acceptable mis-use. Recommend design improvement or innovations to upgrade performance and quality.

This objective was achieved during the actual testing of prototype chairs, stools and cabinet doors. Initial damage in the form of hairline separation/gap of the rear post and rail joint connection is usually observed during the initial stage of the fatigue test. As the test progresses, this hairline gap likewise increased to a certain degree depending on the type of joint construction used. After the required number of cycles, which is 50,000 cycles or 50,000 repeated application of load on the seat and backrest of a chair, this initial hairline damage reached about 1.5 mm to 3.5 mm at its widest gap.

For prototype chairs that failed to attain the required number of cycles, the type of joint used in the construction were determined together with the dimensions of tenon for mortise and tenon joint and the dimensions and number of dowels used for dowel joint. Similarly the presence or absence of corner blocks underneath the seat were examined. If there are corner blocks, the kind of fastening materials, the number and size of fasteners were assessed. After a thorough assessment and evaluation of these factors and components, innovative design or modifications are recommended to improve the strength and performance of the furniture.

Some of the recommended innovations in design and construction to improved furniture performance are:

- a) Place/insert dowel in the chair leg first to ensure maximum length penetrating in the joint or member, then attach or assemble it to the underframe.
- b) Use adequate size dowels passing through the tenon of the rear seat member joint. Place dowels of adequate and right distance from each other and insert it to sufficient depth to the rear legs first.
- c) Use or place adequate size and shape corner blocks of wood species having a specific gravity of 0.500 to 0.650, fine texture and straight grain, double screwed into each seat member/rails. Wood screw as fastener is of sufficient length to provide rigid joint connection. Using nails as fasteners for corner blocks is not recommended by this study.
- d) Use side stretchers of adequate size/dimension placed/inserted in the chair legs at a distance of 100mm from the floor. Stretchers must be doweled to the chair legs. Single dowel is common.



- e) In designing some chairs, the seat plate should be reduced in thickness, and other component parts (legs and posts) should be reduced in size. This will significantly reduce the weight of the chair thereby minimizing their damage or failure during drop test.
- f) In designing curved or rounded components of furniture especially chairs, as much as possible minimize the short grain portion to avoid easy splitting and disintegration of said component/part.

### **Contribution to the Achievement of the Development Objective**

The contributing factors to the achievement of the development objective of the project were the following:

- a) Strict, careful and dynamic financial management system of the ITTO and FPRDI Project Management Staff which allowed funds to flow smoothly on time to the project;
- b) Active and dynamic participation of competent project staff and support personnel in execution of project activities. The extraordinary talent of the International Consultant and his dedicated and complete guidance in testing furniture using established test standards and sophisticated equipment;
- c) The cooperation of Furniture Show and Trade Fair Organizers in allowing the project to participate; and
- d) Timely fabrication/production of prototype furniture used in actual testing. Willingness of some furniture manufacturers/exporters to provide prototype chairs for testing and their cooperation in making some innovations or improvements in design and construction of their products to improve strength, stability and performance.

### **Prevailing Situation After Project Completion**

Although the project has no pre-project component, it can be categorically stated that the situation after project completion is very important and informative particularly to the furniture manufacturers, designers, importer, retailers and users. The designer and manufacturer were able to identify the strength and weakness of their product hence assisting in redesigning or making innovations to improve product quality. They can ensure a consistent quality of their product and provide guaranteed reliability to end-users. They can instill the confidence of using their product by their clientele. The importer and retailer of furniture are assured that their product have met specific standards as claimed by the manufacturer. It will enhance the reputation as a source of quality furniture. The end-users or consumers are assured that they are getting what they have paid for. They have the all-out feeling of comfort and knowing that the products they purchase are strong, durable, safe and of high quality.

### **3. Target Beneficiaries Involvement**

The members and non-members of the Chamber of Furniture Industries of the Philippines (CFIP) are the main beneficiaries of the project. The participation of some of these beneficiaries/furniture manufacturers and exporters was on the fabrication of prototype chairs, stools, tables, cabinet doors and drawers for actual strength and performance tests. These firms are located in Metro Manila area and some are in the provinces. They produce different types of furniture for various intended uses. They supplied both the original and modified test furniture products.

The results of the project will be used by the furniture producers in designing and construction of their products in the future. Although at present, the firms that supplied the test furniture had already benefited from the output of the project since they already modified some of the designs and construction methods by using or adopting the recommended innovations made by the project. They were able to realize and observed that the modified chairs performed very satisfactorily compared to their original test samples submitted for testing. Since the results/outputs of the project is now being disseminated or transferred to the beneficiaries, the beneficial impact will be realized soon and primarily in the very near future.

There was no formal arrangements made with the project beneficiaries for projects implementation however, FPRDI had a dialogued with officers and members of the CFIP where the objectives, expected output and importance of the project were presented and discussed. There was a good impression from the CFIP and they promised to support the intended activities.

Corollary to the project, the FPRDI had set-up the FPRDI Furniture Testing Center (FFTC) at Los Baños to continue testing furniture and cater to other support services to the furniture industry in the country. The operation and maintenance of the project activities will be continued by the FFTC.

### **4. Lessons Learned**

#### **a) Development Lessons**

*Aspects of project design which most contributed to its success in achieving the Development Objective*

- The timely acquisition and installation of the primary testing machines to be used in the project work;
- The proper and effective calibration of the test machines by FIRA engineers/technicians;
- Timely and smooth transfer of project funds by the ITTO to the Executing Agency;
- Simple and effective management system of project personnel in the execution of project work/activities. Total support of the Executing Agency Head to the project;
- Timely supply/procurement of prototype furniture required for the testing. Dynamic cooperation of furniture manufacturers; and

- Dedicated and strong support and cooperation of the International Consultant, the Project Monitoring, Review and Evaluation Committee, and the support personnel contributed to the success in achieving the development objective of the project.

*Changes in Inter-Sectoral Links that Affected the Project Success*

- There was no changes made in intersectoral links made in the project, what is maintained was a strong linkage, coordination and cooperation between ITTO and FPRDI, between FPRDI and the furniture manufacturers/exporters in the implementation of the project. This action will be maintained even after the completion of the project; and
- The decision of the Project Monitoring, Review and Evaluation Committee in its meeting on 21 January 2004 to disseminate the project outputs to the beneficiaries of the project immensely contributed to the success of the project.

*Additional Arrangements that Could Improve Cooperation Between Parties Interested in the Project*

- Constant contact or communication between Project Management and furniture producers and exporters; and
- Frequent participation of the project in Furniture Shows and Trade Fairs showcasing the important activities and objectives of the project.

*Factors which will Most Likely Affect Project Sustainability after Project Completion*

- Continued support and cooperation of CFIP members in having their products tested;
- Proper management and maintenance of the Furniture Testing Center by FPRDI; and
- Training of more technical staff/personnel to manage and implement the day-to-day activities of the Center.

**b) Operational Lessons**

*Project Organization and Management*

- Practical and simple management system that allows timely and direct flow of funds to the project enhances completion of work/activities;
- Sincere and facilitative approach to project supervision and monitoring significantly contributed to attainment of project objectives and expected outputs;
- Transparent and practical leadership style of project management establishes an informal and close cooperation between manufacturers of furniture and project personnel;
- The dedication and support of the International Consultant and the technical and support personnel contributed immensely to the success of the project.

### *Project Documentation*

- Proper documentation of project progress reports including financial update in the process of implementation is very important; and
- Accurate and adequate sharing of information and vital recommendation generated from technical reports is very necessary.

### *Monitoring and Evaluation*

- The Project Monitoring, Review and Evaluation Committee (PMREC) review and evaluate the progress of project work to check whether the implementation is on track and toward the attainment of set objectives. The PMREC makes suggestions and recommendations to project management to ensure successful completion of the project.
- The Project Leader submits progress reports and proceedings of committee reports to the PMREC and ITTO Secretariat for information/documentation for the benefit of ITTO member countries/governments.

### *Quality of Project Planning*

- The project work/activities were carefully planned towards achieving specific objectives to solve identified problems in the project;
- A performance chart, which indicates the activities and planned target for a specific calendar year was prepared. At the end of the calendar year, the actual work done is compared with the planned target. Such performance chart easily identify project activities that are on track, short of planned target or ahead of target; and
- The overall project plan was good and have desirable quality.

### *Definition of Roles and Responsibilities of the Institutions Involved in the Project Implementation*

- As provided in the Project Agreement, the ITTO provided the amount of US \$139,999.00 for the implementation of the project. It conducted monitoring and review of the project implementation and offered recommendations for the successful implementation and completion of the project and the dissemination of outputs to the intended beneficiaries; and
- FPRDI on the other hand provided the office for project staff, the testing laboratory, the testing machines and the energy (electricity) required for the conduct of project amounting to US \$227,900.00. It submits technical progress reports, periodic statements of budget, expenditures and balances, and some other relevant reports to ITTO.

### *Actions Taken to Avoid Variation Between Planned and Actual Implementation (Schedules, Cost, etc.)*

- Provision of a thorough reflection or situation analysis prior to project planning; and
- Project design should provide an adoptive alternative mechanism to take care/respond to any unforeseen constraint so that other project activities will not be adversely affected.

*External Factors that Influenced Project Implementation that Could Have Been Foreseen*

- The period of time between or gestation period of the project proposal from submission to Expert Panel to Council approval, funding and implementation;
- The revision and update of some British Standards (BS) for furniture testing and its combination with European Standards (EN) to form the BS EN Standard; and
- The actual time required to test prototype furniture using established standards and procedures.

*External Factors that Influenced the Project Implementation that Could Not Have Been Seen*

- The rigorous and tedious process of testing led to the request for extension of the project activities for six months from November 2003 to April 2004 to complete the performance testing of prototype furniture samples and recommendation of improved designs and innovations; and
- The implementation of the PMREC recommendation to disseminate the project outputs to the beneficiaries, which is the furniture manufacturers and exporters in the Philippines.

## **5. Recommendations**

*To improve efficiency and effectiveness of future similar projects, the following are recommended:*

- The dissemination of project achievements/outputs should be included as an integral part of the project design thereby requiring a minimum of three years implementation;
- Budget required for the procurement of the necessary test machines and accessories should be included in the project budget requested from financing organization;
- All test standards required for the project should be procured or made available prior to project start-up;
- Project personnel to conduct actual testing work should be properly trained on the operational procedures of the machines to be used in the project; and
- The importance, objectives and expected outputs of the project should be made known in advance to the furniture manufacturers and exporters, retailers, the users before project implementation. This will give them more time to evaluate the benefits of the project intervention.

## **PART II. MAIN TEXT**

### **1. Project Content**

The main goals of the project are to provide furniture manufacturers an information and reference on whether their product would withstand the actual loads or forces and cope with the functional use it will encounter in actual service and to find solution to the problem of furniture buyers and users on the pre-mature failure or inadequate performance of furniture in service. The project will determine and evaluate the strength and performance of prototype furniture (chairs, tables, stools, cabinet doors and drawers) by the actual application of loads or forces that simulate normal functional use, and acceptable mis-use, according to a graded scale of severity following established test standards. Tests will include static, fatigue and impact. Evaluation of defects that may occur will include initial damage and damage propagation and their ability to withstand some acceptable mis-use in service.

The project will recommend some improve designs or innovations in furniture construction particularly on joint construction to upgrade the performance and quality of furniture. Project outputs will be disseminated to the furniture producers, exporters, retailers and users.

#### **Project Outputs:**

- Data and information on the static, impact and fatigue strength and performance of chairs, stools, tables, cabinet doors and drawers made from tropical timber.
- Types of furniture damage identified. Extent of damage propagation in prototype furniture known. Designs or innovations that would improve strength, quality and performance identified and disseminated to furniture manufacturers.

#### **Project Strategy**

##### **Reason for Selection**

Specifically, the Executing Agency (FPRDI) has a dynamic R& D and S & T program addressed to support the furniture industry sector in the Philippines. Research outputs are published in technical journals, bulletins and distributed to furniture manufacturers and exporters for information. The publication of research results are augmented by the conduct of seminar-workshops, hands-on training and demonstration in different regions of the country. These activities significantly enhance the upgrading of manpower capabilities, improved facilities, product quality and their competitiveness in the world market.

During the last four decades, the Executing Agency continuously upgrade its manpower, structure and have played an important role to the development of wood industry in the country.

## **Technical and Scientific Aspects**

In this project, the test standards that will be followed in testing the strength and performance of furniture are the British Standards (BS) and the International Organization for Standardization (ISO). These two standards have specific provisions and procedure in conducting actual test on different category and type of furniture. The testing machines in the project were procured from the Furniture Industry Research Association (FIRA) of United Kingdom. The FIRA is well known for its work and services on furniture testing and test facilities. It uses the BS in performing tests for wooden furniture.

## **Economic Aspects**

The project output will benefit the whole furniture industry in the country considering that its primary objective is focused towards ascertaining that furniture products that will be sold in the market had passed the strength requirements specified by the test standards. This would enhance the quality and performance of furniture and improved the selling price and competitiveness in the world market.

## **Social Aspects**

Considering that about 85 percent of the world population are users of furniture, the users would be satisfied with the performance of their furniture, thus generating tremendous social impact.

Considering further that there will be an improved and smooth trading of furniture, manufacturers will be encourage to grant some incentives to their workers which ultimately would result to their social upliftment.

## **Required Inputs**

The inputs required for the implementation of the project were the research and support personnel to implement the project. The financial resources provided by the ITTO and the Executing Agency and the equipment and facilities for the testing activities. Some furniture manufacturers supplied the prototype chairs, stools, tables, cabinets and drawers for testing.

## **Relevance to ITTO**

### **Compliance with ITTA Objectives**

The project is consistent with objectives d, e, f and g of ITTA 1994.

- d) To enhance the capacity of members to implement a strategy for exports of tropical timber and timber products from sustainably managed sources by the year 2000;
- e) To promote the expansion and diversification of international trade in tropical timber from sustainable sources by improving the structural conditions in international markets, by taking into account, on the one hand, a long-term

increase in consumption and continuity of supplies and on the other, prices which reflect the cost of sustainable forest management and which are remunerative and equitable for members, and the improvement of market access;

- f) To promote and support research and development with a view to improving forest management and efficiency of wood utilization as well as increasing the capacity to conserve and enhance other forest values in timber producing tropical forest; and
- g) To promote increased and further processing of tropical timber from sustainable sources in producing member countries with the view of promoting their industrialization and thereby increasing their employment opportunities and export earnings.

### **Compliance to ITTO Criteria**

The project is consistent with the criteria established by ITTO

- a) Be related to the production and utilization of industrial tropical timber;
- b) Should yield benefits to the tropical timber economy and be relevant to producing as well as consuming members;
- c) Be related to the maintenance and expansion of the international trade;
- d) Should offer reasonable prospect for positive economic returns in relation to costs; and
- e) Should make maximum use of research institution and, to the greatest extent possible, avoid duplication of efforts.

### **Relevance to ITTO Action Plan**

The project is related and strongly linked to the ITTO Libreville Action Plan, which was prepared in response to the new International Tropical Timber Agreement, 1994 (ITTA, 1994), which entered into force on 01 January 1997. The new Action Plan elaborates a strategy for advancing ITTO objectives, operational activities and statistical work as set forth in the ITTA, 1994. The project is in support and in compliance with the new Action Plan considering that the standardization of test for furniture would support marketing methods in the furniture industry sector. Having a uniform and standard test would not only help enhance marketing methods but it will likewise support market opportunities for furniture products. Importers and users of furniture are provided with the assurance that they buying a product with quality, desirable strength and performance.

## **2. Project Context**

The furniture industry is among the country's "export winners" counted on to help propel Philippine economy in the next millennium. It is ranked number 5 among the country's foreign exchange earners in the later part of 1990's. The export of furniture steadily increased from US \$240 million in 1994 to US \$324 million in 1998. The export target for year 2000 was US \$500 million.



The world market for furniture is US \$38 billion annually and wooden furniture share about US \$12 billion. This implies that Philippine furniture has a good prospect to capture a bigger share of the market.

The implementation and completion of the project and the establishment of the FPRDI Furniture Testing Center are important developments that clearly support the improvement and modernization of the furniture industry sector. It is a strong indication that furniture manufacturers could adequately respond to the liberalized market policies among members of the World Trade Organization (WTO) and Asia-Pacific Economic Cooperation (APEC). At present, the project outputs are being disseminated to the furniture makers in the Philippines to enhance their growth and global competitiveness.

### **3. Project Design and Organization**

#### **Comment on the following issues:**

##### **Adequacy of the Results of the Identification Phase**

The design was consistent with the expressed objectives to generate data and information on the strength and performance of furniture from tropical timber using established test standards. Recommend innovative design and construction methods to improve strength and performance in service.

The workplan and strategy for the implementation of activities were strictly followed to come-up with the specified outputs.

##### **Sound Conceptual Foundation of the Project**

The concept of the project is to test and evaluate the static, fatigue, impact strength and stability of wooden furniture under appropriate levels and rates of loading that occur occasionally and during daily use. Determine the damage/defect and its propagation and ability to withstand acceptable mis-use and recommend improved design/innovations in construction to improve the performance and quality of furniture products. The proper and effective implementation of the project work and the support and cooperation of ITTO, FPRDI management, the furniture makers, the organizers of furniture shows and the trade fairs ultimately led to the successful completion of the project.

##### **Adequacy of Time and Other Resources for Project Formulation**

There was an adequate time in the formulation of the project. It was prepared and submitted to ITTO in 1999 and approved in 2000. Funding was made available in 2001 by the ITTC. The project started on May 2002. The time for project formulation and reformulations as required by the ITTO Expert Panel was sufficient and project plans are practicable.

##### **Understanding and Appropriateness of the Roles and Responsibilities of Institutions Involved with Project Implementation**

The cooperation and mutual support of the ITTO, the government of the Philippines, and the FPRDI on the need to upgrade the performance and quality of export wood furniture and enhance their competitiveness in the world market led to the implementation of the project. The ITTO provided the financial

requirements of the project. It requires the executing agency to submit Bi-Annual reports on the technical and financial aspects; it conduct monitoring and review of activities during the implementation; and after project completion, it requires the executing agency to submit the completion report, final technical report and the audited financial report.

The FPRDI implements the project based on terms and conditions stipulated in the Project Document and on the approved Memorandum of Agreement.

#### **Beneficiary Involvement with Project's Efforts and Actions**

The support and cooperation of the furniture producers and exporters from Metro Manila, Laguna and Pampanga provinces was quite commendable. They provide the prototype furniture for actual performance test. Some of these firms likewise provided the modified furniture for further testing and evaluation. Even after the completion of the project, there is continuing walk-in and routine requests from target beneficiaries for actual testing of their products.

#### **4. Project Implementation**

##### **Comment on the following issues:**

##### **The Most Critical differences between Planned and Actual Project Implementation**

The planned duration of the project was 18 months from May 2002 to October 2003. An extension in time for six months was requested and granted from November 2003 to April 2004 to complete the performance evaluation of furniture samples. After the completion of the project, the Project Monitoring, Review and Evaluation Committee decided that the project outputs be disseminated to the beneficiaries using the savings in the budget. With this decision, Project Management prepared an amendment proposal in a form of an addendum to the project with the object of disseminating the outputs to furniture manufacturers and exporters in the Philippines. The duration of this activity is from May 2004 to October 2004.

In terms of project cost, the total project expenditure was US \$ 104,155.41 and a total US \$128,200.00 was released to the project by ITTO. This leaves a savings of US \$ 24,044.59, which was utilized in the dissemination of project outputs in the addendum activities to the project. The FPRDI provided counterpart in cash and kind resources/equipment amounting to US \$227,900.00. The dissemination of project outputs was completed with satisfactory results.

##### **Measures and Actions Which Could have Avoided these Variations**

Provide more time for the project, about 3 years to exhaustively have more detailed and comprehensive test and evaluation.

An implementation of a pre-project could have minimized these variations.

### **Appropriateness of the Assumptions made and the Correct Identification of Risks Involved**

The assumptions made that a strong teamwork among project personnel exists in the project implementation was quite appropriate that it ultimately lead to the attainment of the development objectives. The assumption that there are no breakdowns in the machines used in the conduct of testing activities was very relevant and contributory to the successful completion of the project.

The identified risk that the breakdown of the testing machine would require a big amount of funds to repair or make it operational did not materially affect the project execution. Although there were some stoppage of machine operation but there occurrence is quite minor to affect their operation. On the economic point of view, the risk that the small scale furniture makers might not be ready to face the additional cost that will be involved for the testing of their products. It was clearly manifested in the project that the firms actively involved in the project are the medium and big scale furniture manufacturers.

### **Sustainability of Activities After Project Completion**

After project completion, the outputs will be disseminated to the beneficiaries the furniture manufacturers and exporters. The management and operation of the testing facilities will be continued by the FPRDI Furniture Testing Center. The Center will cater to the strength and performance testing and evaluation of furniture from the industry based on ISO, BS and BS-EN standards. The sustainability or continued operation of the project is assured by the existence of the Center and its day-to-day services in response to the needs of the furniture industry sector.

### **Appropriateness of Project Inputs**

The inputs provided by the institutions/organization to the implementation of the project is very appropriate and logical. These inputs include manpower, trainings, consultancy services, funds for personnel services, provision for travel, capital items, supplies and materials, and other miscellaneous items. These were sufficient to complete all project work/interventions, and the funds were enough to cover all costs up to the extension period and the dissemination of project outputs to the beneficiaries.

## **5. Project Results**

### **Comment on the following Issues:**

#### **Situation Existing at Project Completion as Compared to the Pre-project Situation**

The situation after project completion is enthusiasm and favorable environment for both members and non-members of CFIP numbering about 3,000 (inclusive of those registered and unregistered with Board of Investments of the Philippines). The project does not only generate and provide first hand data and information on the strength and performance of wooden furniture when subjected to various tests using established test standards but it also made some recommendations on improved design or innovations on furniture construction to improve quality and performance.

After project completion furniture makers and exporters have a complete access to FPRDI Furniture Testing Center to have their prototype products tested for any kind of test they require prior to export. They can secure certification that the furniture they are selling had passed the test requirements prescribed by international standards for any kind or category of furniture item. On the part of furniture users or consumers they are assured that they are buying safe and reliable furniture.

After the completion of the project, furniture manufacturers in the country continue to bring their samples to the Center for testing and evaluation. This is a continuing activity.

The project was implemented without a Pre-Project.

### **Extent to which Project Specific Objectives were Achieved**

The following discussion described the extent by which the specific objectives were met:

**Specific Objective 1.** Test and evaluate the static, fatigue and impact strength of wood furniture under high levels and rapid rates of loading that occur occasionally during daily use following established tests standards.

Data and information on static, fatigue and impact strength of different kinds of furniture were generated. Using seat static load of 1,300 Newtons (N), back static load of 560 N and 1,300 N balancing load applied 10 times under test level 3 of the standard for chairs, the performance of the individual prototype chairs from different furniture manufacturers were obtained for information. The test standards used are the ISO 7173 and BS 4875 Part I and BS-EN 1728.

The fatigue performance using a seat load of 950 N and backload of 330 N with a balancing load of 950 N were known and used for the test. Most of the chairs tested passed the 50,000 cycles or repeated loading without any sign of defect. In some chairs however, slight defect start to develop after 10,000 to 25,000 cycles. These defects are in form of separation of the rear leg from the rails and the loosening of the joints.

Impact performance of the seat and backrest were tested and evaluated by drop test with a height of 180 mm of the vertical impactor applied 10 times for the seat and 210 mm height of the pendulum hammer at an angle of 38 degrees and applied 10 times for the backrest. Except for a few chairs most of the test samples passed the drop test using test level 3 of the standards. Specifically one chair passed the static, fatigue and vertical impact test but failed in horizontal impact and drop test. For stools, similar test parameters were used with that of chairs in testing the static, fatigue and impact strength and in drop test. Most of the stools tested passed the test standards.

For pivoted cabinet doors, the standards used were BS 4875 Part 7 and ISO 7170 for strength determination. Results of tests showed that the cabinet doors failed in durability test. Loosening of metal hinges occurred at 20,810 cycles. Test requirement is 40,000 cycles. The pivoted doors also failed when a vertical

load 25 kilograms was applied at 100 mm from the edge. For drawers, similar standards were followed in testing cycling and slamming performance. Drawers performed satisfactorily. The test includes horizontal load movements of drawers and runners slam shut and open.

For table, the test sample failed under vertical load. It tilted after loading 53.3-kilogram force at one end. The minimum load required is 61.6-kilogram force. The table however passed the horizontal impact test. Under strength and durability, the table passed the horizontal and vertical static and fatigue test. It also passed the vertical impact and drop test.

**Specific Objective 2.** Determine the initial damage and damage propagation and withstand acceptable mis-use. Recommend design improvement or innovations to upgrade performance and quality.

Initial damage in the form of hairline gap or separation at the joint portion of the rear post and rail was observed during the initial stage of the fatigue test. This gap increases in size as test progresses. After 50,000 cycles or repeated application of load on the seat and backrest of the chair, the initial gap reached about 1.5 mm to 3.5 mm at its widest. This size of defect was not enough to indicate failure of the chair.

For those chairs that failed to the required number of cycles or load applications, the type of joint used in the construction were determined together with the dimensions of the tenon for mortise and tenon joint and the size and number of dowels used for dowelled joint. The presence or absence of corner block and stretchers were examined. If there are corner blocks and stretchers present the kind of fasteners, the number and size of fasteners were determined and assessed.

Some of the recommended innovations in design and construction to improve furniture strength and performance are as follows:

- Place/insert dowel in chair leg first to ensure maximum length penetrating in the joint or member, then attached or connect it to the underframe;
- Use adequate size dowels passing through the tenon of the rear seat member joint. Place dowels at right distance from each other and insert to sufficient depth to rear legs first;
- Use adequate size and shape corner blocks of wood species having a specific gravity of 0.500 to 0.650, fine texture and straight grain;
- Use adequate size side stretcher placed in chair legs at a distance of 100 mm from the floor. Stretcher must be dowelled to the chair legs;
- Use wood screw of sufficient size instead of nails in fastening corner blocks;
- In designing chairs the seat plate and other components must be of correct dimensions to minimize damage and failure during the drop test; and
- In designing curved or rounded components of furniture particularly chairs, as much as possible minimize the occurrence of short grain portion to avoid easy splitting of parts or components.

## **Impact of Project Results on the Sectoral Programs, Physical Environment, Social Environment, and on the Target Beneficiaries**

### *Impact on the Sectoral Programs*

The project result has a great benefit to the furniture industry sector. Data and information generated by the project will serve as benchmark information on the strength, durability and stability of furniture with specific category and type. Through proper and effective testing of furniture the manufacturers and exporters are assured that they are selling furniture that comply with established international standards. That the products they manufacture are competitive in the world market as far as strength, performance and quality are concerned.

With regard to the general public or users of furniture, the impact is likewise paramount that the product they acquire or purchase are reliable, durable, safe and of good quality. They are highly compensated for what they have paid for.

### *Impact on Physical Environment*

Considering that furniture producers will be adopting the recommendation of the project in their production system, there will be a proper and effective utilization of tropical timber for furniture thereby promoting conservation of the country's forest.

### *Impact on the Social Environment*

The project results generated some social impact to the general population considering that 85 percent of the people in the world are users of furniture. With the project results manufacturers and exporters of the product would experience smooth flow of trade. Favorable business trade will encourage entrepreneurs/capitalists to grant incentives to workers, which could result to social upliftment in society.

### *Impact on the Target Beneficiaries*

The government and the CFIP development programs and policies could be strengthened by the project outputs. It can initiate some regulations and guidelines base from the project results for furniture producers and exporters to adopt in their design and production system. The technical reports and plans are vital documents that will help them in their present and future activities. The impact of the project is favorable to the business and trade of furniture in the domestic and foreign market. Furniture producers have gained vital technical knowledge to improve their product and competitiveness in the world market. Future projects of ITTO with parallel objectives will benefit from the recommendations on the project designing, fund management, implementation, monitoring and evaluation.

### *Project Sustainability after Completion as a Result of Project Conceptualization, Assumptions Made and Conditions Prevailing at Completion*

Project sustainability after completion as a result of conceptualization is considered bright and significant. Considering that the project was conceptualized to offer solution to the poor quality and performance of furniture in actual service resulting to pre-mature failure, the output derived from the

project would enhance and maintain its sustainability. Supportive of this manifestation is the data and information obtained on the strength, durability and stability of various types/category of furniture tested and evaluated by the project.

Project sustainability after completion as a result of the assumptions made remains to be seen. The assumption that a strong teamwork among project personnel exists in the implementation may or may not exist after project completion. The second assumption that all project inputs are available on time and as scheduled during project execution may or may not be complied with, thus would affect project sustainability. The third assumption that there are no breakdowns in the machines used for testing likewise depends on the proper and efficient maintenance of the testing machines. Thus, sustainability of the project is primarily dependent on machine conditions.

Project sustainability after completion as a result of prevailing conditions at completion is very appreciable and encouraging. Considering the conditions prevailing at completion where the testing machines are in operable condition, the FPRDI Furniture Testing Center staff and support personnel are available to continue the various activities undertaken by the project, there will be no gap or obstacle visible that may hinder the sustainability of the project. The actual prevailing situation at completion is that requests for testing of prototype products coming from furniture producers is on line. These requests for furniture testing will progressively increase in the coming years particularly after the dissemination phase of the project outputs to the beneficiaries.

## 6. Synthesis of the Analysis

- |                                     |   |
|-------------------------------------|---|
| (a) Specific Objectives Achievement | <input checked="" type="checkbox"/> Realized<br><input type="checkbox"/> Partly Realized<br><input type="checkbox"/> Unrealized                   |
| (b) Outputs                         | <input checked="" type="checkbox"/> Realized<br><input type="checkbox"/> Partly Realized<br><input type="checkbox"/> Unrealized                   |
| (c) Schedule                        | <input type="checkbox"/> In advance<br><input checked="" type="checkbox"/> Delayed, not seriously<br><input type="checkbox"/> Seriously delayed   |
| (d) Actual Expenditure              | <input checked="" type="checkbox"/> Below planned<br><input type="checkbox"/> > 10% above planned<br><input type="checkbox"/> > 20% above planned |
| (e) Potential for Replication       | <input type="checkbox"/> No potential<br><input type="checkbox"/> Modest Potential<br><input checked="" type="checkbox"/> Significant Potential   |
| (f) Potential for Scaling-up        | <input type="checkbox"/> No potential<br><input checked="" type="checkbox"/> Modest Potential<br><input type="checkbox"/> Significant Potential   |

## **PART III. CONCLUSIONS AND RECOMMENDATIONS**

### **Lessons Learned**

#### **Development Lessons**

- Timely acquisition and installation of the testing machines; Proper and effective calibration of these equipment; and efficient transfer of project funds by the ITTO to the Executing Agency contributed significantly to the success in achieving the development objectives.
- Similarly the adoption of a simple and effective management system of project personnel in the execution of project work and the total support of the Executing Agency head and staff immensely contributed to the attainment of the project objectives.
- Timely and efficient procurement of furniture items for testing and the cooperation of the furniture manufacturers together with the dedicated support of the International Consultant and the proper guidance of the Project Monitoring, Review and Evaluation Committee contributed to the successful completion of the project.
- Constant contact between project management and furniture producers and exporters, and the participation of the project in furniture shows and trade fairs help enhance the success of the project.
- The continued interest of furniture makers to have their product tested and the proper management and maintenance of the testing center together with a pool of technically trained staff/personnel will contribute to the sustainability after project completion.

#### **Operational Lessons**

- Employing practical and simple management system that allows timely and direct flow of funds to the project enhances completion of project activities;
- Facilitative approach to project supervision and monitoring contributed significantly to the attainment of objectives and expected outputs;
- Transparent and practical leadership style of management establishes close cooperation between furniture makers and project personnel;
- Dedication and support of project consultant; technical and support personnel enhance successful completion of the project; and
- Proper documentation of project reports, financial update, accurate and adequate sharing of information is very necessary in such project interventions.

### **Recommendations for Future Projects Regarding:**

#### **Identification**

- Benchmark data and information on social, economic and institutional aspects need to be thoroughly assessed before project designing;
- A bigger project is highly recommended in the future to set-up other testing facilities in Visayas or Mindanao.



## **Design**

- Anticipate all future outcomes given various scenarios. Consider developing important indicators and measures for project's objectives and expected outputs;
- Representatives from furniture makers, exporters and users should be included in the planning process; and
- Careful study and familiarization with all standards and test procedures to be used in the study.

## **Implementation**

- Implementation strategies should be carefully work out to include primary activities, planned duration, manpower requirements, qualifications, their duties and responsibilities in the project;
- Continue with ITTO financial practice of being dynamic and practical in financial disbursements and accounting to allow timely and smooth flow of funds to the project; and
- Make sure that the beneficiaries of the project intervention is fully aware and understand the project objectives and long-term effect on their economic and social well-being.

## **Organization**

- Simplified set-up and arrangement is necessary for continuity of supervision from start to completion of the project. Involving same individuals is more productive and advantageous; and
- It should be supported by an equally efficient and organized project management with a project leader who is authorized to make decisions consistent with policies set by the ITTO and the Project Monitoring, Review and Evaluation Committee.

## **Management**

- A dynamic style of management equated with discipline and defined work and budget plans should be combined with practical decision-making. Giving management certain autonomy in making decisions facilitate delivery of project outputs.

## **Dissemination of Information:**

### **Reports**

The most direct method of passing on performance test information on wood furniture is through test reports. The basic requirements for a report are usually tabulated at the end of a furniture test standard. The report should include sufficient photographs of the whole product to identify it completely. Failures in furniture tested should be properly shown. The report should be informative about the cause of any failure and how it could be prevented. The report should also include statements to help manufacturers not conversant with the standard as to what the selected test level relates to and whether any failure that occurred represent a significant danger or is just a technical breach of the requirements of the standard.

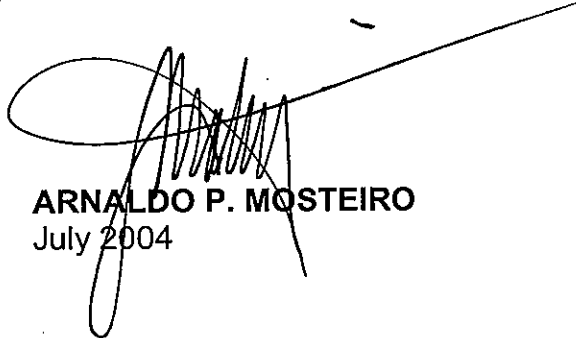
**Seminars**

The other effective means of disseminating information is through meetings, conferences and seminars. This facility is open to manufacturers who cannot get their products to a test facility and enables them to examine samples, ask questions and explain problems.

**Printed Information**

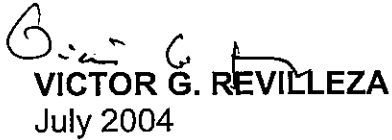
Articles, videos, CD's and fact sheets cannot answer questions or solve individual problems but they reach far more people than test reports and seminars.

**Responsible for the Report**



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