

Chapter 6 Establishment of the “Reference Guideline for Packaging Tests”

6.1 Validation of the "Reference Guideline for Packaging Tests, for Evaluation" at Country Level, and at Regional Level by Data Combination

During the verifications of the PSD diagram in the Study, as stated in the Chapter 6, clause 6.1 of the Report, following characteristics have been confirmed from the gathered data from the surveys, and based on the route classification by route types.

- (1) Truck structures (multiple type of structures used, different types of engines, suspension, number and position of axles, etc.)
- (2) Characteristics of vehicle driving methods
- (3) Variety of route conditions, especially for long distance routes
- (4) Variety of the cargo arrangement in the vehicle
- (5) Characteristics on the distribution system (within urban areas)

Based on this analysis, the following tests have been incorporated and based on their results it was decided to establish the guidelines for the preparation of the "Reference Guideline for Packaging Tests, for Evaluation".

- (1) Vibration Tests (conventional)
- (2) Bouncing Tests
A partial portion of this test can be replaced by the following.
- (3) Repetitive Impact test (The excess portion of above is tested by impact test equipment or, dropping tests by applying repetitive method)

Based on the studies developed during this Study, up to the date of the issue of Progress Report and the Intermediate Report, they represent the results of exhaustive analysis of gathered data during the Transportation Environment surveys of the routes of each country. The next validations have been made considering the best route for drawing up the Reference Guideline for Packaging Tests of MERCOSUR. This Reference Guideline has been developed under limited conditions of time, number of selected routes taken as reference, and type of products transported.

6.1.1 Discussion Items for Drawing up the "Reference Guideline for Packaging Tests, for Evaluation"

Regarding the drawing up of the "Reference Guideline for Packaging Tests, for Evaluation", several items have been subject to discussions, as follows:

- (1) General criteria for the basic concepts for a MERCOSUR standard.
- (2) Route selection as reference in order to validate the MERCOSUR Standard.
- (3) The combination of data gathered in the 4 member countries, and their analysis. Their advantages and calculations development.
- (4) Definition of PSD curves for packaging tests, and the conditions for the tests according to the selected cases.

6.1.2 Detail Discussions and Conclusions

(1) General Criteria and Basic Concepts for a MERCOSUR Standard

- 1) The MERCOSUR standard will consider as reference the most recent data gathered from the developed Transportation Environment Surveys. However, each MERCOSUR standard can be continued in their own development through future revisions of the document, based on new route surveys in each country.
- 2) This MERCOSUR standard will have as area of application, the member countries of the MERCOSUR. The data to be taken as reference have been divided into two groups – above and below 0.33 Grms- taking into account the results of data analysis of data having very high acceleration values, such as the case of some data gathered in Brazil.
 - a. The data equal or below 0.33 Grms are evaluated by Vibration Tests.
 - b. The data above 0.33 Grms are evaluated by the Bouncing Tests.
(A portion of this test can be replaced by repetitive impact tests)
- 3) For vibration tests, this standard will consider two types of products for the tests, depending on the characteristics of the product.

Pattern-A: Products subject to damages due to fatigue of the materials (mainly industrial products).

Pattern-B: Products subject to damages due to friction (mainly food products)
- 4) The frequency ranges for each pattern are defined as follows:

Pattern-A: 5 to 100Hz

Pattern-B: 3 to 50Hz
- 5) The overall “PSD Curve for Tests” 1 of packaging is defined as the resultant of applying all the “PSD Summary curves” 2 of all the 4 member countries.
- 6) The PSD Curve for Tests for Pattern-A must be drawn so that the lines are closer as possible to the peaks of PSD Summary curve. The reason of this is because, the products subject to damages due to fatigue are under tests, they can be subject to

¹ NT: PSD Curve for Tests: A broken line in PSD diagram, applicable for laboratory test.

² NT: PSD Summary curve: The PSD Curve resulting from combining a group of PSD curves.

vibrational stress larger than the actual transportation conditions, due to the application of that simplified PSD curve. Consequently, if the test conditions are different from the physical requirements of the actual transportation, the results to be obtained in the test also would be very different from those under actual transportation.

On the contrary, the tests for Pattern-B are centered in reproducing the abnormal conditions. Since the friction is associated to vibrations, the important point is that the Curve for Tests must be drawn close to the Summary Curve in the zone of low frequencies. But for the high frequencies, there are no major difficulties to apply a simplified curve, instead.

- 7) The final PSD Curve for Test will have a margin of $\pm 3\text{dB}$, so that the expected PSD Curve of actual test must be plotted within this band. It is planned to carry out the verification if the lab test equipment (vibration Test apparatus) can generate the test conditions according to this PSD curve for Test, by INTI (Argentina).

(2) Reference Route Selection from Surveys, for MERCOSUR Common Standard

The selection of the reference route for MERCOSUR standard is based on the following criteria.

- 1) All the surveyed routes up today have been verified (Transportation Environment Surveys) and a combination of pair of routes from different countries have been set. The verifications have been done for a total of 52 combinations (pairs).
- 2) Once analyzed the characteristics of all pairs of routes, they were selected the most representative of each category, this means, "good", "medium", "bad" routes. The selected pairs of routes are as follows:

Good: BsAs—Rosario (AR) +Montevideo—Rivera (UY)

Medium: BsAs—Mendoza (AR) +Loma Plata—Asuncion (PY)

Bad: Aimogasta—Iguazu (AR) +Belem—Sao Paulo (BR)

Note: The route combinations (pairs) indicated above does not necessarily represent the actual route for transportation. These combinations are representative ones for defining each route category.

(3) Data Combination and Analysis of Gathered Data at 4 Member Countries

- 1) The data of a pair of route is analyzed. Then, all data above 0.33 Grms are eliminated.
- 2) The value of Grms is determined and also the test duration based on the data analysis of remaining data.
- 3) The Grms values of each route constituent of the pair have a variety. For calculating the test duration, it is necessary condition that all Grms must be uniform, so that Grms levels of each route must be properly adjusted. That is the reason to make

compensation, taking as reference value the Grms maximum.

A Time Factor M is applied, which has defined values depending of type of products: M=4 for industrial products, and M=2 for food products.

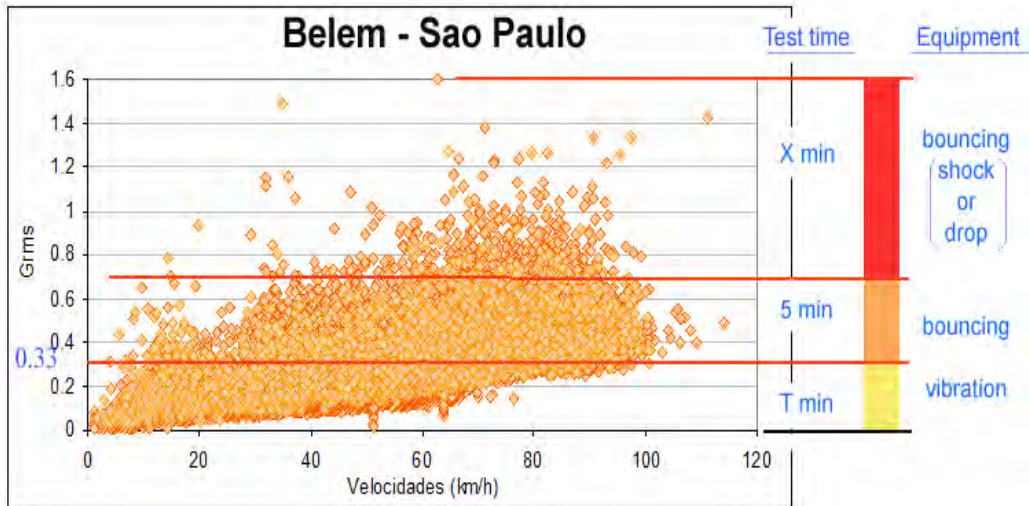
- 4) Furthermore, the duration related to these data are adjusted by means of another Grms compensation, so that the time of test is compressed. The test duration can be selected from the following values: 1hr, 1.5 hrs, 2 hrs. For this purpose, it was determined that the test must be conditioned so that the accelerations must not be beyond 0.9 G.
- 5) All the Grms data beyond 0.33 Grms can be analyzed by calculating the number of events for the entire route, based on "time trigger" setting and number of signals gathered. From here, it was determined that precisely this number will be the number of impact to be applied to the sample. This means, the number of jumps on the Bouncing Test. The conditions for the Bouncing Test are 10Hz frequency, 1.1 G acceleration.
- 6) By calculating the time of test, if this is below 5 minutes, the related time will be a continuous test of 5 minutes.
- 7) In the case that the test time is above 5 minutes, the excess value can be tested by repetitive shock test by using the impact test apparatus, or the drop test equipment. These repetitive shock tests will be carried out under the following method: in case of applying the impact test apparatus, the speed on the sample is 1.4 m/sec; or in case of free drop test, the drop height will be 10cm. Also, the number of impacts for the repetitive shock test will be 1 impact for each calculated period of 10 minutes.

(4) Definition of PSD Curve for Tests (Standard Curve)

- 1) Next, it is determined the PSD Curves for Tests.
- 2) In the case of industrial products, they are suffering the accelerations. In the case of food products, the containers are subject to the effects depending on the frequency band. Consequently, it is necessary to determine the PSD Curve for Tests, taking into account the type of products to be tested.
- 3) Therefore, for the PSD curve for tests, the following two curves are defined:
 Pattern-A: 5 to 100Hz (mainly for industrial products)
 Pattern-B: 3 to 50Hz (mainly for food products)
- 4) The Final PSD Curve for Test is determined by compensated Grms curves for the time compression, considering the container-packaging of each type of product and the frequency ranges.

Furthermore, the validation was conducted by reanalysis of classified 52 combination data from the Transportation Environment Surveys. The sample calculation and route data figures

are shown as follows, and described the leading procedure to the "Reference Guideline for Packaging Tests, for Evaluation" of the MERCOSUR.



Source: JICA Study Team

Fig. 6-1 Transportation Survey Diagram, Divided into 3 Sections

Table 6-1 "Reference Guideline for Packaging Tests, for Evaluation" (preliminary)

MERCOSUR - TEST CONDITIONS TABLE

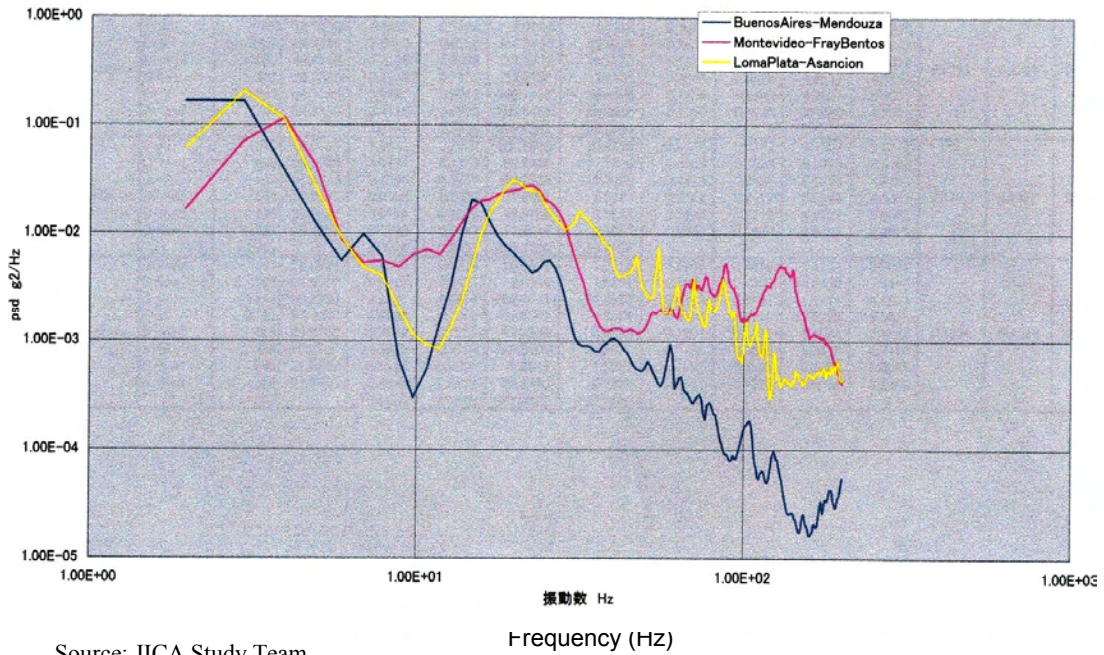
Test	Section	Distance (km)	Vibration				Bounce time	10cm Drop number	
			Patern Grms(G)		Test time(h)	Test Grms (G)			
			M:2	M:4		M:2			M:4
Level 1 Bad	Aimogasta - Iguazu & Belem - Sao Paulo	4651	0.261	0.278	1	1.23	0.53	5 min	24
					1.5	1.00	0.48		
					2	0.87	0.45		
					3	0.74	0.44		
Level 2 Medium	BsAs - Mendoza & Loma Plata - Asuncion	1522	0.243	0.231	1	0.70	0.36	5 min	1
					1.5	0.57	0.33		
					2	0.49	0.30		
Level 3 Good	Rosario - BsAs & Motevideo - Rivera	501	0.236	0.24	1	0.41	0.29	5 min	1
					1.5	0.33	0.26		
					2	0.29	0.25		

*1) Order of Test 1: Vibration, 2: Bounce, 3: 10cm Drop

*2) Bounce test : 10Hz, 1.1G

*3) Shock test : 10cm drop or shock machine test (1.4m/sec)

Source: JICA Study Team



Source: JICA Study Team

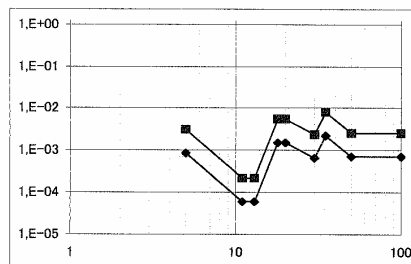
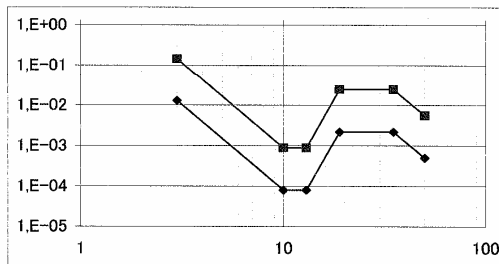
Fig. 6-2 PSD Curves Comparison per Routes: Test Time 2 hours

Table 6-2 Test Conditions for Packaging, for MERCOSUR (Level 1)

MERCOSUR - TEST CONDITIONS TABLE

Oct 22 2006

Level	Bad	11,14	3,63
M:2	Grms:0.261	Grms:0.87	Grms:0.271 Grms:0.53
Freq (Hz)	G ² /Hz	G ² /Hz	G ² /Hz G ² /Hz
3	0.013	0.14482	0.00085 0.00309
10	0.00008	0.0008912	0.00006 0.00022
13	0.00008	0.0008912	0.00006 0.00022
19	0.0022	0.024508	0.0015 0.00545
35	0.0022	0.024508	0.0015 0.00545
50	0.0005	0.00557	0.00065 0.00236
			0.0022 0.00799
			0.0007 0.00254
			0.0007 0.00254



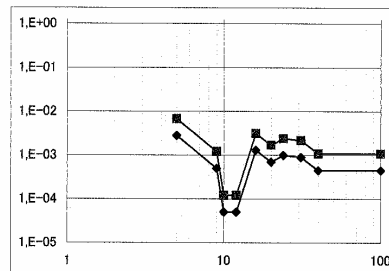
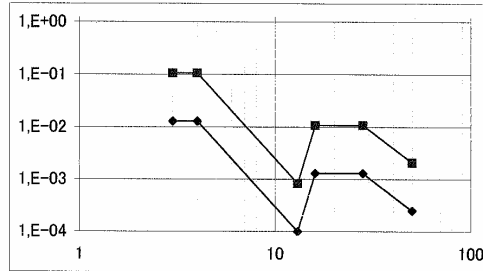
Source: JICA Study Team

Table 6-3 Test Conditions for Packaging, for MERCOSUR (Level 2)

MERCOSUR - TEST CONDITIONS TABLE

Oct 22 2006

Level 2	Medium	8,315	M:4	2.42
M:2	Grms:0.243	Grms:0.7	Grms:0.23	Grms:0.36
Freq (Hz)	G ² /Hz	G ² /Hz	Freq (Hz)	G ² /Hz
3	0,0128	0,106432	5	0,0028
4	0,0128	0,106432	9	0,0005
13	0,0001	0,0008315	10	0,0005
16	0,0013	0,0108095	12	0,0005
28	0,0013	0,0108095	16	0,0013
50	0,00025	0,00207875	20	0,0007
			24	0,001
			31	0,0009
			40	0,00045
			100	0,00045



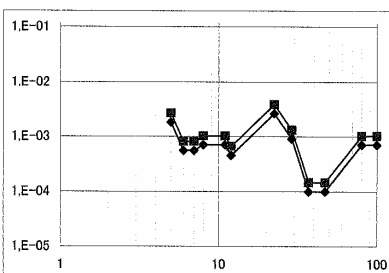
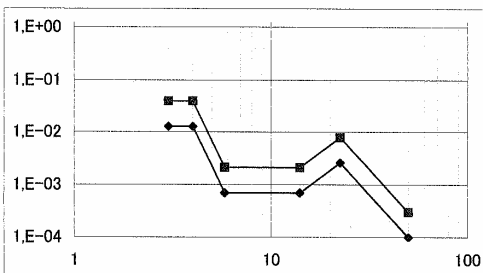
Source: JICA Study Team

Table 6-4 Test Conditions for Packaging, for MERCOSUR (Level 3)

MERCOSUR - TEST CONDITIONS TABLE

Oct 22 2006

Level 3	Good	3,02	M:4	1,46
M:2	Grms:0.236	Grms:0.41	Grms:0.24	Grms:0.29
Freq (Hz)	G ² /Hz	G ² /Hz	Freq (Hz)	G ² /Hz
3	0,0127	0,038354	5	0,0018
4	0,0127	0,038354	6	0,00055
5,8	0,0007	0,002114	7	0,00055
14	0,0007	0,002114	8	0,0007
22,5	0,0026	0,007852	11	0,0007
50	0,0001	0,000302	12	0,00045
			22,5	0,0026
			29	0,0009
			37	0,0001
			47	0,0001
			80	0,0007
			100	0,0007



Source: JICA Study Team

Chapter 7 Packaging Design and Testing

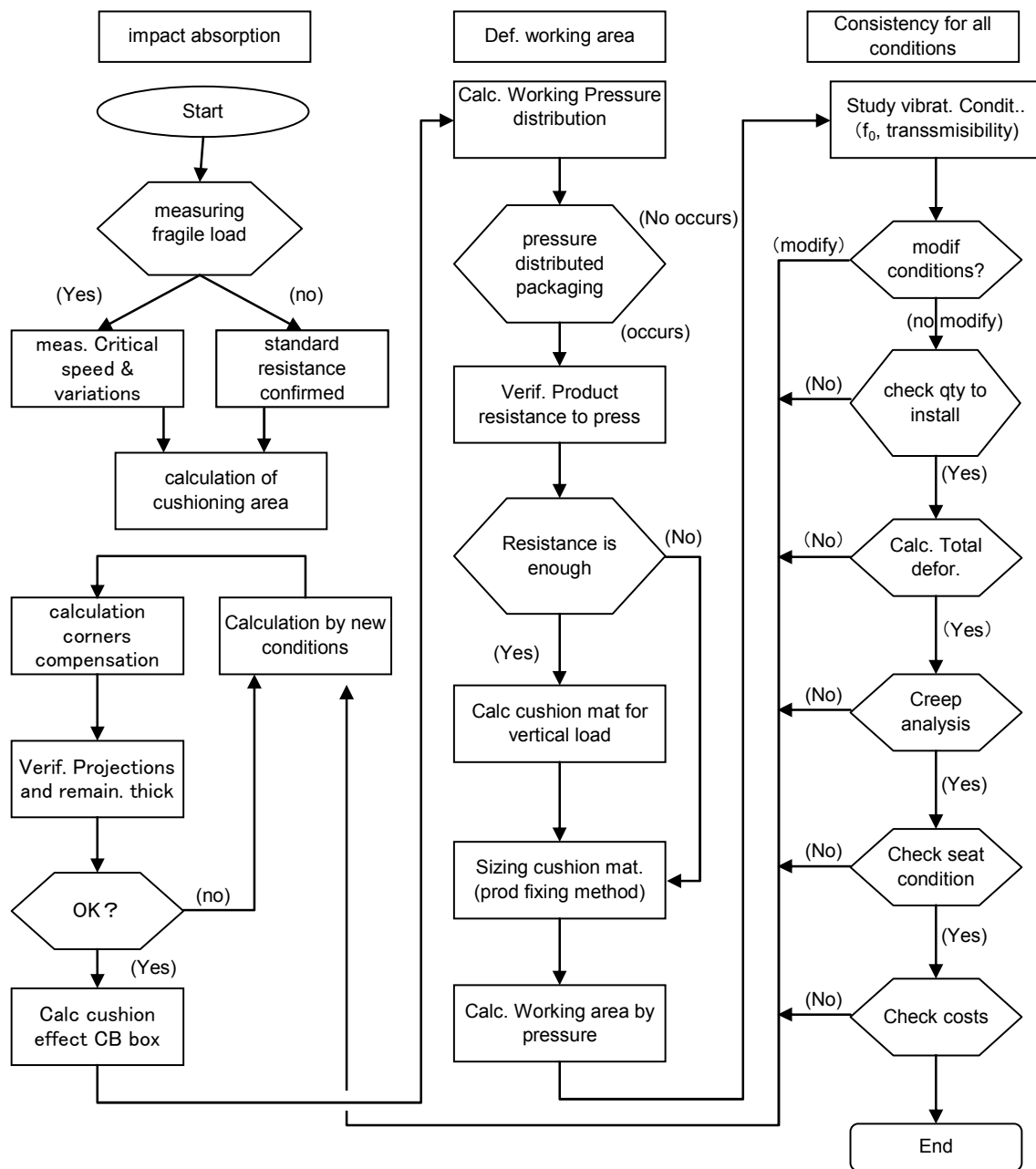
Chapter 7 Packaging Design and Tests

7.1 General Guideline for Packaging Design

The main objective of the packaging is to protect the product transported from production centers up to the end consumers. Factors which can produce damages on the packaging of the cargo are: the impacts due to drops due handling, the vibrations of the vehicles utilized, the stress produced due to piling on the warehouses, the ambient temperature and humidity variations, etc. Among all the factors, the damages caused by the drop during handling could be the most important one. The part of the engineering which is aiming to give the necessary protection against impacts due to drops is the “Cushioning Design”. The objective of the design is to smoothing the external impacts and to protecting the products, protecting them so that it does not suffer the load of the impact, making all the system to a point that the impact forces are becoming within allowable values for the product. The “cushioning design” is an engineering field developed basically for industrial products and the steps are structured basically on the following 3 items:

- (1) Cushioning calculation: Defining the required thickness and areas of cushioning materials
- (2) Defining cushioning materials: To determine the location points of cushioning materials
- (3) Drawings preparation: To define the geometrical shapes of the cushioning materials.

Furthermore, considering the development of all the packaging of a packed cargo, all the steps of the packaging design and cushioning design can be summarized according to the following flow chart.

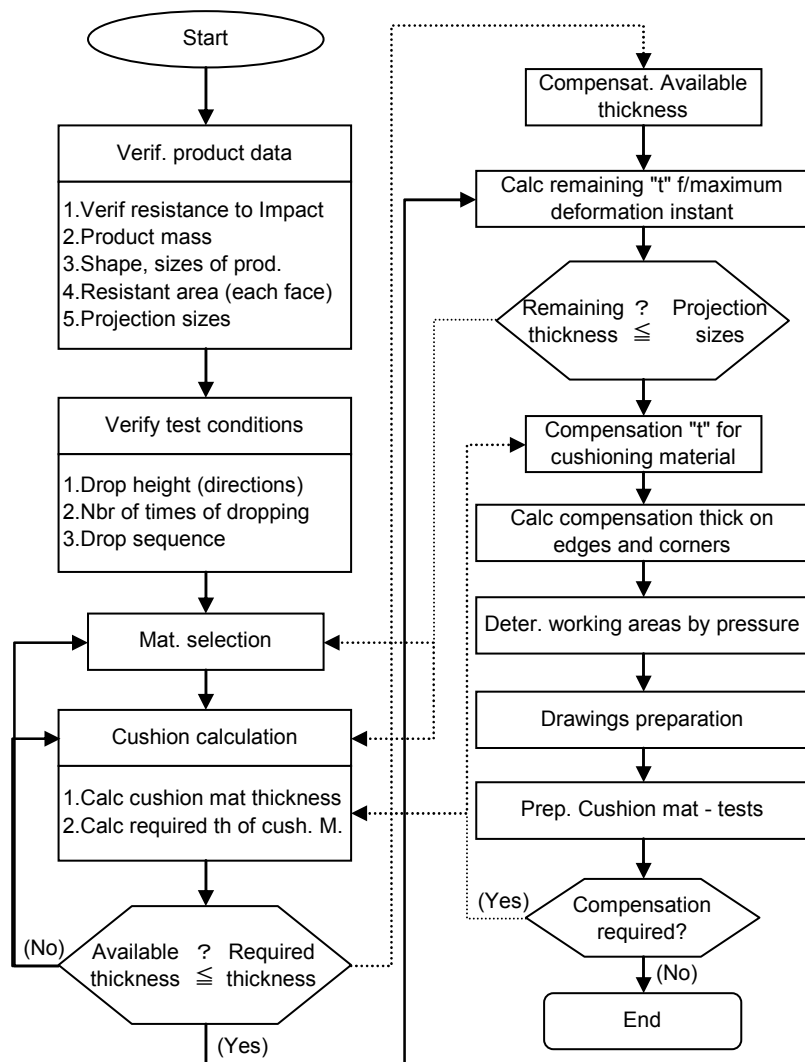


Source: Kiyohide Hasegawa – “Cushioning packaging Technology- Test Methods” Course XXXIX - Nikkan Publishing Co.

Fig. 7-1 Flow Diagram for the Cushioning Design of Packaging

If it is observed the process related to Cushioning Design, the steps can be analyzed on the flow diagram described below. Once the initial conditions for the design are defined, all the processes can be followed up systematically through the related graphics. However, for the study of the drops on corners and edges, since they are no standardized methods, the factors are defined based on experience. Regarding the compensation factors of cushioning characteristics of the materials, such as corrugated board, considering that they are variable depending on the shape of the packaging (boxes) and materials, it is required a certain level of

previous knowledge and experience related to cushioning design.



Source: Kiyohide Hasegawa – “Cushioning packaging Technology- Test Methods” Course XXXIX - Nikkan Publishing Co.

Fig. 7-2 Flow Diagram for the Cushioning Design

7.2 Packaging Design Procedures

The following paragraphs describe the steps required to maintain the quality of products and packaging, in respect of the household appliances selected as target products for this Study.

The five steps for packaging design are: transportation conditions, product resistance control, the study of the packaging material, the packaging design techniques and the packaging evaluation tests. In this case, they all are basically applied to refrigerators.

7.2.1 Product concept for household appliances and packaging design

The main issue to be taken into account for developing a product is its outstanding quality and functions; lately, the sum of the product plus its packaging is being considered. Therefore, factors beyond the external aspect of the packaging should be taken into account, considering the life cycle of the product and the distribution process.

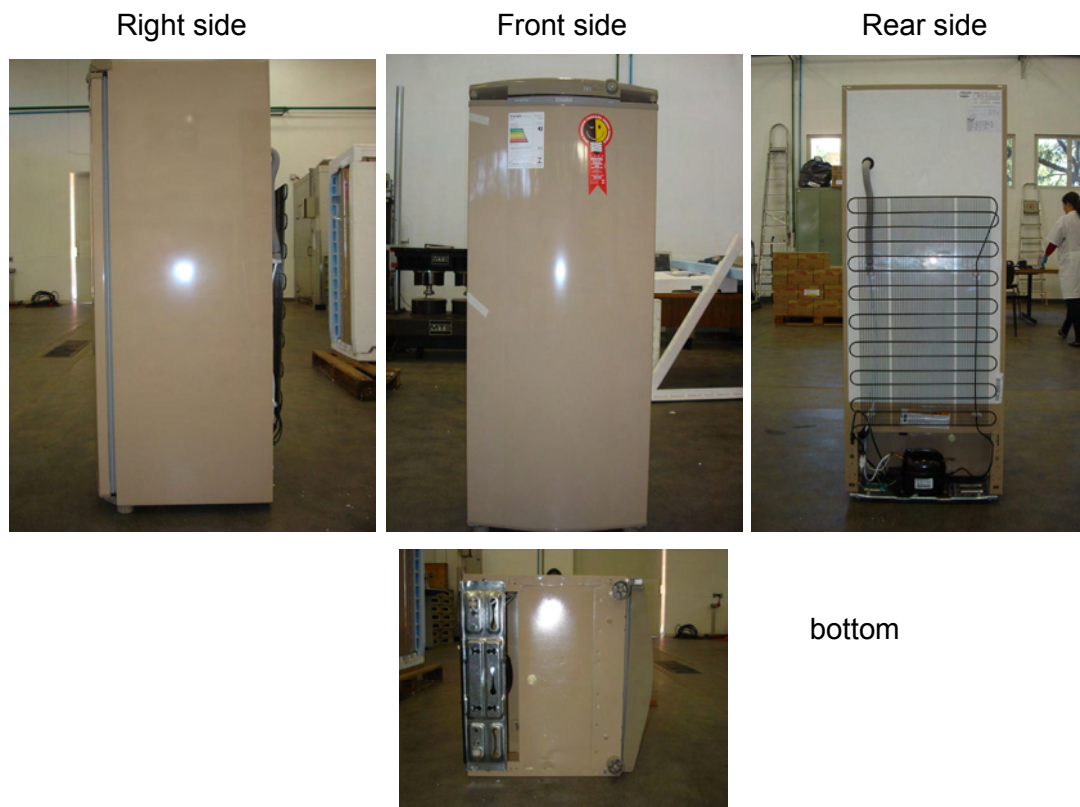
In case of industrial products, packaging is determined by the specific life cycle of the product (product characteristics, production, distribution and consumption), and taking into account how consumers accept the packaging and the transportation conditions of the product. Based on that, processes should be reorganized by analyzing feasibility in order to minimize costs, including the product. In this respect, the items to be taken into account when designing packaging, in furtherance of an effective development of the product, packaging and distribution, are described in Table 7-1.

Table 7-1 Packaging Design Requirements

1. Characteristics of the product	2. Production line
Size, mass	Conveyor belts structure
External aspect, photograph	Packaging equipment
Price, number of units to be manufactured	Palletizers equipment
Vibration, impact properties	Loading/unloading equipment
3. Transportation environment stress test	4. Packaging tests standards
Transportation	Applicable standards and their effects
Storage	Vibration, compression, drop tests
Handling of the cargo	Cargo handling tests
5. Applicable packaging standards	6. Integral packaging
Labels, caution indications	Standards and regulations
Specifications required by the customer	Specifications required by the customer

Source: JICA Study Team

The following is an example of common household refrigerators, the target product of the Study. In this design, the color was selected to combine with the walls of the house, as shown in Fig. 7-3.



Source: JICA Study Team

Fig. 7-3 Product External View (Refrigerator)

Design:

As seen in the photograph, the door can be opened by two sides, to the left or to the right, as required. The design has taken into account drainage details. Since this model opens to both sides, the design is restricted and has specific characteristics since it does not have a handle.

Structure:

The back side of the refrigerator, painted white, is a very thick wall. The appliance is basically a metal box with isolating material adhered to it. However, since the radiator serpentine is exposed, the packaging should protect them.

Compressor:

The compressor is fixed with a clinch, which has a rubber cap to reduce vibrations and ends in a plate stamped protuberance on the tray that supports the compressor.

Door mounting:

The door is placed on hinges; one of the mechanically weak point of the door.

The refrigerators are products having high volume but their price are low, so the cost efficiency for transportation is low as well. In case of long distance transportation, trucks have to carry as many refrigerators as possible, so usually a line of refrigerators is loaded in vertical position plus two lines of refrigerators in horizontal position, or alternatively, 6 horizontal lines.

However, when placed horizontally, the compressor could be subject to additional stress, so to avoid this, the trucks should be loaded very carefully.

In serious cases, the base plate of refrigerator or the clinches that hold the compressor could be damaged.

Five years ago, these refrigerators were packed in cardboard boxes. Then, cardboard was replaced for EPS due to price variations. Actually, EPS is used under the current specifications.

The different aspects of packaging improvement were analyzed taking into account the latest packaging trends and transportation conditions.

- a. Packaging design improvements, taking into account the fragility of the product
- b. Packaging design improvements taking into account the “3R”
- c. Packaging design improvements to comply with the Reference Guide for the Transportation Environment Surveys

7.2.2 Stress test of the distribution environment for household appliances

To perform the stress test of the conditions of distribution of the products, the distribution process itself should be analyzed first. This analysis should include the organizational structure of distribution, storage, transportation and distribution centers, stage by stage. Detailed records of the working methods and the equipment used are maintained. Based on this analysis, the number of times the product has been handled can be determined, as well as the conditions of the loading/unloading equipment, the impacts due to dropping, static compression on the boxes, dynamic compression, vibrations during transportation, etc., obtaining a general overview that can be used to plan the packaging design.

In case of new products, studies based on analysis of actual transportation /distribution routes can be recommended.

Table 7-2 shows the results of surveys performed in Japan on household refrigerators.

Table 7-2 Distribution Environment Stress to Refrigerators (Example)

Transportation, storage, loadn/unloading, others				Stress Analysis						
Product flow	Action on distribution	Equipment	Comments about stress	Manual	Mechanics	Fall impact	Other impacts	Static compression	Dynamic compression	Vibration
1) production line	Palletization	Palletizator palette	1350x2200		<input type="checkbox"/>		<input type="checkbox"/>			<input type="checkbox"/>
2) Factory storage	Handling	Pile with Fork lift	4 units/level/PL/420L distance to around 40m cargo 2 pallets		<input type="checkbox"/>		■		<input type="checkbox"/>	<input type="checkbox"/>
Comm.WH	Warehouse	Palletizer	Cargo 2 pallets - -Storage 2 months max. T 40C 90% RH 1W					■		
	Tr. by truck	12 Ton truck	Travel around 4 km							<input type="checkbox"/>
3) delivery	Warehouse	Palletized	Cargo 2 pallets					<input type="checkbox"/>		
	Transportation by truck	12 Ton truck	Travel around 4 km							<input type="checkbox"/>
4) transportation	Handling	Fork Lift	Travel around 15m, cargo 2 palletes		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Tr. by truck	Handling	1 or 2 persons: Handling. Pull and turn	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
5) WH entry	Tr by train	Handling	Travel around 15m, pull and turn							<input type="checkbox"/>
	Tr by truck	12 Ton truck	Travell around 1300Km.				<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
6) Dist center	Warehouse	Pallete Wagon	1 level, upload turned upside					<input type="checkbox"/>		
	Handling	12 Ton truck	Travell around 1300Km. 15Km from the station						<input type="checkbox"/>	<input type="checkbox"/>
7) Delivery	Truck loanding	Handling	Palletized, pulled and turn	<input type="checkbox"/>		■	■			
	Transportation by truck	Fork Lift	Travell around 15m, upload 2 palletes		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
8) Transportation	Download	Palletized Direct Upload	Upload 2 palletes, 2 levels. Warehouse around 1 month. 30-40°C, 90-95%RH	<input type="checkbox"/>						
	Handling	Fork Lift	Travell around 15m, upload 2 palletes		<input type="checkbox"/>	■	<input type="checkbox"/> ■		<input type="checkbox"/>	<input type="checkbox"/>
9) WH entry	Warehouse	Handling	1 person: hanging. Pull and turn	<input type="checkbox"/>				<input type="checkbox"/>		
	Transportation by truck	4 Ton truck	Delivery truck. Mixed payload with major appliances. Run around 420Km with payload turned above			■	■		<input type="checkbox"/>	<input type="checkbox"/>
10) WH supplier	Download	Handling	Palletized, pulled and turn	<input type="checkbox"/>						
	Handling	Handcart	Travell around 15m with high ground				<input type="checkbox"/>			<input type="checkbox"/>
11) Delivery	Warehouse	Palletized Direct Upload	2 levels upload with 2 palletes 30-40°C, 90-95%RH					<input type="checkbox"/>		
	Truck loanding	Handling	1 person: hanging. Pull and turn	<input type="checkbox"/>		■	■			
12) Transportation	Transportation by truck	4 Ton truck	Route wagon with mixt cargo. Travell along 260 km. Pull and turn						<input type="checkbox"/>	<input type="checkbox"/>
	Download	Handling	Pull and turn	<input type="checkbox"/>		■	■			
13) WH entry	Handling	Handling	Hang at the back, pulling, turn	<input type="checkbox"/>		■	■			
	Warehouse	Direct upload	1 level, few days					<input type="checkbox"/>		
14) shop	Truck loanding	Handling	Pull and turn	<input type="checkbox"/>		■	■			
	Transportation by truck	Small truck	Cable placing							<input type="checkbox"/>
15) delivery	Handling	Handling	Hang at the back, pulling, turn	<input type="checkbox"/>		■	■			
	Handling	Handling	Dragging ahead packaging stock	<input type="checkbox"/>		■	■			
15) delivery	Handling	Handling	Product handling, download and upload stairs. Return of packaging stock	<input type="checkbox"/>		■	■			
	Handling: aproximately 11 manoeuver				Other impacts: It is required the cargo study respect on the manual maneuver					
Mechanic manoeuver: 5 with fork lift and 1 with palletizer in factory				Stactic compression: In storage 2 levels and 3 months						
Fall impact: 50 times around during 11 manoeuver. It's considerer the testing manoeuver of falls of JIS to respective step				Dynamic compression: Upload turning above + vibration on travel						
				Vibration on travel: on 11 ton truck. And 1800Km more in a small truck 300Km, and run on forklift with 2 levels of full palletes						

Source: JICA Study Team

7.2.3 Household appliances production line and packaging

Packaging of large volume products, such as refrigerators, has some limitations from the point of view of the production line as indicated below.

- (1) Assembly line: The packaging material may not be adequately transported on the conveyor belt (especially soft materials or those easy to bend). They should be considered in the product assembly stage.
- (2) Problems related to the packaging equipment: The production line platforms should have a hole at the bottom to allow the passing of air during the shrinking process when using shrink type material.
- (3) Packaging of accessories: This allows for the reduction of manufacturing steps (the method used to pack the accessories should be defined).

7.2.4 Design of packaging for dairy products

The following is a summary of the tasks required for the design of packaging for dairy products as well as the specific details related to milk pouches, aluminum foil lids for yogurt pots and milk jam pots.

(1) Design and evaluation of packaging for dairy products

To design (re-design) packages, the specifications of the currently used packaging should be determined and then establish the objectives of the new design. These factors should be taken into account throughout the whole design process.

- 1) Packaging design and objectives
 - [1] Level of security and hygiene of the product
 - [2] Level of protection (mechanical, thermal, moisture resistance, gas or water barrier properties)
 - [3] Workability (handling of the packaging, mechanical and filling properties)
 - [4] Cost efficiency (production-materials-transportation, final price of the product)
 - [5] Functionality (easy to transport, easy to open)
 - [6] Marketability (display effects, easy to display)
 - [7] Environmental adaptation (waste treatment and recycling properties)
- 2) Packaging design and pilot sample evaluation procedure

The evaluation procedure is carried out step by step making the pertinent adjustments.

[1] Step 1: Evaluation of the pilot sample (manual)

After completing the design of the improved packaging, a sample is manually prepared and evaluated. Tests are performed using sensors and other devices. Sensor tests are very important as well as those to verify whether the packaging is easy to open.

[2] Step 2: Evaluation of the sample using mechanical equipment

Mechanical tests are performed as well as tests using sensors and devices. The mechanical properties of the packaging are also tested. In case of difficulties, the design shall be modified.

[3] Step 3: Market evaluation tests

A small batch is prepared using the redesigned packaging and launched to the market for evaluation in a selected area. Comments not considered during the design stage could be made by consumers such as: consumer friendly product, handling difficulties or failures etc.

All the comments both from consumers and carriers should be taken into account, analyzing them and considering when redesigning the packaging.

[4] Step 4: Launching of the improved packaging to the market

The improved packaging is gradually marketed. If problems arise, new modifications should be made.

3) Mechanical evaluation of the pilot sample

The redesigned packaging is tested using sensors, opening tests and mechanical tests are also performed to analyze resistance.

[1] Drop tests

[2] Compression tests

[3] Hot seal tests

[4] Sealing tests

[5] Vibration tests

(2) Pouches for dairy products

Pouches for dairy products are prone to leak both through the body of the pouch as well as through the upper and lower seals. Leaks through the body occur due to a deficient central sealing line, which is a “pillow type joint”, sealed by heating only one side. This kind of sealing should be replaced by a method whereby the 2 sides are heated.

The upper and lower seals are of the “melting and cut” type. This method uses a heated piano string that cuts the pouch simultaneously melting and sealing it. Therefore, the seal width is very small so the security is critical.

In conventional pouches the sealing is of approximately 5 mm wide, so the level of security is also high. To solve the leaking problem of pouches, the existing filling machines should be modified, which is very difficult. Therefore, this alternative should not be considered when determining the improvement of sealing methods. However, even if the existing machines are used, this problem may be solved by carefully monitoring the heat sealing operations and increasing quality control. This is so because of the variations in results observed among the different companies and in lots from the same company.

To improve packaging design using the existing equipment, the LDPE film material specifications should be modified.

L-LDPE linear low density polyethylene has excellent sealing properties, higher sealing strength, better sealability with impurities and better hot-tack properties. Therefore, the percentage of this L-LDPE should be increased in the material to be used.

(3) Aluminum foil lid for yogurt pots

Aluminum foil lids are prone to occur pin holes during transportation, causing leaks. Besides, the material may tear when opening the pot. The opening properties can be improved reducing the adherence of the adhesive band. However, a pot having both function of good sealing properties and good opening properties is very difficult to be obtained.

If aluminum vapor deposition film is used, pin holes during transportation and tearing problems would be reduced, but this material cannot be used in the existing equipment because the film curls.

To solve the tearing problem, the material should be changed, i.e. aluminum foil laminated with plastic should be used.

(4) Milk jam pots

During the vibration tests performed on milk jam pots, it was seen that pin holes are caused by friction between the external plastic cap and the internal aluminum foil lid, causing leaks.

Besides, it was found that, in addition to friction, the fatigue of the aluminum material also generates leaks.

Consequently, the plastic cap was modified to avoid contact with the aluminum foil. Besides, the aluminum foil material should be replaced by foil plus plastic lamination.

Chapter 8 Transportation Tests (Model Project)

Chapter 8 Transportation Tests (Model Project)

8.1 Transportation Tests, Target Products and Routes

The activities for the 3rd Site Survey of the Study basically consist of the development of the re-engineering of the packaging through the data analysis of collected information during the Transportation Environment Surveys along the 4 countries, and the establishment the "Reference Guideline for Evaluation of Packaging Tests".

On this way, once implemented the improvements on the design of the packaging, a cargo having the re-designed packaging will be loaded in a truck together with cargoes packed with normal design, for the purpose of carrying out a field tests. This step will be done after completed the evaluation tests at laboratories.

For the 4th Site Survey of the Study, the JICA Study Team prepared the work plan through the coordination with the Counterpart institutes of the 4 countries, in order to define the participation of the cooperative companies, the target products, the routes to be run and the schedule of the field tests, as shown in the following Table.

Table 8-1 Transportation Tests Schedule

Country	Sequence of Routes	Dist. (1 way) km	Dist. km	Cooperative Company	Schedule 2006	Days
Argentina	Rosario — Bs Aires (route for Model Project)	300	600	FRIMETAL	11/27 ~ 11/28	2
	Rafaela — Neuquen (route for Model Project)	1300	2600	Williner	11/2 ~ 11/6	5
	Aimogasta — Bs. Aires (route for Model Project)	1200	1200	NUCETE		3
Brazil	Joinville — Recife (route for Model Project)	3000	6000	Multibrass	10/9 ~ 10/18	10
	Hortolandia — Recife (route for Model Project)	3000	6000	BSH	10/30 ~ 11/8	10
Paraguay	Loma Plata — Asunción (route for Model Project)	500	1000	Chortitzer	10/9 ~ 10/11	3
Uruguay	Montevideo — Fray Bentos (route for Model Project)	300	600	Conaprole	10/19 ~ 10/20	2

Source JICA Study Team

On Table 8-2 they are indicated the planned field transportation tests and those already executed.

Table 8-2 Transportation Tests: Target Products and Routes (Status)

	Company	Product	Routes of stretch		Transp. Co.	Remark
			Origin	Destinat.		
Argentina	Frimetal	Heladeras	Rosario	Bs. As.	Proper	
	Mastellone	Lacteo/D leche	BsAires	Santiago	—	Cancelled
Brazil	BHS	Heladeras	—	—	—	Cancelled
	Multibras	Heladeras	Joinville	Sao Paulo	Proper	
Paraguay	Chortitzer	Leche	Loma Plata	Asuncion	proper	
Uruguay	Conaprole	Yoghurt	Montevideo	Fray Bentos	—	postponed

Note: The reasons of cancellation or postponement are described in the related chapters.

Source JICA Study Team

8.1.1 Argentina

8.1.1.1 Household Appliances

Table 8-3 describes the specifications for the actual transportation test and the routes covered in the survey performed using refrigerators as target product (product selected for Argentina).

Table 8-3 Actual Transportation Test and Routes Covered using the Target Product

		Argentina
Actual transportation test of the target product		
	Target product	Electric Refrigerator
	Type	Capacity 350 liters
	Qualitative weight of packaging (kg)	56
	Packaging measures L x A x H (mm)	625×624×1,695
	Sample using improved packaging	1 Class Review of the EPS
Route		
	Stretch	Rosario - BuenosAires
	Distance (km)	300
	Duration of the survey (day)	1
	Units to be tested (units)	2
	Vehicle used	Semi trailer truck

Source JICA Study Team

(1) Analysis of the data obtained in the actual transportation test and measures for improvement

Although some results are not final conclusions as to be considered measures for improving the quality of packaging design, the results of the actual transportation test and lab tests performed on the samples are summarized in Table 8-4.

Table 8-4 Analysis of the Data Collected and Measures for Improvement

Argentina	
Gathered data	a. Measurements taken from the back of the trailer: data under analysis b. Inside the refrigerator: data under analysis.
Measures for packaging improvement	The results of the actual transportation test, both in respect of the products as well as the packaging, were successful. The vibration and drop test results were also very good.

Source JICA Study Team

During the transportation test, impact sensors were placed in the trailer and inside the product. The sensor placed in the trailer was used to measure the vibrations during transportation and the one inside the product was used to measure impacts during the handling of the product. In order to measure the drop impact of the refrigerator, an impact sensor was placed on the compressor tray located at the bottom of the product but upon several analyses of the measured data, the handling impacts could not be accurately measured due to the propagation of the reaction to the impact inside the compressor. To avoid this, the measurements were taken from a location not closed to the compressor and accurate results were obtained. The analysis was performed by the counterpart.

(2) Laboratory Tests (Argentina)

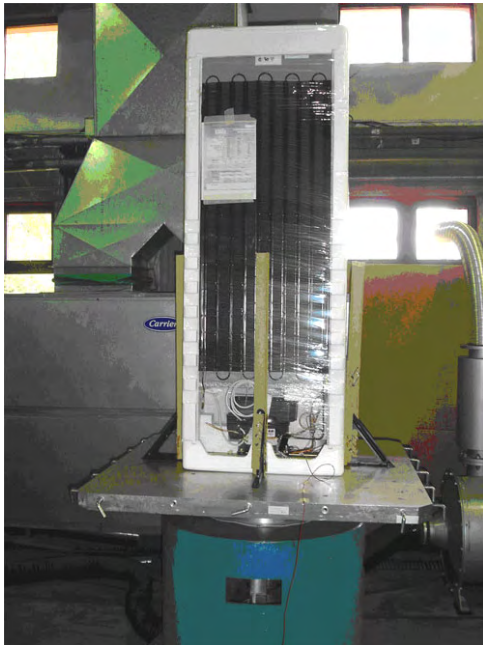
Table 8-5 shows the results of the lab tests performed in Argentina.

Table 8-5 Laboratory Tests Results: Argentina

Description of the Test	Product and Improved Packaging	Traditional Packaging
Vibration test		
Testing conditions	The PSD was calculated performing random tests based on the transportation vibrations measured along a 1300km stretch between Rosario and Bs.As. and Mendoza and Bs.As., applying vibrations with a PSD equal to 3 hours.	The reactions to the vibrations were measured.
Results	Satisfactory both as to products and packaging.	(Used as background information for the improvement of the packaging).
Drop test		
	Msec applied speed G (duration of the impact msec)	Applied speed G (duration of the impact msec)
Dropping height 5cm	6.4 (28.5)	6.5 (23.5)
10cm	11.9 (22.0)	13.0 (22.5)
20cm	14.3 (33.0)	14.6 (23.5)
30cm	19.5 (29.0)	- (-)
Results		
Inside parts loosened.	Generation (Solved by implementing the packaging of parts)	Generation

Description of the Test	Product and Improved Packaging	Traditional Packaging
Door unlevelled	Generation: Refrigerator side 3mm, freezer side 1mm.	Generation: Refrigerator side 3mm, freezer side 1mm.
Thermal plaque unlevelled	Generation	Generation
Compressor tray	Not deformed	Deformed: 1mm longwise, 1mm widthwise.
Side deformation	Not deformed	Not deformed

Source JICA Study Team



Source JICA Study Team

Fig. 8-1 Vibration Tests, Improved Product



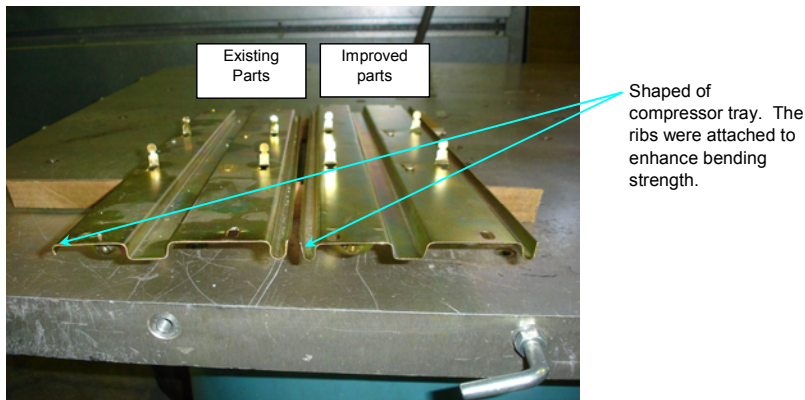
Source JICA Study Team

Fig. 8-2 Drop Tests, Improved Product

The packaging improvement specifications were mainly related to the shape of the EPS that supports the bottom of the refrigerator for it to move with the refrigerator at the time of the impact. As regards the deformation of the door, some effects were seen but since the inside parts were damaged, the resistance to impact of weak points should be improved.

Now then, the following is related to the potential improvement of the product based on the test results indicated in Table 8-5.

- (1) The loosening of inside parts can be solved by the implementation of the proposal for the packaging of individual parts.
- (2) Based on the results of the impact tests, it was seen that the compressor tray was defective, so improvement measures were proposed to the manufacturer that is performing the pertinent tests. See Fig. 8-3.



Source JICA Study Team

Fig. 8-3 Improvements on Compressor Tray

Although the drop test was carried out pursuant to the standard set at 10 cm, upon the evaluation of the mentioned improvement specifications, the basic resistance was tested, concluding that the volume of EPS used may be reduced by 30%.

8.1.1.2 Transportation tests of dairy products: cancellation and reasons

At the beginning of October, the Chilean government increased the customs tariffs applicable to Argentine dairy products by 21%, so that the company suspended shipments. According to the Company, there have been no difficulties related to packaging, at least up to Mendoza, a flat stretch. The problems occur when crossing the Andes. But the company cancelled the actual transportation test because if no products are going to be exported to Chile, carrying out the Model Project would be useless.

8.1.2 Brazil

8.1.2.1 Household appliances

Table 8-6 describes the actual transportation test specifications and the routes covered in the survey performed using refrigerators as target product for Brazil.

Table 8-6 Actual Transportation Test and Routes Covered using the Target Product

		Brazil
Actual transportation test of the target product		
Target product		Electric Refrigerator
Type		Capacity 350 liters
Qualitative weight of packaging (kg)		51
Packaging measures LxAxH (mm)		692×642×1,562
Sample using improved packaging		2 Classes Packed in cardboard boxes, with EPS

		Brazil
Route		
Stretch		Joinville - SaoPaulo
Distance (km)		500
Duration of the survey (day)		1
Units to be tested (units)		2
Vehicle used		Semi Trailer truck

Source JICA Study Team

(1) Analysis of the data obtained in the actual transportation test and measures for improvement

The same process applied in Argentina was performed in Brazil. Although some conclusions are not final so as to be considered measures for improving the quality of packaging design, the results of the actual transportation test and lab tests performed on the samples are summarized in the following Table.

Table 8-7 Analysis of the Data obtained in the Actual Transportation Test and Improvement Measures

		Brazil
Collected data		a. Taken from the back of the trailer: data analysis failed b. Inside the refrigerator: data analysis failed.
Measures for packaging improvement		The results of the actual transportation test, both in respect of the products as well as the packaging, were successful. The implementation of the improvement specifications will be verified through lab tests.

Source JICA Study Team

Like in Argentina, during the actual transportation test, impact sensors were placed in the trailer and inside the product. The sensor placed in the trailer was used to measure the vibrations during transportation and the one inside the product was used to measure impacts during the handling of the product. In order to measure the drop impact of the refrigerator, an impact sensor was placed on the compressor tray located at the bottom of the product but the sensor failed and no data could be obtained so the measurement was postponed.

(2) Packaging test based on the improved design

In Brazil, packaging tests using cardboard were performed (see Fig. 8-4) with the cooperation of a packaging company and based on the specifications set forth by the industrial design area of the counterparty. This was implemented in the production line of the cooperating company, preparing the packaging to perform the actual transportation test.



Source JICA Study Team

Fig. 8-4 Pilot Packaging by using Cardboard

8.1.3 Paraguay

8.1.3.1 Packaging Design and Transportation Tests

A package was prepared for testing (milk pouch) made of material improved by increasing the percentage of L-LDPE polyethylene by 15% as compared to the usual material.

Based on information from the production plant, this improved packaging resulted in 50% reduction of sealing damages caused in the production line.

Besides, the JICA Study Team, visited the production plant. By taking samples of full pouches, a significant improvement was seen in the properties of the improved pouch through compression and drop tests. Although the pouch has been improved, it was verified also that high quality cannot be attained if the processing control are deficient. To obtain good results, not only improved materials should be used but strict production line controls should be implemented.

The samples prepared using improved materials were tested for transportation, along the Loma la Lata - Asunción stretch.

8.1.3.2 Testing schedule (PY)

Date: October 12, 2006 (Thursday)

Date	Itinerary
October 12 (Thursday)	15:20 Departure
	16:06 Chaco route crossing
	17:53 Pozo Colorado
	20:46 Villa Hayes
	21:12 Asuncion – stop at gas station to fill the truck up
	21:45 Asuncion – arrival to Chortitzer's Distribution Center

Note: The truck speed in this case was better than in the test performed the previous year (from September 27 to October 4, 2005).

Source JICA Study Team

8.1.3.3 Organization of the Transportation Tests (PY)

JICA Study Team: Mr. Tsuyoshi Kage, Ms. Yuko Matsunaga (Interpreter)

INTN: Mr. Ovaldo Raul Barbosa

Cooperating Co.: Mr. Javier Romero


8.1.3.4 Routes covered by the survey

The stretch from Loma Plata to Asunción was 440 km long. From Loma Plata up to the crossing of the Chaco Route, unpaved stretches or route sections under repair were found for a total of 20 km. The condition of the route was a little better – only in some parts – if compared to October, 4, 2005.

Besides, the transported cargo consisted of milk crates with 18 units (pouches) each.

8.1.3.5 Vehicle and cargo

The truck and the cargo used in the survey.

	Main Features	Photographs
Type of truck	Semi-Trailer	
Axes and suspension	Closed with refrigeration 1(S) + 2(D) + 1(D) + 1(D) Spring+Air+spring+spring	
Maximum load	25 ton	
Cargo	Milk pouches in crates	
Carried load	25.3 ton	

Source JICA Study Team

8.1.3.6 Results of the transportation test

To test the packaging made of the improved material, a visual inspection of all the transported units was made on the following day, verifying the location and the possible causes of the damages identified. Since no inspections were made at the plant before departure, it could not be determined whether the damages were suffered during transportation or not. Therefore, it was assumed that the total damages found upon arrival include both, those suffered in the plant and during transportation.

$$\text{Final damages} = \text{Plant damages} + \text{Transportation damages}$$

Within the different kinds of damages, “damages to the material and pin holes” occur in the production line due to “hitching” and/or to the internal protuberances of the plastic crates.

On the other hand, damages to the seals were comparatively low in pouches made of the improved material, about 1.5 / 1,000 units; showing a significant improvement as compared to the current material.

Comparative Analysis of Damages to Milk Pouches

	Date of Transp.	Inspec. Number	Location/ cause of the Damage		Total	Damaged Seals (1/1000)
			Seals	Material, Pin Holes		
Improved material	Oct 12, 06	1,332	2	2	4	1.5
Current material	Oct 18, 06	1,620	8	5	13	4.9
Current material	Oct 19, 06	1,620	5	6	11	3.0
Current material	Oct 20, 06	1,620	2	4	6	1.2
Total Current material		4,860	15	15	30	3.1
Current material *	Oct 20, 06	810	4	1	5	4.9

*Note: Cargo carried from Plant number 2 (taking Route number 2 to Ciudad del Este, Campo 8 in Caaguazu, Asuncion. Total 300km)

Source JICA Study Team

8.1.4 Uruguay

Yogurt pot lids are made of aluminum foil (AL40 μ / Laquered).

Two kinds of improved material were tested in this Survey: Aluminum foil of the current thickness but laminated with PET12 μ and another one, less thick (aiming at reducing costs).

The specifications of those materials are the following:

- a) Improved material: AL40 μ /PET12 μ /Lacquer
- b) Improved material 2: AL30 μ /PET12 μ /Lacquer

Unfortunately, the supply of these materials by the lid supplier is delayed due to union disputes. In addition, the Company is also facing union problems. These problems are expected to be solved in the short term. Once they are solved, and once the materials are supplied, the counterparty, LATU, will perform the pertinent transportation tests.

**Chapter 9 Improvements Proposal to
Reduce the Rate of Damages**

Chapter 9 Improvement Proposals for Reducing Damages Index

9.1 Improvements to Prevent Damages to the Target Products

9.1.1 Clarification about the Causes of Damages

During the development of the Transportation Environment Surveys as well as the packaging design activities, the parties to the Study, the members of the Study Team and the members of the counterparty have analyzed some cases of direct damages to products. Since these cases can be used as reference to analyze damages to packaging, a summary of the conclusions is shown in the following table.

Table 9-1 Number of Cases of Damaged Packaging

Case	Household appliances	Food products
Impact due to dropping during handling	1	1
Vibration during transportation	3	5
Compression load during storage	2	4
Variation of temperature, moisture, atmospheric pressure	0	3

Source: JICA Study Team

In the case of household appliances, damages occurred during long distance transportation, storage and loading /unloading; in the case of food products, during storage, handling for arrangement on pallets for storage, vibration during long distance transportation and changes of temperature during the distribution process.

9.1.2 Damage Rate of Products of the Cooperating Companies

The damage rate of the different products of each cooperating companies of the four countries, mainly during transportation, was calculated based on forms completed by the cooperating companies, as described in the following table. However, since this kind of data is considered confidential in almost all companies, the names of the parties that cooperated in this survey are not mentioned, upon request of the companies and the counterparts.

(1) Manufacturers of Household Appliances

Company	Percentage of Damages	Comments
Company A	0.03% (only refrigerators)	Damages directly related to packaging
Company B	0.22 (All the products)	Percentage of returns (85% are due to damages directly related to packaging)
Company C	2.66 (All the products)	Percentage of returns (No specific information)

(2) Manufacturers of Food Products

Company	Percentage of Damages	Comments
Company A	4% (All the products)	Percentage of returns (No specific information)
Company B	0.58% (All the products)	Percentage of returns (20% are due to damages directly related to packaging)
Company C	1.48 % (All the products) 2.13% (Target products for the Study)	Percentage of returns (No specific information)

However, companies in general do not have any policy or regulation in place to determine the rate of damages to their products and, since they do not have a system where information about the damaged parts, the possible causes of the damage, etc can be entered, such information could not be obtained in detail.

Therefore, in the case of household appliances, the damages to the products were analyzed. In the case of food products, since the percentage of returns include claims due to product expiry, most companies have information more related to the rate of returns than those of damages.

Specifically in the case of food, since most products are transferred to the client in the plant – under the pertinent contracts – the wholesaler or distributor is responsible for controlling and handling the delivered goods, so there is no information available about the causes of damages throughout this process, even when many claims are received.

This Study included detailed surveys performed together with the cooperating companies to verify the number of damages to products. The following form was used in respect of company “B”, that operates in the food sector. Unfortunately, the design of this form does not allow to identify the cause of the damages, so the data collected may not be sufficient to perform the design improvement test.

Form used by Company “B” (Food Producer)

Code #	Item	Amount of Damages	Number of Damages
1*	Damages during transportation		
2*	Deficits (difference between the number of contracted units and delivered units)		
3	Visible defects (identified by the retailer upon delivery)		
4	Error in the Order		
5	Change of product by request of the customer		
6*	Product Expired		
7	Error in the invoice		
8	Quality of the product		
9	Error in the orders		
10*	Cancellation of the order due to default in payment		
11	Change due to payment date problems		
12	Unknown causes		
13	Cancelled order		
15*	Accident during transportation		
16	Error in the bar code		
17	Production line problems		
18	Excessive orders		
19*	Error in distribution		
20	Pricing error		
21	Unpaid distribution taxes (ICMS)		
22	Error in the computerized registration of customers		
23	Error in the registration of customer data		
24	Products returned due to nonperformance of contractual obligations		
25*	Error in the counting of the pallets		
26	Error in the calculation of distribution taxes (ICMS)		
27	Excessive stock (Return due to lack of room in the customer's warehouses)		
28*	Problems with the Carrier		
29	Returns due to special contracts (eg. Christmas, etc.)		
30*	Losses during transportation		
99	Other		

In company “B”, as regards the item marked* classified as “Distribution”, the main reasons for the return of products are: distribution and quality deficiencies. For example, from 0.58% of returned products, of which 0.19% were returned due to “1. damages during transportation” and 0.24% due to quality deficiencies (First semester, 2006).

9.1.3 Economic Advantages Resulting from the Packaging Improvement

The information on the impact of packaging costs on the final price of the products and on production costs is companies confidential nature, so calculating the economic margins that would result from improving packaging is very difficult.

As reference, some economic calculations are shown.

(1) Savings after reducing the damages ratio

The following calculation should be made:

$$\text{US\$ } 700 \text{ (production cost)} \times 220,000 \text{ (units / year)} \times 0.03\% = \text{US\$ } 46,200$$

→ Under the current conditions, where the rejection rate due to damages is 0.03%, the annual loss amounts to US\$ 46,200. If packaging is improved, these figures could be reduced almost to zero.

(2) Reduction of transportation and handling costs

The cost of transportation by a truck from a home appliances manufacturing plant to a consumer center is approximately US\$ 650 per one way trip. If a shipping product is a refrigerator, a standard size truck's maximum loading capacity is 80 units per truck. Therefore, this home appliances manufacturer needs 2,750 trucks per year for their shipping since they produce 220,000 units of refrigerators per year. The current damages ratio is 0.03% for refrigerators of this home appliances manufacturer on their processes of shipment, transportation, storage and handling.

If a current damages ratio of 0.03% is considered, it can be said that 66 units ($220,000 \times 0.03\%$) are rejected and returned to the plant per year. If there is no merchandise returns, then the annual transportation cost of this home appliances manufacturer is calculated as:

$$2,750 \text{ units} \times \text{US\$}650 = \text{US\$}1,787,500 / \text{year}$$

If 33 units out of total 66 units of refrigerator returns per year would be returned to a manufacturing plant, the transportation cost of US\$21,450 ($\text{US\$}650 \times 33 \text{ units}$) can be increased in case of 1 unit refrigerator returns per 1 time truck transportation. This cost can be reduced by the improvement of packaging with a probability of returns to profit.

(3) Reduction of Packaging Expenses

In this company 3.4% of the manufacturing costs are absorbed by packaging materials and labor costs. Logistics is aware that the currently used packaging is excessive and that if the proposed improvements are implemented, packaging costs will be reduced by 1%, representing savings for US\$ 1.5 million in production costs.

Besides, this would result in a significant reduction of damages that would benefit not only manufacturers but also wholesalers, carriers, retailers and related parties.

The following table shows the results of a survey made in private companies about the increase of packaging costs and the policies in place to reduce the same.

1) Causes of the increase of packaging costs

	% with positive response
a. Increase in packaging materials	52.9%
b. Increase in distribution process	23.5%
c. Increase in returnable packages	11.8%
d. Increase in contracts executed and outsourced services	11.8%
	100%

2) Packaging costs reduction policy

	% with positive response
a. Recycling of the packaging material (reuse)	16.2%
b. Simplification, elimination of packaging material (reduction)	15.3%
c. Modification of the design of the packaging material	15.3%
d. Operative/ work efficiency (Standardization)	14.4%
e. Review of the pricing system applicable to contracts or outsourced services	12.0%
f. Recycling of materials	12.0%
g. Execution of contracts	6.0%
h. Review of contracts	4.6%
i. Addition of equipment for distribution	3.7%
j. Elimination of equipment for distribution (humanization)	0.5%
	100%

(multiple answers are included)

In respect to the packaging costs reduction policy, if verified per type of task, the highest number of tasks are performed during manufacturing. This specifically shows the change in the design of the packaging material. The next most important one is simplification /elimination (reduction) and finally recycling of the packaging material (reuse) that shows the actions performed by companies that attain optimization through the modification of designs.

As regards wholesalers, the recycling of packaging materials is the most important one, followed by operative/work efficiency (Standardization).

As seen in this JICA Study, if the policy is implemented as a common standard and both recycling and environmental problems are considered important issues within the MERCOSUR, the four items mentioned below will certainly arise, according to a survey carried out in Japan.

- | |
|---|
| <ol style="list-style-type: none"> 1. Modification of the packaging material 2. Operative / work efficiency (Standardization) 3. Simplification /elimination (reduction) 4. Recycling of the packaging material (reuse) |
|---|

Based on these principles, packaging costs should be reduced.

Besides, the following distribution weaknesses identified in the MERCOSUR should be highlighted: lack of organization to control the distribution process, lack of funds for storage security as well as long distance transportation security, high cost of installing GPS in the truck and high transportation insurance costs.

The lack of organization in the distribution management system may be due to the fact that contracts are not clear as to the distribution schedule. The distribution activities, where damages occur, are: manufacturing, entrance to the storage, storage tasks, dispatch, distribution processing, transportation, loading and unloading tasks. Within this classification, the main activities where packagings are damaged are loading and unloading and transportation.

This JICA Study included Transportation Environment Surveys using long distance trucks within the MERCOSUR and the provision of advice as regards the creation of adequate packaging based cargo handling surveys. However, more awareness should be risen in respect of the analysis of damages, through the consolidation of an organized distribution control to monitor the whole process, from the distribution activities up to delivery to the customers.

3) Economic evaluation of packaging

[1] Distribution costs = Selling price x 5.26% : (Average standard in force in Japan)

Structural comparison per item:

a. Transportation costs:	5.66%
b. Household appliances:	2.45%
c. Food products:	7.96%

[2] Current proportion of distribution costs

a. Transportation costs:	56.6%
(Supply, Internal: total transportation costs for sale)	
b. Storage costs:	20.5%
c. Packaging costs:	6.0%
d. Loading/unloading costs	9.7%
e. Administrative costs related to distribution	7.2%
(Expenses related to security within the Mercosur; no data available)	
	100%

[3] Percentage of damages to products within the Mercosur (simple calculation)

Household appliances	0.97% (average)
Processed food:	2.21% (average)

[4] Household appliances (target product for the Study: refrigerators)

(Eg) Selling Price	= US\$ 700/Unit
Distribution costs: 700 x 2.45%=	US\$ 17.15
Packaging costs: 17.5 x 6.0%=	US\$ 1.029
Manufactured units (annual):	220,000 units
Total annual packaging costs:	US\$ 226,380.00

The annual losses due to damaged products suffered by this company (calculated based on an average percentage of damages to products of 3 companies) is US\$/year 2,195.89-

However, the losses due to packaging damages are shown as a % of the distribution costs, so in the case of household appliances, this percentage is proportional to the 2.45% of the total price (see above)

Therefore, 220,000 units/year x US\$ 17.15 (distribution costs) = US\$ 3,773,000.00

Applying the product damages factor:

US\$ 3,773,000.00 x 0.97% = US\$ 36,598.00.-

Which represents the annual total losses.

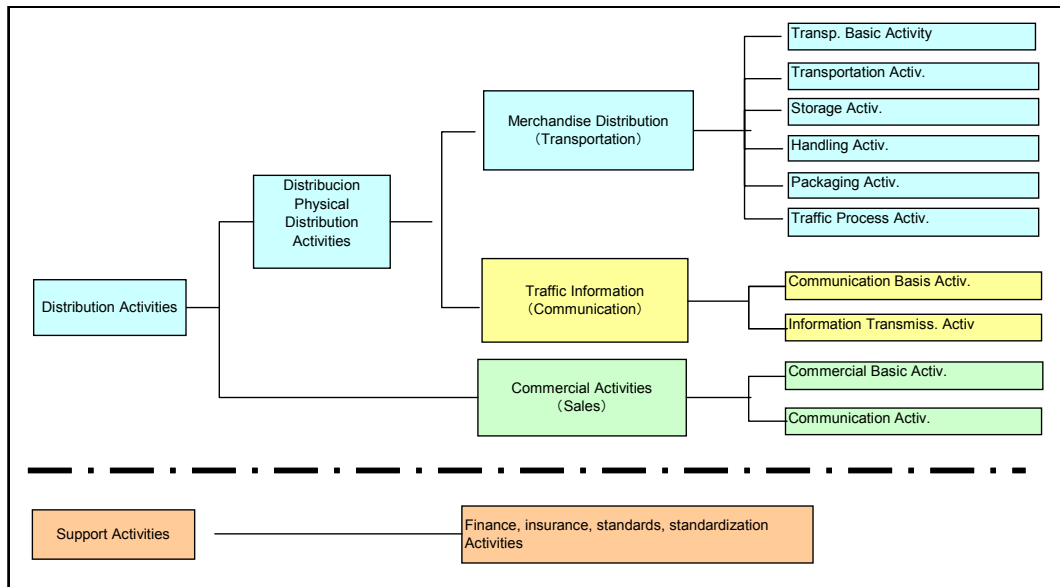
[5] Other factors

Security issues as well as insurance are important factors that affect operative expenses in the MERCOSUR region. However, this can be solved by implementing an organized distribution management system. To such end, the methodologies to be implemented in order to reduce losses should be determined first.

9.1.4 Improvement in Logistics

9.1.4.1 Logistics

In general, the logistics system or physical distribution, which includes the distribution networks, is as presented below.



Source JICA Study Team

Fig. 9-1 Logistics System General Diagram

It is named as physical distribution or logistics system to the series of activities performed during the transportation process of goods within a certain established time and distance, from the supplier to the demander. These activities include packaging, transportation, storage, handling, distribution, and the information system to be collected and generated for this purpose. When all these activities work systematically, it is possible to reduce the overall cost. Also, these can be further defined as provider, production, sales, recollection, among other types of logistics, based on the activities within a specific part of the process.

As it is shown in the Table 9-1, the activities that take place in the goods' distribution process, such as transportation, storage, handling and packaging were researched from the standpoint of the improvement of the transportation and packaging technology through this JICA Study. Based on the data analysis from the Transportation Environment Surveys, improved packaging for testing has been made and the Model Project has been carried out.

Regarding the reduction of costs, the following objects were performed.

(1) Cost of the Packaging Material

- a. Changes of the process to standardized equipment and procedures
- b. Savings through the reuse of packaging materials

Regarding to standardized materials and actually applied standards, the currently used standards in Argentina and Brazil have been analyzed. In regard to the reuse of packaging materials, the following is presented as a recommendation.

(2) Reduction in Packaging Costs

- a. Replacement of some packaging materials
- b. Revision of the machinery and packaging production line
- c. Revision of the inspection procedures of materials, at the stage of reception at factory

Regarding the issues above, it was proposed to replace the EPS by corrugated cardboard, the improvement of the utilized surfaces of the EPS and the packaging production line for electric home appliances, target product of this JICA Study. Similarly, for the products consisting of processed foods (dairy), improvements were performed for the lids of individual containers and the films for pouches.

(3) Reduction in Distribution Costs

- a. Revision of the grouping packaged products

The primary focus was on the products that consisted of processed foods, to improve the packing arrangement in the corrugated cardboard boxes for those products packaged in pouches. The recommendation resulted in a better arrangement accommodating a larger number of pouches per box.

Regarding the improvement in methodology to prevent damaging of goods during handling, transport and storage, there were two aspects that were discussed, and further recommendations were developed for those managing each of the phases of distribution.

1. Warning methods for handling process, by using warning signs
2. Improvement of the stacking (load up) method

On the subject of components of distribution cost in respect to sales, the data for the case of Japan is presented below as a means of an example.

- 1) Based on statistics¹, the cost percentage of the distribution cost in comparison to the sales cost equals 5.26%. Further subcategorized by activity, there is a 5.26% in the manufacturing industry, 4.54% in the wholesale commerce, and 4.28% in retail commerce.

¹ Source: Institute of Logistics System

- 2) From the industries pertinent to the present Study of JICA
 - a. Electric artifacts for industrial and household uses: 2.45%
 - b. Foods:
 - At ambient temperature: 7.96%
 - Refrigerated: 7.95%

The break-down of the physical distribution costs by logistic arrangement is as follows:

a.	Transportation cost	56.03%
b.	Storage cost	18.01%
c.	Other	25.96%
		100.00%

9.1.4.2 Topics of analysis: An environment friendly logistics

Based on this JICA Study, if a general revision is made to the “Actual Improvements and Near Future” from a logistic perspective, the obtained results would be those displayed in Table 9-2.

Table 9-2 Check List for an Environment Friendly Logistic System

Classifier	Aspects for Evaluation	Logistical Issues to be Revised with respect to the Natural Environment	Sample of Determining Data	Sample Determining Data related to the Natural Environment	
Revision of the Packaging	Reducing the packaging materials. Thinning	Are the packaging being reduced or simplified enough to minimize the amount of wasted material?	<p>Reduction of excessive packaging materials; are they slimming (simplification of the material)?</p> <p>Thinning of the packaging material, reduction in weight (use of lighter corrugated cardboard, etc.)</p> <p>Reduction in weight of the packaging by replacing the shock-absorbent materials</p> <p>Reduction in the use of internal cardboard separators within each corrugated cardboard box</p> <p>Avoid the packaging in small boxes, and prepare group packaging within large boxes.</p> <p>Weight increase through the reduction of multi-layered material is avoided, utilizing part of the container itself as shock-absorbent material.</p> <p>Simplification of the packaging (transport without packaging, only with label ticket), in accordance with the receiver of the merchandise (buyer)</p> <p>Simplification of the packaging considering the method to discard the material by the consumer.</p> <p>Transportation of merchandise without packaging, in the actual state in which these products will be used (transported in hanger hooks, and their recollection after delivery)</p> <p>Reduce the use of cardboard pallets and one-time-use slide stoppers (disposable)</p>	<p>Volume of packaging material.</p> <p>Reduction in the volume of packaging material.</p> <p>Packaging material reduction index (compared to previous year)</p>	<p>Product</p> <p>The volume of emitted carbon dioxide can be calculated by multiplying the amount of energy consumed to process the wasted packaging material by their carbon monoxide emission coefficient.</p>
		Is the reuse and recycling of materials being implemented to reduce the amount of wasting material?	<p>Implementation of the systematic reuse and recycling of cases and packaging for the entire transport branch (including sub-sectors)</p> <p>Introduction of two-way cases, going and returning (cases with common specifications within the company, other companies within the branches, or common for the diversity of that products)</p> <p>Substitute the use of corrugated cardboard cases and shock-absorbing materials for one time uses, with those that are reusable; recollection of the used cases and boxes.</p> <p>Recollection and reutilization of the shock-absorbing materials.</p> <p>Use of materials for reusable storage.</p> <p>Utilization of reusable pallets.</p> <p>Utilization of recyclable pallets.</p> <p>Utilization of recyclable packaging for storage.</p> <p>Fabrication of filling material using the wasted corrugated cardboard boxes, recycling it for shock-absorbent uses and others.</p> <p>Use of recyclable packaging materials.</p> <p>Reduce the use of complex packaging materials (utilization of very simple elements to facilitate their recycling).</p>	<p>Volume of packaging material.</p> <p>Reduction in the volume of packaging material.</p> <p>Packaging material reduction index (compared to previous year)</p> <p>Packaging material rotational (reuse) index.</p> <p>Packaging material recycling index.</p>	

Classification	Aspects for Evaluation	Logistical issues to be Revised with respect to the Natural Environment	Sample of Determining Data	Sample Determining Data related to the Natural Environment
3)	Use of Elements with Low Impacts to the Natural Environment Is the nature of the packaging materials composition being considered to reduce their environmental impact at the time of disposal?	Reduction of the packaging through the use of corrugated cardboard boxes packaged with film. Reduction of the use of corrugated cardboard boxes, packaging directly on the product's container with film. Change of the wooded packaging for large merchandise for polyethylene bags. Packaging the external box of merchandise, individually or grouped, with contractile film. Change of the shock-absorbent material, from plastic to paper, to reduce the impacts towards the natural environment. Reduce the use of toxic materials harmful to the natural environment. Change the packaging material from chlorine vinyl with polypropylene, polyethylene to avoid the emission of dioxides during their incineration. Reduce the use of toxic materials harmful to the natural environment (for example, the use of paper adhesive tape to seal boxes.) Use of plastic materials with organic decomposition properties.	<ul style="list-style-type: none"> ▶ Quantity of used and reduced packaging material (actual materials) ▶ Quantity of used and reduced packaging material previous materials) ▶ Packaging material reduction index (compared to previous year) ▶ Quantity of used and reduced contaminant material 	
4)	Incorporation of Machineries with Low Environmental Contamination Are the machines being used of low contaminant emission to reduce their environmental impact during packaging?	Incorporation of packaging materials of low energy consumption. Incorporation of packaging machineries with low impacts to the natural environment (for example, incorporation of the labeler that does not produce toxic elements). Incorporation of environmentally friendly machineries such as packaging machines and fabricators of shock-absorbent materials Daily revision of loading volumes and comparison with the distribution plan to select the appropriate sized vehicle. Deliveries during night time and on holidays to avoid traffic congestions.	<ul style="list-style-type: none"> ▶ Machinery units in use ▶ Number of reduced machineries in use ▶ Machinery reduction index (compared to previous year) ▶ Traveling distance ▶ Reduced distance/ distance reduction index (compared to previous year) ▶ Number of trucks (units) ▶ Reduction in truck units/ reduction index (compared to previous year) 	<ul style="list-style-type: none"> • Entrance (gasoline, gas oil, gas, electricity etc.) Calculate the total energy consumption for the transportation and distribution process. • Product (carbon dioxide, NOx, etc.) Calculate the total energy consumption for the transportation and distribution process. Calculate the emission of carbon dioxide, NOx, etc, by multiplying the consumption with the emission coefficient.
1)	Revision of Routes and Delivery Dispatch Are the traveling plans and itineraries (delivery vehicle, times, routes, etc.) revised to reduce the use of fuel?	Selection of appropriate routes through simulations, in accordance with the delivery plan. Reduction of the traveling distance by dividing the delivery convoys between direct routes and intermediate locations, based on the Reduction of the transport distance through the revision of the location of the recycling companies.		

Classifier	Aspects for Evaluation	Logistical issues to be Revised with respect to the Natural Environment	Sample of Determining Data	Sample Determining Data related to the Natural Environment
2)	<p>Increase of the Loading Coefficient</p> <p>Is there sufficient effort towards increasing the loading efficiency and reduce the number of delivery vehicles?</p>	<p>Delivery convoys with consolidated mixed freight for low volume transactions.</p> <p>Improve the loading coefficient by rotating the delivery dispatches with mixed loadings for different commercial stores.</p> <p>Recollection of the reusable material by the trucks returning to the distribution dispatch location.</p> <p>Use of two-way containers that are foldable (increases the efficiency for the recollection logistics)</p> <p>Systematic control of the vehicle delivery plan to prioritize the dispatch of larger sized vehicles.</p> <p>Reduce the frequency of the delivery dispatches by increasing the size of the transport vehicles (trucks).</p>	<ul style="list-style-type: none"> ▶ Number of trucks (units) ▶ Reduction in truck units/ reduction index (compared to previous year) ▶ Loading coefficient ▶ Evolution of the loading coefficient (comparing to previous year) 	
3)	<p>Check-up and Maintenance</p> <p>Are controls and maintenance regularly performed on the vehicles to improve their energy</p>	<p>Periodic maintenance and control prior to the dispatch of the vehicles to reduce the cost of fuel, lubricants and gas emissions.</p>	<ul style="list-style-type: none"> ▶ Number of days in between control and maintenances; evolution of the fuel consumption 	
4)	<p>Driving with an Ecological Conscience</p> <p>Is the way the vehicles are driven paid attention to, with the purpose of reducing the unnecessary use of fuel?</p>	<p>The vehicles are driven with an ecological conscience (avoiding peeling out and aggressive acceleration), with aims to rationalizing the energy and reducing the emission of toxic gases.</p> <p>Avoiding the unnecessary idle running of the engine (turn off the engine when it is not necessary)</p>	<ul style="list-style-type: none"> ▶ Ecologic driving. Number of days and peop ▶ Eliminate the unnecessary idling of the motor engine. Number of days and 	
5)	<p>Incorporation of Low Contaminant Emission Vehicles</p> <p>Are low contaminant emission vehicles used, with the purpose of reducing the emission of gasses for loading unit?</p>	<p>Incorporation of vehicles with low gas emission, or those running on clean energy (ecologic)</p> <p>Installing devices to reduce the gasses, such as DPF (diesel particles filter?)</p>	<ul style="list-style-type: none"> ▶ Number of low emission vehicles; incorporated units and the corresponding incorporation index (in comparison to the previous year.) ▶ Reduction in the number of diesel units; reduction index (compared to the previous year) 	

Classifier	Aspects for Evaluation	Logistical Issues to be Revised with respect to the Natural Environment	Sample of Determining Data	Sample Determining Data related to the Natural Environment
Revision of the Handling, Storing and Distributing Processes	1) Incorporation of Machineries and Tools; their Efficient Use	Are there improvements in place regarding functionality and incorporation of machinery tools, to reduce the emission of toxic gases and wastes in each logistic activity?	Reduce the units of forklift trucks. Regular maintenance of the machinery Incorporation of machineries for storing, handling, processing of the distribution, all with low impacts on the natural environment. (for example, labelers that do not use toxic materials) Incorporation of machines with low energy consumption. Incorporation of machines with low environmental pollutant emissions.	<ul style="list-style-type: none"> ▶ Incorporation of low energy consumption machines. ▶ Number of newly incorporated low energy consumption machines. ▶ Number of incorporated low energy consumption machines.
	2) Maintenance of the Facilities; their Efficient Use	Are there improvements in place regarding the functionality and maintenance of the facility, to increase energy efficiency in each of the logistic activities?	There are waiting rooms available for the drivers, to avoid the idle running of the engines during waits in the summer, winter and for nighttime dispatches and deliveries. Use of post pallets to reduce the energy consumption for the lighting (improves the storing efficiency) Automimization of the reception and delivery dispatch jobs. Use of tools of low energy consumption, such as those with inverse Defining the handling processes with human intervention and those with machinery. Control of the placing of the merchandize to be stored; appropriate signalling for the storage. Use of the Freon substitute for the cooled and refrigerated trucks.	<ul style="list-style-type: none"> ▶ Number of incorporated low energy consumption machines. ▶ Number of newly incorporated low energy consumption machines. ▶ Number of incorporated low energy consumption machines.
	3) Normalizing the Volumes	Are the distribution volumes normalized to prevent the high and low extremes in the handling and storing activities?	The volume fluctuation between receptions and dispatches is avoided. Establishing the storing volume. Increase the handling efficiency by leveling the volume and reducing the number of merchandise handling machineries units.	<ul style="list-style-type: none"> ▶ Number of days in stock ▶ Reduction in the number of days in stock / Reduction coefficient (compared to the previous year)
	4) Reduction in the Resources	Are there efforts to reduce the use of resources involved throughout the logistic process, with the purpose of reducing wastes?	The information for the transport is printed directly on the packaging. Use of transport labels (STAR labels), to reduce the number of labels. System and methods for storing to avoid the unnecessary use of materials during storage.	<ul style="list-style-type: none"> ▶ Number of used labels ▶ Reduction in labels/ reduction coefficient (compared to the previous year) ▶ Use material volume ▶ Reduced material volume ▶ Reduction coefficient for material volumes (compared to the previous year) <p>• Product The volume of emitted carbon dioxide can be calculated by multiplying the amount of energy consumed to process the wasted packaging material by their carbon monoxide emission coefficient.</p>
Source: (Inc.) Japan Logistics Corp.				

Source: Japan Institute of Logistics System

9.2 Improvement in the Design of Primary Packaging for Food Products

As one of the purposes of food packaging is to protect its content, the product must arrive in good condition and perfectly packed to the hands of the consumer after transport / distribution. One of the purposes of this Study is to reduce the number of damages during transportation. A series of alternatives referred to handling, storage and transportation improvement are proposed. Some recommendations are also made as to design improvements of primary packaging of dairy products.

(1) Milk Pouches

The advantages of milk pouches are: minimum quantity of material, low cost, low accumulation of waste after consumption. However, the main point is the hot sealing, through which leaks occur. Leaking is a fatal defect. In case of packaging of confectionery products commercialized in South America for example, “3 side joint sealing” is used, where the seal bands are broad enough to make it resistant. Instead, in the case of pouches, problems must be specifically analyzed and improvements be proposed, since there are design compromise solutions between opposite factors in this type of packaging.

The most common pouch sealing method is “pillow type joint” (as compared to the “3 sides joint sealing” method). This type of sealing is made by applying heat on one side to obtain fusion with the second film, for which reason at this point the sealing can be quite weak.

The “side joint sealing” is highly resistant because the heat is applied on both sides of the joining point. If shifting from the “pillow type joint” sealing to the “3 sides joint” sealing is considered, there would be no problems since there would be no changes in the size of the pouch.

Sealing of the upper and lower part of the pouch is made by “fusion and cut”, and since it is very narrow, it is easy to tear. Sealing design should have a minimum width of 5mm. The sum of the width of the upper and lower part of the sealing should amount to 10mm. As a result, if height of the currently used pouch is approximately 230mm, it should change to 240mm, and the material consumption will increase by almost 5%. Considering that the cost of the material is of USD 4 cents, according to the sector, costs would be increased up to USD 0.2 cents per unit. Nevertheless, since shifting to a material with a higher L-LDPE percentage brings about a higher resistance, it is possible to reduce thickness by 5%, completely offsetting the increased sealing cost.

In order to face all these changes in the sealing method, change in the existing production equipment should be considered. Besides, it is necessary to bear in mind all these considerations when equipment is replaced by new ones at the plant. Even in those cases when the machinery updating cannot be done immediately, by improving the quality control on the

production line, outstanding improvements can be attained, reducing leaking defects. This has been motivated by the fact that, as a result of milk pouches resistance evaluation tests carried out in Argentina, Paraguay and Uruguay, it could be observed that some brands' pouches were of excellent quality without leaking at sealing and body, even using "pillow type" joint sealing method. On the other hand, it should be mentioned that some brands had leaks, even though side "3 sides joint sealing" was used.

(2) Aluminum foil for packaging

Aluminum foil has excellent gas and sunlight barrier properties, therefore, it is highly recommended to manufacturing flexible materials for packaging. However, it has certain weaknesses: it is easy to tear, and subject to pin holes by punching or by folding. As a result, it is generally laminated with a plastic film. For example, it is usually applied together with a polyethylene film, PVC, PET in laminated form, for medical or food products.

In the case of chocolate bars and cigarettes, aluminum is used in separate wraps, but at the same time they are placed in other carton or paper containers for protection.

In South America, the aluminum foil is used as a lid for yogurt and milk jam pots, and tear and leaking at arrival to the consumer are usual. From the point of view of the packaging design and product protection, this is a very serious problem. Therefore, it is very important to study the subject and redesign the pots, replacing the aluminum foil by a laminated plastic material to compensate that weakness.

9.3 Improvements in the Storage and Handling of Cargos

9.3.1 Food Products (dairy, olives, and other products)

(1) Company A and B use PE pouches and plastic crates. As to materials, some cases of damaged crates and protuberances or sharp parts remaining from manufacturing could be observed on the internal parts of the crates. Due to such defects, tearing or pin holes could occur during transportation due to vibration.

On the other hand, in the case of the Company A, several wood pallets were damaged or had bulging nails, resulting in damages to Kraft paper bags and spillage.

To implement improvements to reduce damage in the storage and transportation of products, the quality of the elements used, such as pallets, crates, etc. should be strictly controlled.

(2) Both in Company A and B, during palletization of cargo many cases of deformation of boxes could be observed. Besides, boxes were also damaged due to their being

inadequately placed in the pallet, protruding from it. A comprehensive analysis of the size of the boxes with respect to the product should be carried out as well as a verification of the resistance of boxes, the loading and palletization methods, etc. performing a comprehensive study to reduce damages.

- (3) In the case of Company B, it could be observed that due to the low cost of labor, loading and unloading tasks are mostly made manually.

Should labor costs increase in the future, the loading and unloading method should be modified and fork-lift should be implemented, so as to have a uniform and safe working method and prevent impacts due to dropping, with the consequences they may have.

9.3.2 Household Appliances (white goods)

To ensure the quality of a product that is commercialized through a distribution network, without a quality control is inadmissible. Besides, the manufacturer is responsible for the final quality of the product that should have security controls in place in respect of the handling and storage of products.

The following table describes the aspects related to the equipment and improvements to be implemented in the packaging design control system, in respect of the target products used in this Study.

- | | |
|---|--|
| (1) Standard handling survey: | Setting of the weight of the cargo and number of employees for loading/unloading |
| (2) Packing standard for loading / unloading and product storage: | Place slots to grab the upper, lower and inferior sides of boxes |
| (3) Safety controls in loading / unloading of products from the top of the truck: | Safety is essential. Safety controls of auxiliary and packaging equipment. |
| (4) Verification of the safety level in pile up storage: | Take the necessary steps to prevent deformation of boxes in the long term, considering the location of the center of gravity (in Argentina specially, improvements were developed focused on this aspect). |

9.4 Transportation Improvements

9.4.1 Food Products (dairy, olives, and others)

- (1) In the case of Company B, transportation of yogurt pots is made by piling up 2 layers inside crates, one in a normal position and the other one upside down. <with the lids facing each other> By applying this method, due to the friction between the aluminum lids, there appear pin holes, spilling the product in the upper layer pots, affecting the other containers around. Both lids should be placed in normal position, using a separator, to reduce damages.
- (2) In the case of Company C, for the transportation of pots of milk jam (dulce de leche) to Chile, 2 layers of pots are placed upside down in carton boxes. When performing the lab vibration tests, the lids of upper layer of upside down pots suffer from friction, and as a result the printing on the cap loses quality. Besides, it has been observed that the aluminum lid have pin holes that cause leaks.

Nevertheless, the transportation survey crossing the Andes Rockies had to be temporarily suspended due to the effects of increase of customs tariffs. If exports are resumed, the same problem will be arisen.

To reduce leaks, a separator should be placed between lids. Besides, as to the pin holes in the material, it could be confirmed that by replacing the aluminum foil for a laminated plastic material, the problem can be solved, therefore this type of material should be used to manufacture the lids.

9.4.2 Household Appliances (white goods)

From the point of view of transportation improvement, the packaging system should be analyzed by considering that products are distributed by land or by marine in containers. As to the target product (white goods household appliances) used in this JICA Study, since transportation was restricted to land (for export), the required packaging quality surveys were carried out taking into account this fact, and the applicable specifications were prepared.

Clause 4.5 of this report describes the results of surveys carried out directly by this Study team on products that arrived at the final warehouse.

As a result of said surveys, the following improvements are proposed:

- | | |
|---------------------------------------|---|
| (1) Shipment from plant: | Improvement of QC of the product to be shipped (Several defects were observed in the cover of the shrink type film) |
| (2) Problems when loading the trucks: | Verification of loading equipment used and their operation |

(Packaging defects were found, especially in the units loaded horizontally on top. Possibly due to loading procedures)

- (3) Common subjects applicable to marine transport: Standardization of the transportation module

9.5 Situation about Transportation Insurance

It could be confirmed that all nine visited cooperating companies have taken out insurance on the goods at the time of dispatch from the factory. Thus, economic losses arising from any eventual damage during transportation are avoided.

Regarding the cost of the insurance policy, it will obviously depend in each case on the terms and conditions of the agreement signed with the client. In the case of the manufacturers of white goods, since most sales are agreed to be transferred to the client “at factory”, the buyer or the carrier company to which the goods are transferred shall be responsible for taking out insurance. In the case of foodstuff manufacturers, the insurance shall be the responsibility of the manufacturer, since in most cases, transportation is done by the same manufacturing company.

However, there is a case of a foodstuff manufacturer where transportation is entrusted to a third party company, but the insurance is taken out by the manufacturing company, or in other cases by the buyer, so, in any cases the carrier is not held responsible for the damages during the transportation.

As consequence of this situation, comments were heard stating that the handling of goods are becoming more hard, without care.

9.6 Interesting Aspects in the Regional Transportation for involved Sectors

9.6.1 Household appliances (white goods)

The target product in this Study carried out by JICA for cases in Argentina and Brazil are white goods home appliances. Among them, the refrigerator has been chosen as a specific product for this Study.

One company from Argentina and two companies from Brazil collaborated in this Study. The transportation environment survey in the main routes for the selected products started with the close cooperation among the members of the mission, the counterparty institutions, and the cooperating companies. As the ground transportation of the selected products uses extremely long routes in a vast territory, with great climate variations, modern sensors devices were used,

allowing the simultaneous measurement of temperature, humidity, vibrations and impacts. This Study has built up high expectations concerning the reduction of damages in the products in a short term. Data were collected and analyzed geographically on the route chosen for the Study, by means of the data-crossing of the measurement sensors with a GPS positioning system. It is pertinent to say that this achievement was possible to a great extent, not only because of the interest in the Study, but thanks to the cooperation of the household-electric appliances manufacturers and the transportation companies.

This Transportation Environment Survey carried out by JICA would not have been possible without the cooperation of the carriers with whom a fluid and close communication was established concerning the coordination with the measuring instruments, as well as the characteristics of the cargoes and the trucks. Particularly it is worth mentioning the truck-drivers, without whose inestimable cooperation the data collection would not have been possible.

The products selected for this Study were loaded on trucks in the factories, and then transported and unloaded in the distribution centers, where they were stored in the warehouses. In this integral sequence of transport-distribution of the goods, the measurement of impacts during cargo handling was of great importance. It is through this analysis of the integral process that these studies carried out by JICA arouse the interest of the involved sectors.

After analyzing the data collected in the Transportation Environment Surveys, laboratory tests were made iteratively on the basis of this information, so that a design of a packaging adapted to the studied routes could be developed. Concerning the preparation of the test samples, the cooperation offered by the suppliers of packaging material has been indispensable.

In this study of JICA, in the case of Brazil, a new packaging for a product was prepared using 100% cardboard, based on a design of an improved packaging, with the cooperation of a packaging material manufacturer.

In Argentina, the improved packaging for testing has been prepared practically with the intervention of the personnel of the counterpart (INTI) and the support of the members of the mission, using available materials in the local market, and modeled manually by the same personnel.

Through this JICA Study, it was possible to hold the personnel training program and carry out the technology transfer through theoretical and practical courses on topics such as measurements in the transportation environment, taking into account the relevance of the packaging technology for transportation and distribution. This Study, despite the fact that it has been carried out in a limited context of time, products, transportation routes and involved industrial sectors, it has succeeded in catching the interest of the manufacturing industry and the transportation sector, as well as the packaging material sector. The overhauling aspects are the

control of the process in: a) factory, b) exit and entrance of cargoes, c) transportation, d) storage and distribution to the consumer sector.

However, for the manufacturing sector, sudden implementation of improvements in the packaging processes would imply a great financial burden. Therefore, the implementation of improvements in the design, with the consequent modifications in the production lines, etc., shall require a certain time for fulfillment. But on the other hand, the advisory services offered to the manufacturing plants, the carriers and the suppliers of packaging material have been effective, particularly if the implementation of systematic improvements applicable in a near future is considered.

9.6.2 Processed Food Products (mainly dairy products)

Household electric appliances and processed food products were chosen as the target of this JICA Study. In the case of Brazil, only household electric appliances were taken as a target.

In Argentina, Paraguay and Uruguay, dairy products were chosen due to their relevance in the productive matrix in these three countries. On the other hand, in Argentina, products derived from olive and vegetable oil were added because of the great interest of the cooperating companies which supported this Study.

In the first stage of the project, with the first set of measurement devices arrived in Argentina, a first demonstration test of the Study of the Transportation Environment was carried out simultaneously with the application of the GPS. Tests with products derived from olive were carried out, in a section of 1200 km between Aimogasta (Province of La Rioja) and Buenos Aires. On the other hand, in order to carry out measurements for the handling of cargoes, a “dummy” cargo (olive product box) was designed and prepared. The object of this study was the improvement and technological development of secondary packaging.

Next, after holding a technical training course about the operation of the devices, the transportation environment survey with previously selected dairy products was carried out in Argentina, Uruguay and Paraguay. For the purpose of carrying out simultaneously the measurement of impacts during the handling of the cargoes, a “dummy” cargo of a dairy product for each country were designed and prepared, and placed together in the cargoes to be transported. Then, distribution studies were carried out with different types of dairy product cargoes in small trucks in cities and their surrounding areas, taking into consideration the damages during the handling of the cargo in the distribution process. Moreover, temperature control was performed on the refrigerated trucks, where the deterioration of the quality of the products due to the increase in the room temperature during the summer is unavoidable. In the light of the results of this Study, the authorities at management level of the cooperating

companies showed a high interest in promoting policies aiming at the improvement of the control of the distribution of their products.

On the other hand, as the JICA Study moved forward, the interest of the manufacturers on specific damages caused a change in the approach of the studies. The focus which was first put on secondary packaging but later shifted onto primary packaging (individual packaging). More specifically, the studies aimed at improvements in the packages, the lids of packages, the filling process and the materials of the packages.

On the basis of the analysis of the packaging material available in the local market and the technology of Japan, the mission members studied the possibility of developing improvements in the design for each of the three mentioned countries separately. In the case of the individual package, a specific case of damages in packages was studied, then an analysis of the probable origin of the damages was carried out, and taking into account this hypothesis, a series of laboratory tests was planned and carried out iteratively. Once the origin of the damages was determined with precision, a series of improvements, such as modifications in the design of the package, changes in the material of the package, changes in the process of the production line were proposed. As a result of all these studies, technical recommendations regarding improvements in the packages (sachets) of milk, yogurts, “dulce de leche (milk jam)” and some other products could be given. The accomplishment of the improvements in the design of packages drew the interest of the executives of the cooperating companies concerning the concrete possibility to reduce damages in the products.

On the other hand, we consider that we have succeeded in drawing the interest of the suppliers of packaging material regarding the contribution that could be made in technological improvements, incorporation of technology and in addition, the increase of companies' awareness of the need to offer a better product to the final consumers.

9.7 Type of Transportation (shipments by ground, water, and air)

According to the information received from sources such as truck drivers' data, reports from IIRSA (South America Regional Integration Initiative) Group, investigations sponsored by the IDB and the ECLAC, it can be inferred that most of the goods transported within the four countries of the MERCOSUR flows by ground, using trucks.

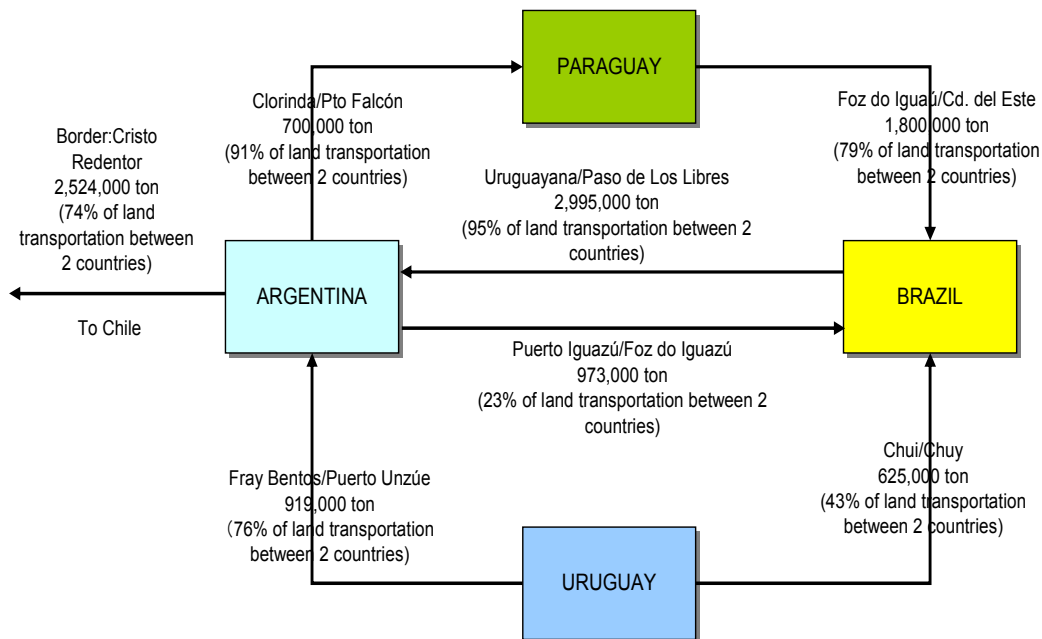
Table 9-3 Distribution of Ground Transportation in the Four MERCOSUR Countries

Country	Transportation by land using trucks	Remarks
ARGENTINA	80%	Cereals like wheat is transported through rivers
BRASIL	67%	Cereals are transported 28% by train and 5% through rivers
PARAGUAY	89%	The import-export trade of goods are made 90% by ground and the remaining 10% is made through rivers
URUGUAY	76%	Wood transportation from the forestall area is made by train

Source JICA Study Team

The present Study carried out by JICA is based on products for import-export trade that are transported by land (trucks). Currently, the transportation for shipments from the North zone (continental part) into the South zone (port coastal zone) of the MERCOSUR region is by train and through rivers. Another observation that surfaced through this Study is that the goods move from the east to the west. Also, the import-export trade from and to countries limiting with the MERCOSUR is made, in most cases by land using trucks.

This observation can be proved particularly with the transportation of products selected by this Study (electric household appliances and processed food –dairy products). Despite there is no current data available, the following graphic can show a comparison between the quantity (in tons) of goods that passed through the border of the four MERCOSUR countries by land and the ones that passed the borders between two countries.



Source JICA Study Team

Fig. 9-2 Ground Transportation: Percentage against Totals among 4 Countries of the MERCOSUR Region

Chapter 10 Results and General Recommendation

Chapter 10 Results and General Recommendation

10.1 Analysis and Detailed Review of the Work Schedule for the Study, including the Exchange of Information on the Progress of the Monitoring Survey Performed with the Counterpart Institutes

10.1.1 Results of the rotary technical guidance courses in the 4 countries (TG)

The following stages were defined within the general scope of the Study aiming at improving the technical level and the development of skills of the staff from the four countries:

- (1) First year: First field survey carried out as follows: (Part 1), and then (Part 2).
- (2) Second year: Second field survey performed as follows: (First part), then (Second part) and then Third field survey.
- (3) Third year: Fourth field survey, Fifth field survey, Sixth field survey planning, completion of the 4th field survey.

In the meantime, expert groups of the Study Team visited the 4 countries in a “Rotary Cooperation Program at Regional Level” to provide technical guidance (TG) and training courses. These activities were focused on the relevant tasks scheduled in the Work Flow Diagram and in each trip they were focused on the main relevant activity of the work plan.

Through a series of training courses i.e. 3 training courses developed in Japan (based on an independent program organized by JICA headquarters office), the present TG training program and related work shops (WS), they were developed the activities aiming the improvement of the staff's technical skills.

However, there were some difficulties with the Transportation Environment Survey due to significant size of the 4 countries (different compared with Japan) that generated further differences on the methodology of loading of trucks of cooperating companies, the selected routes and the coordination of the schedule of the survey. Further, even after selected the products, there were also problems for the export process because of customs delays at the border that delayed the completion of the survey within a short time.

Regarding to the Rotary Training Program, a total of ten Technical Guidance Courses (TG) were originally scheduled to be carried out in the first 3 years, but only nine had been completed by the fourth operative year.

The mentioned courses were developed as described below:

(1) TG (1): First field survey in the first year (Part 1), November to December 2004.

For this TG, the members of the JICA Study Team were divided into two Groups, I and II. Group I mainly held meetings with the C/Ps in each country where the most difficult issues and the Inception Report (IC/R) were considered, whereas Group II verified the basic features of the cooperating companies, and the equipment available in each country. The obtained results were analyzed in detail. As regards the First field survey (Part 2, from February to March 2005), the Transportation Environment Survey was carried out as a demonstration test. To such end, DER-SMART measuring equipment was used together with a GPS within the dummy cargo along the selected route in Argentina, (a 2,400 km round trip between Buenos Aires – Aimogasta, transporting olive by-products (packed olives) supplied by NUCETE, one of the cooperating companies). The obtained data was analyzed together with the C/P and the results were discussed in the 4 countries. Then, the C/P received technical training. It should be mentioned that the INTI played a key role in the analysis of the data as Argentine coordinator.

Changes in the Work schedule after the Second field survey

At the beginning of the second year of the Study, the sensors supplied to perform the transportation environment survey were different from those previously sent to Argentina, so important changes had to be made in the Work Schedule.

These changes in the schedule generated the need to coordinate the operation and technical adjustment of the different sensors.

(2) TG (0): Second field survey (Part 1), Second Year, July –August 2005

In order to amend the Work Schedule, a technical description of the SAVER 3X90 sensors and of the calibration of the DER-SMART/SAVER3X90 equipment was planned so as to adjust the transportation environment survey using different sensors and carry it out using DER-SMART sensors along selected routes in Argentina pursuant to the amended schedule. To this end, the members of the JICA Study Team were divided into two groups, in order to deliver a theoretical course on the SAVER 3X90 sensors and the adjustment of the Transportation Environment Survey using different sensors. Said course was carried out in the 4 countries as an additional Rotary Technical Guidance Course TG (0).

(3) TG (1): Brazil, September - October 2005**Joint Technical Guidance Course of the 4 Countries in Paraguay (August 22 – 29, 2005)**

This course dealt with the theory, operation and demonstration of the application of the SAVER 3X90 sensors in the Transportation Environment Survey, and provided training on the analysis of the collected data.

After the completion of this course in Paraguay, the equipment was distributed to the respective C/P. Brazil, as well as the members of the Study Team and the C/P, received DER-SMART and SAVER 3X90 sensors. Then, the Transportation Environment Survey was performed in Brazil with the participation of MULTIBRAS and BSH. The survey covered a one-way distance of 3000 km and the knowledge acquired in the technical guidance courses on the analysis of vibration and impact data using the OJT method were applied, supervised by the JICA Study Team.

(4) TG (2): Paraguay, end of September to Beginning of October, 2006

The first Transportation Environment Survey was performed along the 3 selected routes using SAVER 3X90 sensors. A survey on the handling of cargo (dairy products) during transportation in Asuncion and the Gran Asuncion area was also performed using a dummy cargo specifically designed and assembled to such end. The trucks used in this Transportation Environment Survey were owned by the cooperating company, CHORTITZER; besides, 4 ton hired trucks were also used along the stretch from the Loma Plata factory, north of Paraguay, to the supermarkets and shops. Along this stretch, and mainly where the roads were in bad conditions, the temperature control of the truck refrigerator was checked.

(5) TG (3): Uruguay, Beginning to mid-September 2005

The First Transportation Environment Survey was carried out along the three selected routes using SAVER 3X90 sensors. First, a dummy cargo of butter (the product selected for this survey) was designed and assembled. The survey started at the low temperature storage chamber of CONAPROLE's Florida factory along the selected routes using a hired truck covering the Montevideo – Rivera stretch, about 500 km north, at the border with Brazil. Then, a mixed cargo was carried from Montevideo to Fray Bentos (at the border with Argentina) about 300 km to the west.

The issues discussed in this TG were the improvement of the computer data matching process (that was too slow) and the process of delivery (factory/ carrier/ supermarket) of the dummy cargo for the transportation environment survey.

At the beginning of November, the JICA Study Team temporarily returned to Japan to prepare the draft of the Progress Report (PR/R) while the cooperating companies performed

their independent Transportation Environment Surveys, and later analyzed the data from the surveyed routes. Meanwhile, simultaneously with the preparation of the Progress Report draft, the JICA Study Team analyzed the significant amount of gathered data through third party searchers.

Coordination Meeting: INTI – Argentina, November 1, 2005

During the Second field survey (Part 2) of the export of products from Chile, across the Andes, to be performed in Argentina with the collaboration of Frimetal (that supplied refrigerators) using SAVER 3X90 sensors was cancelled due to a strong snow storm. It was finally carried out on July 2005, as well as the analysis of the data (corresponding to the three routes) collected during the Transportation Environment Survey performed using DER-SMART sensors, supervised by the C/P INTI. Finally, upon completion of the Second field survey, the JICA Study Team held a coordination meeting in Buenos Aires with the MERCOSUR coordinators (INTI) in order to discuss the development of the Transportation Environment Survey performed in the 4 countries.

(6) TG (4): Argentina, Mid – January, 2006

After the return of the JICA Study Team to Japan in November 2005, the data obtained in the Transportation Environment Surveys independently performed by the C/P was compiled and analyzed. Special attention was given to the processing and control of the data obtained in the second survey of the Aimogasta-Iguazú stretch that had to be repeated due to GPS failure. In addition, the methodologies and techniques applied in the data analysis were also discussed based on the results of the Transportation Environment Surveys performed along the routes selected in each country by the MERCOSUR coordinator, the INTI.

On the other hand, regarding to the starting stage of the 3rd field survey, the methodology and techniques for data analysis of information gathered during the transportation surveys were discussed with INTI (as coordinator of MERCOSUR).

Also, discussions have been made about the draft of Progress Report, particularly to the topics related to mutually agreed basic rules of the "Reference Guideline for Packaging Tests, for Evaluation". As a result, both parties agreed to proceed based on the methodology described in the Progress Report.

(7) TG (5): Paraguay, End of January to Beginning of February, 2006

Simultaneously with the technical training on the processing methodology and analysis of the data collected in the Transportation Environment Survey, the discussions were held about the technical aspects of the analysis of the data collected in the transportation survey performed between the Gran Asuncion and Asuncion city area.

(8) TG (6): Uruguay, End of January, 2006

The results of the analysis of the data obtained in the independent Transportation Environment Surveys performed by the C/P along the Montevideo – Rocha and Montevideo – Rivera stretches were discussed.

(9) TG (7): Brazil, Beginning of January – End of February, 2006

Simultaneously with the discussion on the methodologies and techniques applied to process the data obtained in the Transportation Environment Survey, and the presentation of the draft of the Progress Report (PR/R), the basic project related to the construction of the database (DB) and the establishment of basic guidelines for the Evaluation of Packaging Tests were considered. This TG (7) carried out in Brazil is related to the WS held from February 13th to 16th and the Second Joint Meeting of the 4 countries, where an agreement was reached on the methodologies and techniques applicable in the Joint Workshop of the 4 C/P countries.

(10) TG (8): Fourth field survey, May to July, 2006

Through a TG delivered as the first activity of the third operational year, the rotary approach was established for the WS (11) between C/P countries and cooperating companies to establish the basic parameters of packaging design based on the results of determination of the basic guidelines for the evaluation of packaging tests, in accordance with the results of the Transportation Environment Survey. In the first meeting with the counterpart of Argentina, the JICA Study Team's explanation of the third year operational plan on the process and technique to develop the "Reference Guideline for Packaging Tests, for Evaluation" was insufficient. The JICA Study Team had to move to other country, so that both parties did not reach to the agreement. By the following meetings with other counterparts of three countries, the discussion on development of the "Reference Guideline for Packaging Tests, for Evaluation" was revised and established the basis of packaging design by continuing "PSD" and "Grms vs Speed" scatter diagrams for the road condition evaluation.

(11) TG (9): Fifth field survey, October 23 to November 01, 2006October 24, 2006 – Argentina

A meeting was held between the JICA Study Team and the INTI, in order to confirm the final details of "Reference Guideline for Packaging Tests, for Evaluation", which have been done intensively on the same month. The INTI promised to make the diffusion of the results of the studies to others 3 countries. Also, they were discussed the following topics:

- [1] Work Plan for the Model Project by using the improved packaging
- [2] Details about the preparation of the 4th Joint Meeting and the Public Seminar of Results

of the Study, to be held on January 2007

October 26 2006 – Uruguay

The meeting was held between the related parties, in order to confirm the final details of "Reference Guideline for Packaging Tests, for Evaluation", based on the draft summary document.

Also, it was reported that the Model Project is slightly delayed due to specific problems on the cooperating company. Therefore, the execution of the surveys for the model project was done by the counterpart exclusively.

It was reported about the Schedule of the 4th Joint Meeting of 4 countries, and the Public Seminar of Results of the Study, to be done on January 2007.

October 27, 2006 – Paraguay

A meeting was held between the related parties, in order to confirm the final details of "Reference Guideline for Packaging Tests, for Evaluation".

Since the Model Project in this case, has been completed by the counterpart and JICA Study Team, the meeting continued with topics related to improved packaging (primary packaging) and their evaluation.

It were reported the Schedule of the 4th Joint Meeting of 4 countries, and the Public Seminar of Results of the Study, to be done on January 2007.

November 01, 2006 – Brazil

In the case of Brazil, after completed two meetings with counterparts of Brasilia and Rio de Janeiro, a final meeting was held with CETEA (Campinas) for explaining the process and final details of the "Reference Guideline for Packaging Tests, for Evaluation".

After that, it was discussed the details of the model project. It was reported that some cooperating companies were facing difficulties for the execution of the model project, so that it is decided to reschedule completely the work plan, including the provision of materials, preparation of test package, transportation surveys, monitoring of cargo handling and lab tests.

Also, they were discussed the details of the program of the Public Seminar of Results of the Study (Jan. 2007), specially the aspects how to show the development of the studies in the so wide environment such as of Brazil.

10.1.2 Results of the Workshops (WS)

Workshops were carried out as secondary TG activities. There were great expectations but the participation was not as planned. The fact that the follow-up distances in each country

exceeded 30,000km, the separation between the working groups and the countries due to the delay in the analysis of the data because of geographical distances and the time required by the field surveys, the sudden increase of the work load in Japan led to the reduction of the WS and TG. However, due to the cooperation of the C/P of each country, the WS were successful. Besides, it should be noted that the WS have had a positive effect on the awareness of the counterparts as to the application of the obtained knowledge to identify those issues that require improvement in respect of their own products as well as on obtaining the cooperating companies' management interest in this Study. A total of 12 WS were performed from the 1st year to the 4th field survey in the 3rd year. The topics discussed in such WS are described below.

(1) WS (1): Asunción, Paraguay (Westfalienhaus Hotel), August 29, 2005

This first technological training WS was carried out in Paraguay, from August 22 to 28, 2005, with the participation of the 4 countries according to the following agenda: a) review of the SAVER3X90 sensors operation techniques seen in the previous training course, b) exchange of ideas on the planning of the Transportation Environment Surveys that would begin in September 2005 in each country.

The WS also included technical advice on the analysis and compilation of data obtained during the Transportation Environment Survey performed between Asuncion and Encarnacion (PY). Afterwards, the C/Ps from each country made their technical presentations.

Then, discussion meetings were held to define the procedures applicable to the Transportation Environment Surveys to be carried out as from September 2005 and finally, the last important issue was the provision of advice on the preparation of special data processing forms and the creation of databases (DB) for each survey.

Besides, each Transportation Environment Survey in the 4 countries is jointly executed by the Study Team and the C/P Institutes. To such end, the JICA Study Team supplied sensors to each C/P.

(2) WS (2): Campinas, Brazil October 26 2005 (CETEA)

In Brazil, prior to this Workshop (WS2), the technical meeting was held on October 4, at MULTIBRAS (cooperating company) to analyze the results of transportation survey along the Joinville-San Pablo stretch (3000km) performed from September 9 to 12, 2005.

In the Workshop (WS1) held at CETEA, Campinas, the following issues were discussed:

- Transportation survey along the Manaus-Belem-San Pablo route (4700km) carried out from September 14 to 23, 2005. The target products for this survey were MULTIBRAS household appliances (external air conditioners)

- Transportation survey along the Joinville-Argentina- Santiago de Chile route (2700km) carried out from October 11 to 18, 2005. The target products for this survey were MULTIBRAS household appliances (refrigerators)
- Technical discussion meeting about the results of the analysis of the data collected along the Hortlandia – Recife route (3000km) transporting BSH household appliances (refrigerators)

In addition, the JICA Study Team carried out the technical course where the specific characteristics of the data analysis and the results of the survey carried out along the Manaus-Belem-San Pablo route were discussed as well as the aspects to be taken into account considering a long distance road trip.

The C/P Institutes made presentations on the analysis of the data collected along the Joinville-Salvador route.

As regards the pending issues, the problem of the excessive time taken to matching the GPS Data Logger data and the SAVER3X90 sensor data were highlighted. Regarding this problem, the JICA Study Team would contact the manufacturers in order to find a solution.

(3) WS (3): Asunción del Paraguay (Westfaltenhaus Hotel), October 21, 2005 WS

The Transportation Environmental Survey in Uruguay began on September 23, 2005. It started in Montevideo and covered three selected routes. This survey was jointly performed by the JICA Study Team together with the members of C/P Institute (LATU) using SAVER 3X90 sensors.

Almost at the same time, the technical training course was carried out for the techniques of the dummy cargo to be used in the impact test to be performed during the handling of the cargo in the Gran Asunción.

At the same time, the Transportation Environment Surveys were carried out in Paraguay, except on the Campo Grande-Brazil route (due to the lack of milk products because of the reduction of export caused by the bad weather conditions).

The C/P from Paraguay made its presentation on the results on the surveyed roads.

During the presentation, the managers of the cooperating company identified the problems caused by inadequate distribution conditions and (low) temperatures during the distribution of their products, based on analysis of the data obtained from said surveys. These discussions raised awareness of the need to maintain strict temperature controls during the distribution process.

(4) WS (4): September 9, 2005. Montevideo, Uruguay (Conaprole)

Before performing the Transportation Environment Survey using SAVER3X90 sensors, the survey on butter, as target product, was carried out as requested by CONAPROLE – one of the

cooperating companies. To such end “Dummy” loads were designed and manufactured for the Study, and they were placed together with the normal load in the refrigerated warehouses of said company in Florida.

On September 8, 2005, the dairy products supplied by CONAPROLE were carried from Montevideo to Rivera (at the border with Brazil). On September 15th, the dairy products supplied by CONAPROLE were carried from Montevideo to Fray Bentos. Sensors were placed to study both the handling of the cargo and the transportation environment.

Based on the results of the data analysis, the WS was held with the attendance of 2 officers of the company. The members of the counterpart institutes made presentations about two the surveyed routes.

During the WS, the company required advice in order to improve its secondary packaging as well as primary packaging. In such respect, the JICA Study Team made a technical explanation through a PowerPoint presentation based on Japanese technology and experiences.

After the presentation, the officers of the company said that they found the information provided very useful to solve some production line problems facing the company.

(5) WS (5) January 19, 2006. Buenos Aires – Argentina (INTI)

This Workshop (5) consisted of a series of technical meetings to analyze the applied methods and the results of the analysis of the data collected in the transportation environment survey from Aimogasta to Iguazu, carrying olive by-products (olives) supplied by NUCETE, one of the cooperating companies.

There were some difficulties during the survey carried out on October 2005, since some GPS data were missing. To solve this problem, the C/P organized another survey along the same route that was performed in December. The details of the PSD diagrams corresponding to this route were discussed in the WS.

During this WS, the JICA Study Team explained the characteristics arising from the analysis of the data collected from all the routes surveyed (almost simultaneously) by the C/Ps in each country.

Issues related to reference parameters validation process described in the draft “Reference Guidelines for the Evaluation of Packaging Tests” included in the P/R, were discussed.

Finally, an agreement on this process was reached between the parties (the JICA Study Team and the MERCOSUR- INTI - Coordinator).

(6) WS (6) February 2, 2006 – Asunción, Paraguay (Westfalienhaus hotel)

The JICA Study Team provided advice on the data collected in the transportation environment surveys performed in Paraguay up to such date:

- 1) Loma Plata-Coronel Oviedo- Ciudad del Este

- 2) Loma Plata – Asunción – Encarnación
- 3) Gran Asunción & Asunción
- 4) Loma Plata – Asunción
- 5) Asunción – P.J. Caballero (PA) – Ponta Pora (BR) – Campo Grande

It should be noted that most of the routes were surveyed by the C/P themselves, with no support by the staff of the JICA Study Team but for technical support on the process of result analysis.

The president and 7 officers of CHORTIZER (the cooperating company from Paraguay) and two representatives of the suppliers of packaging materials attended the Workshop.

The members of the C/P from Paraguay made presentations about the routes mentioned above, explaining the characteristics of the transportation survey and the analysis of the data.

During the WS, certain inquiries were made about the results of the analysis, especially as regards the Gran Asunción, Asunción and the Asunción -Campo Grande (BR) routes.

Then, the JICA Study Team made the technical presentation about packaging resistance tests for liquid food products, and transportation environment tests using impact sensors. Then, demonstration seal tests of the cooperating company products were performed using the Seal Tester.

(7) WS (7) January 26, 2006 – Montevideo, Uruguay (LATU)

As from November 2005, the C/P institute has independently carried out the Transportation Environment Survey of these 2 routes: Montevideo-Rocha, Montevideo-Rivera (2nd survey).

Based on the analysis of the data, the JICA Study Team provided some technical advice. During the WS, the C/P made the presentation about the surveys on the 2 routes addressed to the cooperating companies and other participants.

Subsequently, the JICA Study Team carried out a course on packaging resistance testing for liquid food products and a demonstration test on dairy products using the Seal Tester.

The staff of Conaprole, the cooperating company, made several questions about the material used to manufacture the lids and the containers, as well as about the Japanese sealing technology.

(8) WS (8) & WS (9) February 13 - 15 - 2006 – Campinas, Brazil (CETEA-ITAL)

Workshop (8) performed at CETEA in Campinas, Brazil, was focused on the progress made in the analysis of the data collected during the Transportation Environment Survey, and on the consistency of the results of such analysis. The counterpart institutes of the 4 countries and the JICA Study Team made presentations.

The main subject of WS (9) was the data gathering from each country and the performance of lab tests of “target” products, such as household appliances (refrigerators) and food products (long-life milk and olives).

The presentations made by each country using PowerPoint included explanations of the analysis of the data gathered during the Transportation Environment Survey and the conditions of the routes.

The JICA Study Team carried out the course focused on the importance of the Transportation Environment Surveys in each country, using measuring sensors, and their impact on packaging redesign. Interesting technical discussions were held based on the questions made.

From another point of view, lab vibration and drop tests were carried out using refrigerators and dairy products. The counterpart institutes made presentations on the conditions of the routes based on the collected data.

One of the cooperating companies, MULTIBRAS a Brazilian producer of household appliances, made a presentation about its own laboratory in Joinville. One of the packaging experts of BSH’s headquarters in Germany was present. The JICA Study Team discussed technical aspects with this person.

Regarding food products, CHORTIZER from Paraguay supplied samples of long life milk (UHT) and “Valle Fértil” (a subsidiary of the NUCETE group in Brazil) supplied olives. Lab tests were performed using both products.

A representative of “Valle Fértil” attended the workshop and the JICA experts provided technical advise about its product.

(9) WS (10)

May 18, 2006 Buenos Aires – Argentina (Conference Room – Argentine Ministry of Foreign Affairs)

May 23, 2006 – Rafaela, Province of Santa Fe, Argentina (Campo Alegre Hotel)

At the beginning of the 3rd and 4th field survey, the WS (10) was organized as an Information Seminar in Buenos Aires City, sponsored by the INTI, the Argentine Ministry of Foreign Affairs and the JICA Argentine Office.

The next WS (10) was held in Rafaela City, one of the main milk and dairy producing regions of Argentina. Besides, an important research center of the INTI and the WILLINER’s (one of the cooperating companies from Argentina) production plant are located in that area.

The Seminar held on May 18, in Buenos Aires, attended by many participants, included presentations about the Transportation Environment Survey, its background information and analysis, the improved accuracy of the surveys by using sensors, and the design of packages for household appliances.

After the presentations, questions were made about the transportation of vegetables, packaging design security ratios, etc.

In the second Seminar held on May 23 in Rafaela, the background information on the Transportation Environment Survey and the technology for food/dairy products in place in Japan were discussed. Special attention was given to packaging materials and the aspects to be taken into account from the consumer's point of view. The attendants showed much interest in these matters.

(10) WS (11) May 25, 2006 – Montevideo, Uruguay (LATU)

May 30, 2006 – Asunción, Paraguay (INTN)

June 1, 2006 – Campinas, Brazil (CETEA)

WS (11) was mainly focused on the guidelines and activities necessary to define the "Reference Guidelines for the Evaluation of Packaging Tests". In addition, presentations were made on resistance tests carried out on food packaging using a Vacuum Desiccators. All these presentations were held in each of the 4 member countries.

In the Workshop (11) carried out on May 25, 2006 in LATU (Uruguay), tests were performed on dairy products using the Vacuum Desiccators, which was implemented at that time, in the 3rd operational year.

Then, technical meetings were held to discuss the steps to be taken to define the "Reference Guidelines for the Evaluation of Packaging Tests", the main topic of this 4th stage of the Study. The methodology and basic procedures had already been agreed upon at the 2nd Joint Meeting held in February, 2006.

The tasks defined in the plan for the 3rd year of the Study began to be performed. Routes were classified into 3 main categories, based on PSD diagrams and Grms/Speed graphics for each one. Based on the analysis of these data, and upon a graphic analysis of photographs, the routes were classified into the following categories: A (good), B (medium), and C (bad).

Then, the Grms/Speed scatter diagrams were plotted based on the data obtained in the Transportation Environment Survey, and the A, B, and C curves were defined. The percentage of each A, B and C category for each route was calculated. As a result of this analysis, the following conclusions were made:

- 1) Montevideo-Rivera route: no differences between the 1st and the 2nd survey.
- 2) Montevideo-Rocha route: significant differences between the 1st and the 2nd survey, so the studies should be repeated.
- 3) Montevideo-Fray Bentos route: many impacts were recorded so it is classified as a "bad route".

The WS carried out on May 30, in Asuncion, Paraguay (Conference Room of the Westfalenhaus Hotel) included demonstration tests using the Vacuum Desiccator,

presentations on packaging technology for dairy products and technical discussions to define the "Reference Guidelines for Evaluation of Packaging Tests".

Representatives of the cooperating company attended the WS. They showed special interest in improving the quality of packaging and the methods for packaging/handling of cardboard boxes.

A Workshop focused on the determination of basic rules for the evaluation of packaging tests was carried out on June 1, at the CETEA- Campinas, Brazil. The PSD Curves made based on the analysis of the Transportation Environment Survey performed in Brazil were analyzed as well as the scatter curve of Gms/Speed. Based on that, a new category, "D" was added to the existing ones, A, B and C. This new category was considered necessary due to the size of the country. Finally, the experts of the JICA Study Team explained the MERCOSUR standards (draft) related to vibration tests on packed cargoes. Besides, the PSD scatter graphs and the Gms/Speed scatter graphs were unified to be used as reference data in respect of the routes surveyed in the 4 countries. Said unified graphs were used as guidelines to discuss the location of the routes to be used in the Study. The JICA Study Team agreed to verify such graphs to prepare a final version.

10.2 Technology Transfer to Counterpart Institutes and the Private Sector

The main purpose of this Study is to establish basic standards for the evaluation of packaging tests for the MERCOSUR as a whole. To attain such purpose, the most important matters to be considered are: improving the technical level of the four member countries of the MERCOSUR and obtaining the cooperating companies' support. To such end, the following guidelines were established:

- (1) Rotary Technical Guidance Courses (TG)
- (2) Workshops (WS)
- (3) Additional matters related to technical training in Japan

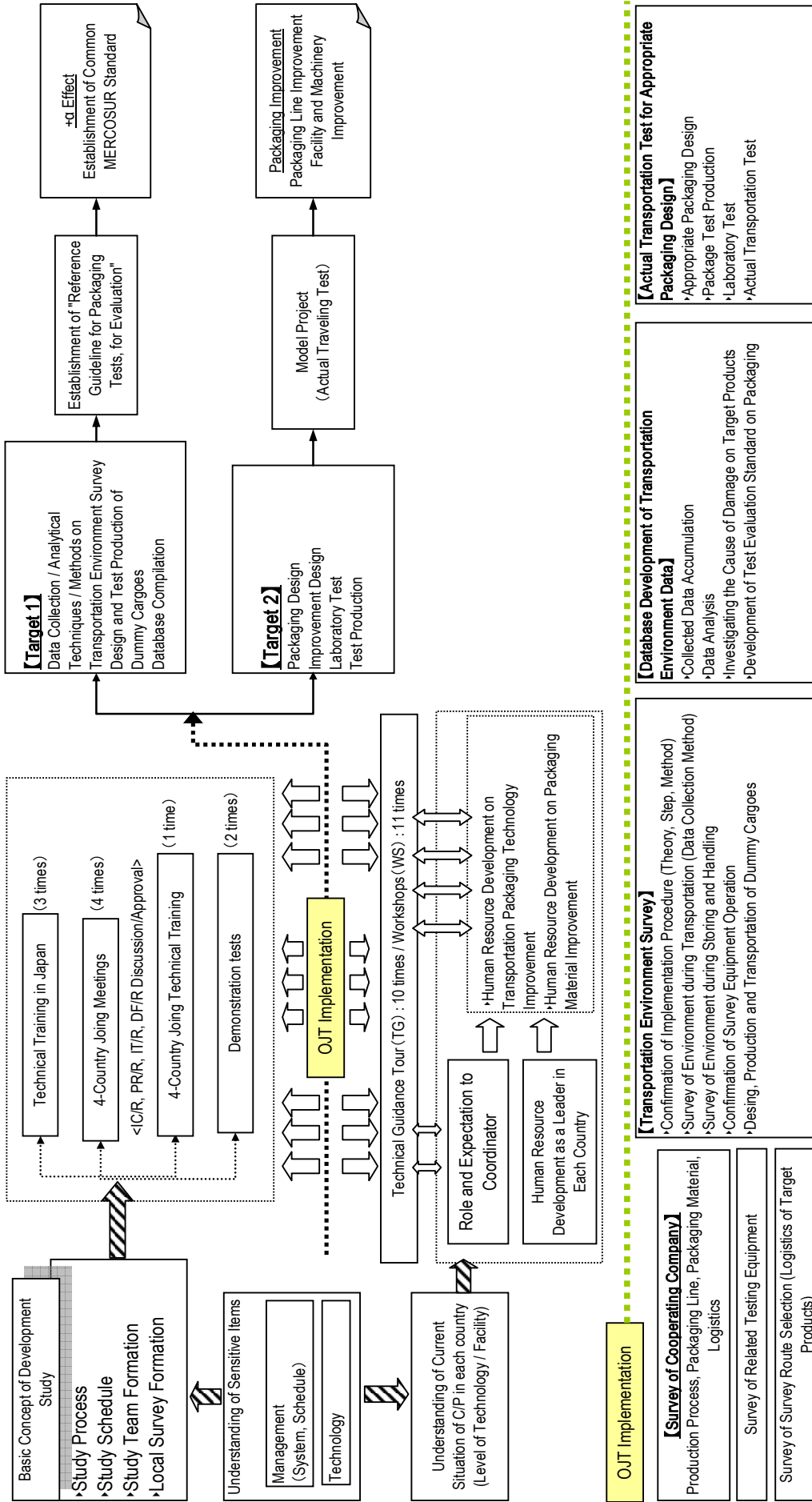
Based on these basic items, in the field survey performed during the first year, the methodology applicable to the selection of routes (specially international routes for exports) for the Transportation Environment Survey as well as to the selection of the target products was discussed with the C/P from the four countries and the cooperating companies. In February 2005, a demonstration of the Transportation Environment Survey was performed using DER SMART sensors, along 1,200 km, between Buenos Aires and Aimogasta, with the cooperation of the Argentine company NUCETE. In order to perform vibration tests and impact tests during the handling of the cargo within the scope of this survey, "dummy" cargoes were prepared and placed on the pallets together with the usual cargo in order to collect data. The

survey was carried out repeating the technical guidance course with the Study Team, the C/P and the cooperating companies.

In particular, the survey strategy was developed by listing up and understanding of the sensitive items in the field of the survey management and technology of this JICA Study. During the OJT implementation phase, the Technology Instruction Manual, the Equipment Operational Manual, and various survey form sheets were prepared for explanation to the counterparts and/or the counterpart coordinators.

These are described in each phase of the reports (IC/R, PR/R, IT/R). These procedures of the technology transfer are shown in Figure 10-1.

The joint meetings by the cooperating target products manufacturers, the JICA Study team and the counterparts were conducted for the purpose of technology transfer to the private sectors on the technical survey procedures/method/techniques in the OJT implementation phase; design, test production and setting procedures of dummy cargoes; setting of measurement sensors onto the transportation trucks; and the process of measured data confirmation; the collected data accumulation.



Source: JICA Study Team

Fig. 10-1 Correspondence and Effect to Technology Transfer on Development Study of Packaging Technology Improvement

10.2.1 Results of the technology transfer

Besides, 3 technical guidance courses (including the one in March, 2004) were carried out in Japan as an additional activity of this Study. The first course took place in March 2004, and was focused on basic packaging techniques, attended by 8 persons (2 from each country). The other courses were organized based on the scheduled activities of the Study. Topics such as theory on and preparation of dummy loads, transportation, data collection and analysis were discussed in the second course held in March, 2005 with 8 attendants (2 from each country). All these contents were applied in the field survey performed in February, 2005. During the second year, the distribution of sensors to the 4 countries was arranged. Due to delays in the supply of the equipment and the fact that a different sensor was supplied to Argentina by mistake, significant changes had to be made in the schedule. This led to the following situations:

- (1) The Transportation Environment Survey was performed along the route selected in Argentina using the equipment provided (Transportation of dairy products from the cooperating company Williner along the Rafaela – Asunción del Paraguay and Rafaela – Neuquén routes used by said company).
- (2) The Joint Technical Guidance course for the 4 countries and demonstration test along the Asunción – Encarnación stretch, using different equipment (subsequently replaced) in Paraguay. This Joint Technical Guidance course carried out between August 22 and 28, 2005, included: basic knowledge and operation of the sensors and demonstration tests using said sensors. Two specialists from each country attended with a total of 8 participants, mainly young people. This was positive due to their capacity to understand the technical information that led to the execution of the plan by applying the OJT approach, intensively and quickly. It should be highlighted that the supply of staff and the cooperation in the installation of the equipment by Paraguay led to the improved effectiveness of the course.

After this course, the main Transportation Environment Surveys were started, upon the distribution of the new equipment (SAVER 3X90) to the C/P from the four countries and the delivery of the equipment supplied during the First Stage to Argentina and Brazil. To such end, the Study Team was divided into groups that were sent to each country. The surveys were consecutively performed in each country on the selected routes and with the target products. However, the First Survey (in all the countries) was carried out under the supervision of the JICA Study Team, using the equipment (continuous vibrations, impacts, temperature and moisture measurements, and using GPS) installed in the trucks. The follow-up was made using a vehicle where 1 or 2 members of the JICA Study Team and 1 or 2 members of the C/P trained

in Paraguay traveled. During the follow-up the forms described in the demonstration course carried out in Paraguay applying the OJT method were used. It should be noted that the Brazilian team recorded data up to the analysis stage. The following table shows the results for each country.

Table 10-2 Original and Actual Schedule for the Transportation Environment Surveys

County	Original Plan				Actual Plan				
	Route	Target Product	Distance One way	Company	Route	Target Product	Distance	Company	Date
Argentina	Bs.As. - Aimogasta	Processed Olive	1,200km	NUCETE	Bs.As. - Aimogasta	Processed Olive	2,500km (Round trip)	NUCETE	2/9 - 2/12 '05
	Rafaela - Asunción	Powdered Milk	800km	Willner	Rafaela - Asunción	Powdered Milk	1,600km (Round trip)	Willner	7/3 - 7/7 '05
	Aimogasta - Curitiba	Olive Product	2,500km	NUCETE	Aimogasta - Curitiba	Olive Product	2,500km	NUCETE	7/19 - 7/23 '05
	Rafaela - Neuquen	Dairy Product	1,300km	Willner	Rafaela - Neuquen	Dairy Product	1,800km	Willner	7/8 - 7/12 '05
	—	—	—	—	Neuquen-Santa Rosa	Only measurement	500km	Willner	7/11 '05
	Neuquen - Bariloche	Dummy Cargo Handling Survey	—	Willner	Neuquen - Bariloche	Dummy Cargo Handling Survey	—	Willner	Dummy was improved for impact test after 3 months past
	—	—	—	—	Aimogasta-Iguazú	Olive Product	1,600km	NUCETE	11/20-21 '05
	Rosario - Mendoza - Santiago	Refrigerator, Showcase	1,500km	FRIMETAL	Cancelled because of Chile boarder closing due to heavy snow ('05)				
	Uruguaiana - Medoza - Los Andes	Refrigerator	1,700km	Multibras	Uruguaiana - Mendoza - Los Andes	Refrigerator	1,700km	Multibras	10/11-20 '05
	Rosario - Mendoza - Santiago	Refrigerator, Showcase	1,500km	FRIMETAL	Cancelled because of Chile boarder closing due to heavy snow ('06)				
	Bs.As. - Mendoza	Vegetable Oil	1,000km	MOLINOS	Bs.As. - Mendoza	Vegetable Oil	1,000km	MOLINOS	5/26 '06
	Bs.As. - Rosario	Refrigerator	300km	FRIMETAL	Bs.As. - Rosario	Refrigerator	300km	FRIMETAL	Several times including model projects in 2006
Brazil	São Paulo - Recife	Refrigerator	3,000km	Multibras	Joinville - Salvador	Refrigerator	2,500km	Multibras	9/8 - 9/12 '05
	Sã Paulo - Recife	Refrigerator	3,000km	BSH	Campinas - Recife	Refrigerator	2,650km	BSH	10/21 - 26 '05
	Manaus - Belem - São Paulo	Refrigerator, Other Home Appliances	4,700km	Multibras	Manaus - Belem - São Paulo	Air Conditioner	4,700km	Multibras	9/14 - 9/23
	São Paulo - Uruguaiana - BsAs	Refrigerator	2,500km	Multibras	Joinville - Uruguaiana - Santiago	Refrigerator	2,700km	Multibras	10/11 - 20 '05

Country	Original Plan				Actual Plan				
	Route	Target Product	Distance One way	Company	Route	Target Product	Distance	Company	Date
Paraguay	Loma Plata - P.J. Caballero	Dairy Product	800km	Chortizer	Asunción - PJ Caballero - Campo Grande	Dairy Product	1,000km	Chortizer	12-'06
	Asunción - Cd. del Este	Dairy Product	340km	Chortizer	Loma Plata - Asunción - Cd. del Este	Dairy Product	860km	Chortizer	9/27 - 28 '05
	Asunción - Encarnación	Dairy Product	400km	Chortizer	Loma Plata - Asunción Encarnación	Dairy Product	900km	Chortizer	10/4 - 10/5
	—	—	—	—	Gran Asunción Delivery	Dairy Product	—	Chortizer	9/30 '05
	—	—	—	—	Asunción City Delivery	Dairy Product	—	Chortizer	10/14 '05
Uruguay	Florida - Montevideo	Butter, Powered Milk	100km	Conaprole	Rivera - Florida - Montevideo	Long Life Milk	4,800km	Conaprole	9/8 - 9 '05
	Montevideo - Chuy	Butter, Powered Milk	250km	Conaprole	Montevideo - Rocha	Long Life Milk	200km	Conaprole	Several times in LATU
	Montevideo - Fray Bentos	Butter, Powered Milk	300km	Conaprole	Montevideo - Fray Bentos	Long Life Milk, Yoghurt, Cheese	400km	Conaprole	9/5 '05

Source: JICA Study Team

Note): In Paraguay, the transportation environment surveys were implemented by INTN and Chortizer during the absence of the Study Team.

1. Loma Plata – Asunción; 550km (one-way) × 6 times=3,300km
2. Loma Plata – Encarnación; 1,100km (one-way) × 1 time
3. Asunción - Campo Grande (BRA); 1,000km(one-way) × 1 time
4. Loma - Plata Ciudad del Este; 800km(one-way) × 1 time

Due to the significant volume of data and long hours dedicated to analyze it in Japan, the evaluation and verification tasks were made during the training course in Japan (March 2006) together with the C/P.

10.2.1.1 Know-how acquired by the counterpart institutes

This JICA Study focused on the joint performance of the following activities: attainment of technological targets in three stages, site surveys in 8 stages, 3 Technical Guidance Courses in Japan, rotary local Technical Guidance Courses (TG), Work shops (WS) and 2 annual Joint Meetings of the representatives of the four countries (every 6 months). Besides, the following activities were scheduled: demonstration field tests using measuring equipment (place: selected Argentine routes), operation of equipment, demonstration measurements using the equipment (during the Joint Training Guidance Course for the four countries in Paraguay) and joint Workshops for the 4 countries to carry out Lab Tests in Brazil.

Successful results were obtained in the three stages (see the table below) and the institutes of the four countries obtained technological knowledge on packaging due to the joint activities performed at the beginning of stage II. Besides, as regards the training of the staff, technicians have progressed successfully throughout the stages of the Study, in special young ones.

Stage	Objective	Results
I	(1) Creation of a framework for the Study and basic Study	Explanation and understanding of sensitive information, Inception Report (IC/R)
II	(2) Collection and analysis of basic packaging data for transportation. (3) Creation of a database of the packaging evaluation tests.	Successful analysis performed with the counterparts based on the transportation environment survey supervised by the Study Team Meeting to present the Progress Report and the Interim Report and to discuss the definition of Packaging Standards for the MERCOSUR in detail
III	(4) Packaging design test, execution of the Model Project	Preparation of samples to test the improvement of individual packaging for processed food (dairy products) improved packaging for household appliances (white line appliances)

C/P Institute	Staff			Cooperating Companies (Number)	Training Course in Japan (Number of trainees)
	I	II	III		
INTI - Argentina	2	2	4~5	5	7
INT	2	2	3		
INMETRO	1	1	1		
CETEA- Brazil	2	4	4		
INTN - Paraguay	2	4	5	2	7
LATU - Uruguay	2	5	5	2	7

Source: JICA Study Team

The counterpart institutes contributed as follows, especially to the training of young technicians: 1 member of the INTI of the General Packaging Technical Area, in Brazil (CETEA, INT, INMETRO) 2 to 3 persons of the General Packaging Area together with the Packaging Materials Area; as regards the Packaging Design Area, training courses were addressed to management, from the INTN, of Paraguay and the LATU, of Uruguay, 2 to 3 technicians attended the Joint Technical Guidance Course for the four countries carried out in Paraguay in August 2005.

Besides, from the analysis stage of the Transportation Environment Survey to the Packaging Design stage, objectives were attained such as the creation of contacts with the packaging materials sector due to the participation of specialized technicians from the counterpart institutes of the four countries. Based on these results, it can be said that the technical training of the counterparts' staff has been successful, mainly considering the accomplishments of the first stage such as: the operation of the sensors, the collection and analysis of data, the evaluation of packaging tests (lab and field transportation tests), the provision of advice to final users. All this applies specifically to individual packaging for dairy products and packaging for household appliances such as refrigerators, i.e. the target products of the Study that were selected in advance.

10.2.1.2 Levels attained by the counterpart institutes in packaging design

As explained in item 10.2.1(1) in respect of the activities performed in the first stage, the counterpart institutes were able to implement technology related to the collection of field data and the analysis of data. However, during the packaging design stage, since the target products for the Study selected in each of the four countries were different, i.e. processed food and white goods appliances (refrigerators) the testing conditions of each counterpart were also different.

(1) Processed food (dairy products)

During the packaging design stage in respect of dairy products, the activities focused on primary packaging. The damages to the products of the cooperating companies were considered and a technical solution was sought. To such end, several technical analysis meetings were held among the Study Team, the counterparts and the cooperating companies (including packaging materials suppliers) and the following activities were carried out in order to improve packaging design.

[1] Survey to identify the possible origin of the damages (leaks)

[2] Tests to investigate the causes of the damages and verify the results

Based on the results of these activities, materials were selected and new packaging shapes were defined (designs). The final design was made after performing several resistance tests. In Argentina, Paraguay and Uruguay, the tests performed on materials involved specialized staff of the counterpart institutes. As a result of the analyses and tests, the numerous lab tests aiming at improving lid design and material, the counterpart staff obtained important OJT knowledge.

(2) Household appliances (white goods: refrigerators)

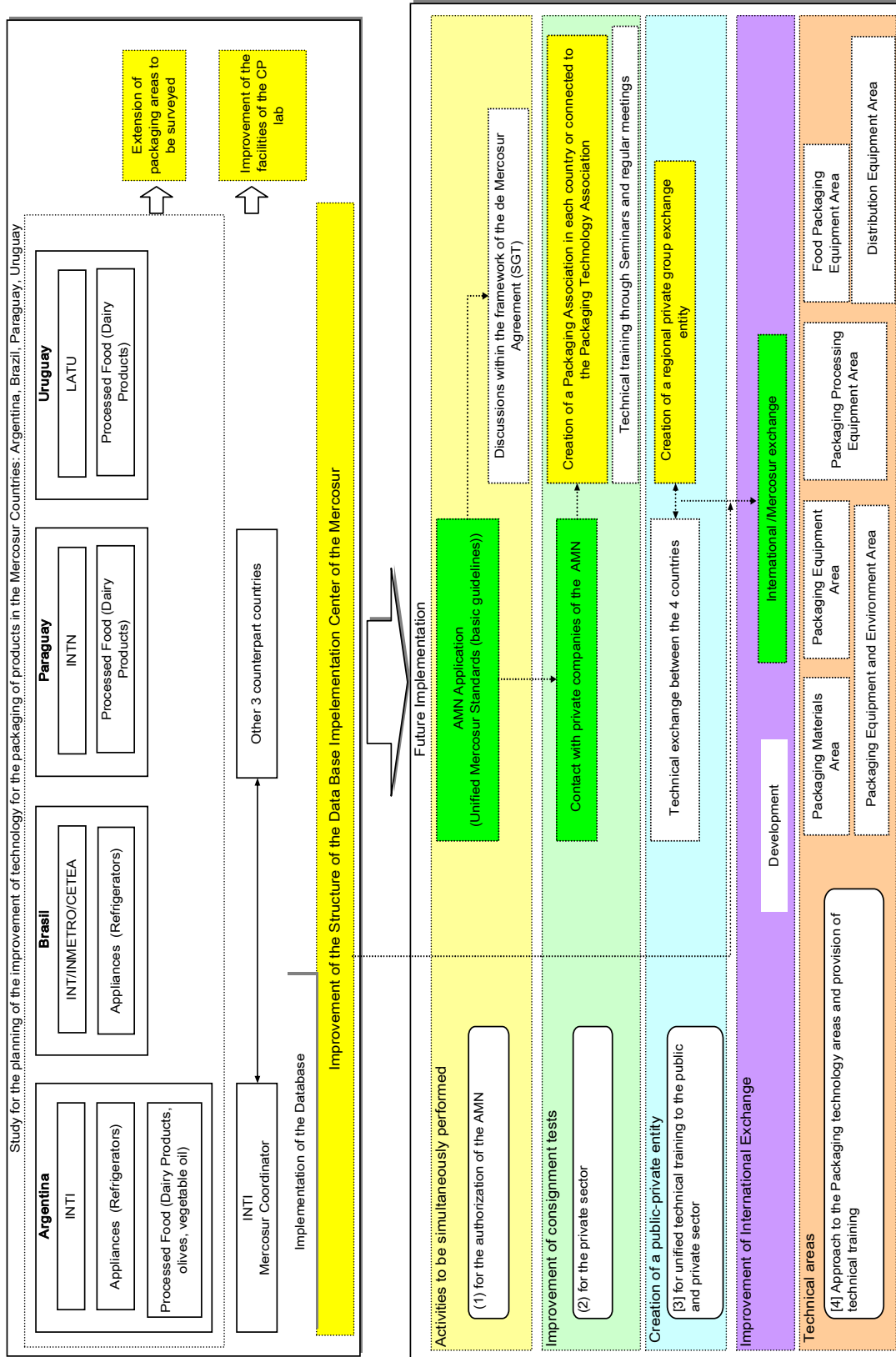
The Transportation Environment Survey included several successful tests in the four countries, not only in respect of the target products but others too. As regards household appliances, the counterparts from Argentina and Brazil obtained practical knowledge. The counterpart institute's labs had the facilities and equipment necessary to carry out their own tests even before the Study was performed. In the case of the Argentine INTI, several lab tests were performed before focusing on packaging design. The results were used to prepare a packaging prototype for the model project. The target product of this model project was refrigerators and the route surveyed was Buenos Aires-Rosario. The efforts of the INTI to perform the design tasks as well as to supply material and prepare the prototype should be noted, since they contributed to the success of the experience and stimulated the self confidence of the staff. Besides, in Brazil, criteria were unified between the CETEA, in charge of the lab tests, the INT, that has an industrial design sector, the supplier of materials that cooperated in the manufacturing of the prototypes and the cooperating companies, aiming at improving packaging.

10.2.2 Recommended strategies for the technological development of the MERCOSUR counterpart institutes

During this JICA Study, the rules were established as regards data storage and the data analysis of the information obtained from the Transportation Environment Survey along the main routes (especially those used to export products by land and distribute goods to the main local distribution centers) using the target products (dairy products, and white goods appliances) for the four MERCOSUR member countries. Besides, technology was transferred in stages during the packaging design process, through several lab tests, the preparation of packaging for testing based on improved designs and the subsequent execution of the model project, including an actual transportation test with the participation of the Study Team, the members of the counterparts and the cooperating companies. The contribution of the MERCOSUR coordinator, the Argentine INTI, in the organization of the joint meetings of the four countries in each stage of the transportation environment survey should be specially noted.

The results obtained up to date and the future development in connection with these results and the technological training are shown in Fig. 10-1.

- (1) The upper part of Fig. 10-1 describes the implementation and the guidelines for the creation of the database. It indicates the way the gathered data should be shared. Figure 10-3 of this chapter indicates the progress of the suggested measures.
- (2) Then, the tasks necessary to obtain the official approval of the Common Standards (basic guidelines) by the AMN mentioned in item (1) at the bottom of the graph were performed. Specifically, by the end of July, 2006 a meeting was held between the JICA Study Team, the counterpart institutes and the AMN at the AMN headquarters in Sao Paulo. At that time, it was concluded that a commission should be created to perform all the tasks necessary to obtain such authorization, based on the explanation of the AMN application procedures.
- (3) The efforts to create an AMN Commission would involve the Packaging private sector of the four countries in order to gradually improve technology through the exchange of information on how to solve the problems facing the private sector.



Source: JICA Study Team
Fig. 10-2 Results of the Survey and Sustainability for the Improvement of Packaging Technology in the MERCOSUR

- (4) The previous item (3) mentions the collaboration between official entities (the public sector) and the private sector, including the cooperating companies from the four countries. Although the “packaging area” is specifically mentioned, all the other related areas that require technical improvement should be included.
- (5) The areas related to this Study are included in the figure. Their internal functions should be strengthened by establishing a specialized association. Besides, the regional MERCOSUR / international exchange should be encouraged in furtherance of an appropriate technological exchange.

10.2.3 Recommendations related to promoting the importance of technological improvement in the distribution process in respect of the private sector

The packaging area is closely related to other areas of the different industries. As regards the Transportation Environment Survey, from departure of the truck carrying the cargo packed in the plant to the arrival of the products to the retailers, the cargo is handled several times, beginning with the dispatch of the goods, then in the truck up to the warehouses and then during distribution to the retailers. Therefore, technical training is very important, including institutional relations within the distribution process. There are 6 different areas related to packaging.

Table 10-2 Industrial Areas related to Packaging

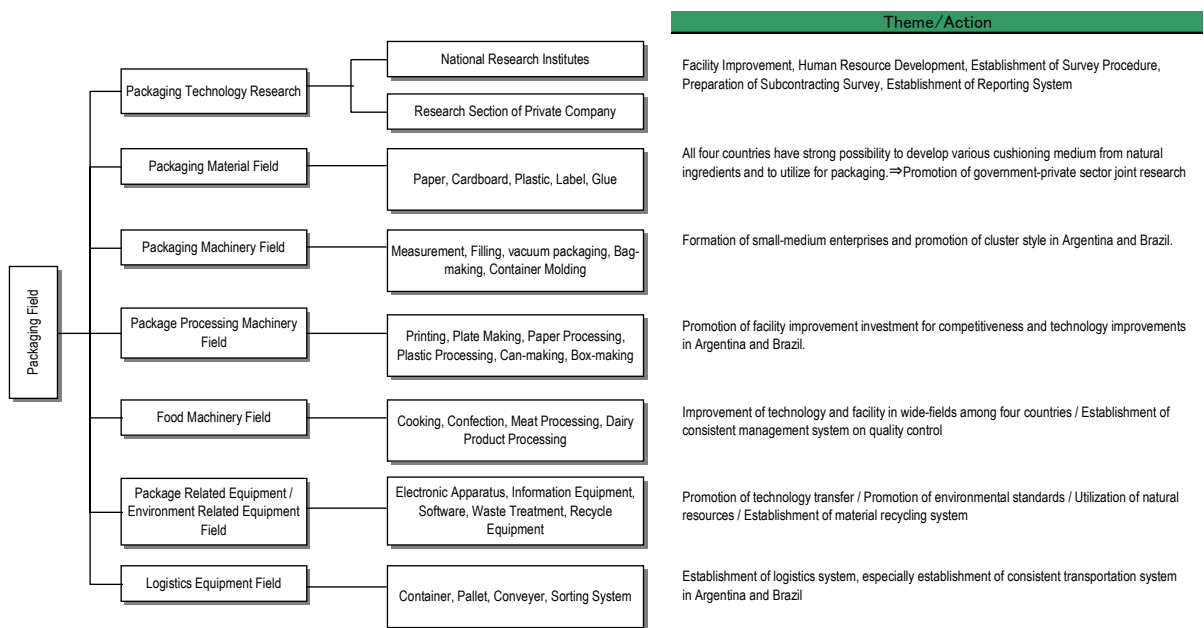
Areas	Description
Packaging materials	Paper, Bristol board, paper items, cardboard, plastic, metal, glass, tying and gluing material, isolating material, artificial fabrics, labels, and glue
Packaging equipment	Scales, filling equipment, vacuum packaging equipment, bag packager, molder, external packager, label machine, box packager, sealing machine, strapping equipment, and washing machines
Packaging materials processing equipment	Printer, photo recorder, paper processor, plastic processor, bag processor, box processor, can processor, stapler, Guillotine, Cutter, and isolating materials processor
Food packaging equipment	Kitchen ware, bread and pastry processors, meat processors, dairy processors, rice-based food processor, spinner, water pump, sanitary equipment, and HACCP products
Packaging equipment – equipment for the environmental survey	Testing devices, testing devices equipment, inspection equipment, classification equipment, analysis equipment, washing machines, electronic equipment, IT equipment - software, waste processor, recycling equipment, and environmental protection equipment
Distribution equipment	Containers, Pallets, Shelves, conveyor belts, transportation systems, compacting machines, shredders, classification systems, pallet wrapping machine, and transportation equipment

Source: JICA Study Team

The area related to the packaging of food is one of the most important ones and probably its contribution to the industry of packaging technology would be significant.

The recommendations from this JICA Study on improvement of packaging related industry field is shown in Figure 10-3 “Theme/Action.” The request of tests commissioned by the private sector has been increased with the improvement of technology and human resource in packaging technology field in national research institutes.

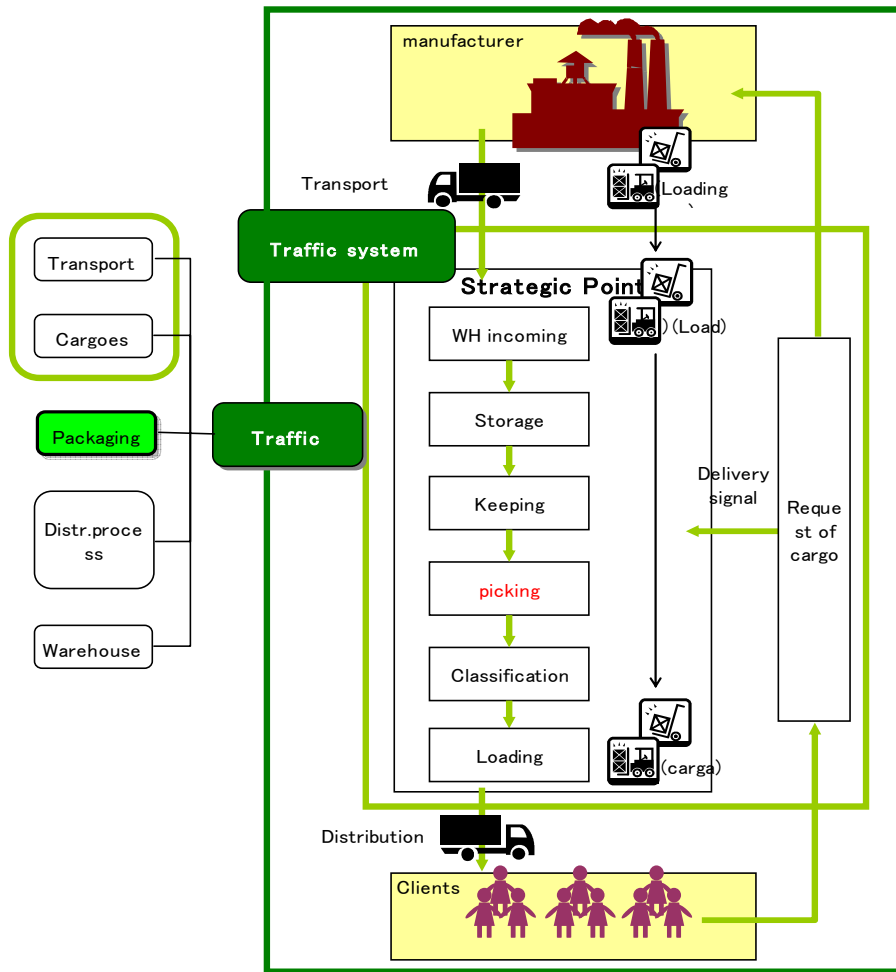
The Study Team implemented the Transportation Environment Surveys and the analysis and evaluation of collected data. Based on those experiences, it is said that the implementation organizations’ management system, manual development including evaluation report, and reinforcement of the cooperation with other groups of related fields are desired since the target products and commissioned tests have been increased.



Source: JICA Study Team

Fig. 10-3 Improvement of Packaging Related Industry Field

Traffic and the role of packaging in the traffic system



Source: Prepared by the JICA Study Team, Distribution Structure, published by Editorial KANKI, Author: Kazuo YUSAWA

Fig. 10-4 Role of Packaging within the Distribution and Distribution Systems

10.3 Outline for the Achievement of Overall Goal of the Study

10.3.1 Sustainability of the "Reference Guideline for Packaging Tests, for Evaluation"

The establishment of the "Reference Guideline for Packaging Tests, for Evaluation", the objective of the Study for development of JICA, has defined as final objective to lower product damages during its distribution within MERCOSUR countries, by means of strengthening the technology for transportation-suitable containers and packaging design. Once the product transportation damage records are lowered, exportation competitiveness will be improved.

The first step aiming to this goal started by the preparation of the Reference Guideline for the four MERCOSUR countries (see Chapter 6, Interim Report by JICA Study Group), through the data gathering and analysis during the transportation environment survey on selected target products and transportation routes.

However, as the process of data analysis is going on, big differences aroused between the results of the data between the four MERCOSUR countries, which surpassed the initial estimation of making analysis considering only the road status factor. This led to the first conclusion: many factors have to be taken into account for the preparation of a complete reference guide.

Therefore, additional factors have been included in the analysis, such as: road type, truck structure, truck driving method, etc. Taking the hardest route (among field itineraries) as a reference, and studying the Grms vs Speed scatter diagram, the study range was split into three wide portions:

- a) the range from Grms= 0.00 to 0.33, as the pure vibrations zone
- b) the range from Grms= 0.33 a 0.70, as the bouncing vibration zone
- c) the range above Grms= 0.70, as the shock/drop zone

Based upon the above, the MERCOSUR Transportation Environment Surveys' results were classified into three levels.

Level 1 (Bad Condition)

Level 2 (Normal Condition)

Level 3 (Good Condition)

After that, the data of all surveyed routes were verified and making route combinations by pairs, from two different countries, they were obtained 52 combinations for the total of four MERCOSUR countries. As result of the calculations, the reference guide was prepared based on the type of routes taken from the most representatives' ones from each country and combined by pairs. The reference guide specifies all the parameters (test duration, frequencies, drop heights, etc.) for each of the tests described therein: vibration tests, bouncing tests, and free drop tests (drop height= 10cm, counting the number of drops).

The Transportation Environment Surveys performed under the scope of the present JICA Study were developed under predetermined conditions such as selected routes and products (dairy products and home appliances (refrigerators)). In the future, the updating of above mentioned data will be of the utmost importance, by continuing the data gathering based on similar conditions and trough an sustainable study. The final purpose is in order to fulfill the needs of end users of the "Reference Guideline for Packaging Tests, for Evaluation". In addition, it will also have a direct relationship with the activities of maintenance and integration process of the database (DB) and also the IIRSA plan, which includes the MERCOSUR region, under development.

The MERCOSUR infrastructure has been improving year by year, regarding the transportation routes and physical distribution as well. Due to a structural change of the industries, the production focuses have changed also, affecting subsequently the related distribution networks. These changes led to a further improvement on packaging test standards for evaluation, to a higher level (as shown in its classification included in this Chapter) and the routes reference data have also changed, provided that new data have been gathered along the new distribution routes to be used in the future.

On the other hand, this "Reference Guideline for Packaging Tests, for Evaluation" can also be kept as an indicative reference for packaging cost reduction, aiming to improve transportation competitiveness. High expectancies are being held regarding the potential of packaging technologies and the counterpart's laboratory equipment, which can becoming the attraction poles for further studies for private sector. For this reason, it is highly recommended to continue the transportation environment surveys in order to update the database.

10.3.2 Management/ Maintenance of the common regional database (DB)

The construction of the MERCOSUR Common Database has been described in above Chapter 5. By compiling all the available data as per today (gathered during the transportation environment survey along more than 30,000km across the four countries), the whole data can be grouped as follows:

- [1] "Raw" data, gathered along transportation routes
- [2] Data analysis results
- [3] Reference values recorded for packaging evaluation tests

The next step was the starting of transportation-suitable packaging re-design, in accordance to the data analysis of information from the transportation environment survey and the preparation of improved packaging by using local materials. For primary packaging improvements, they have been introduced new piling up methods on storage, for dairy products and other manufactured products (i.e., milk, yogurts, milk jam, olive-derived products, vegetable oil).

Cooperating companies faced the problem of product damage, and now the technical capacity for improvement of primary packaging has been strengthened, as response of their request. Laboratory tests and real transportation tests have been performed on selected products from each of the four MERCOSUR countries, and the model project that summarizes those tests was implemented. These data have been added to the compiled database.

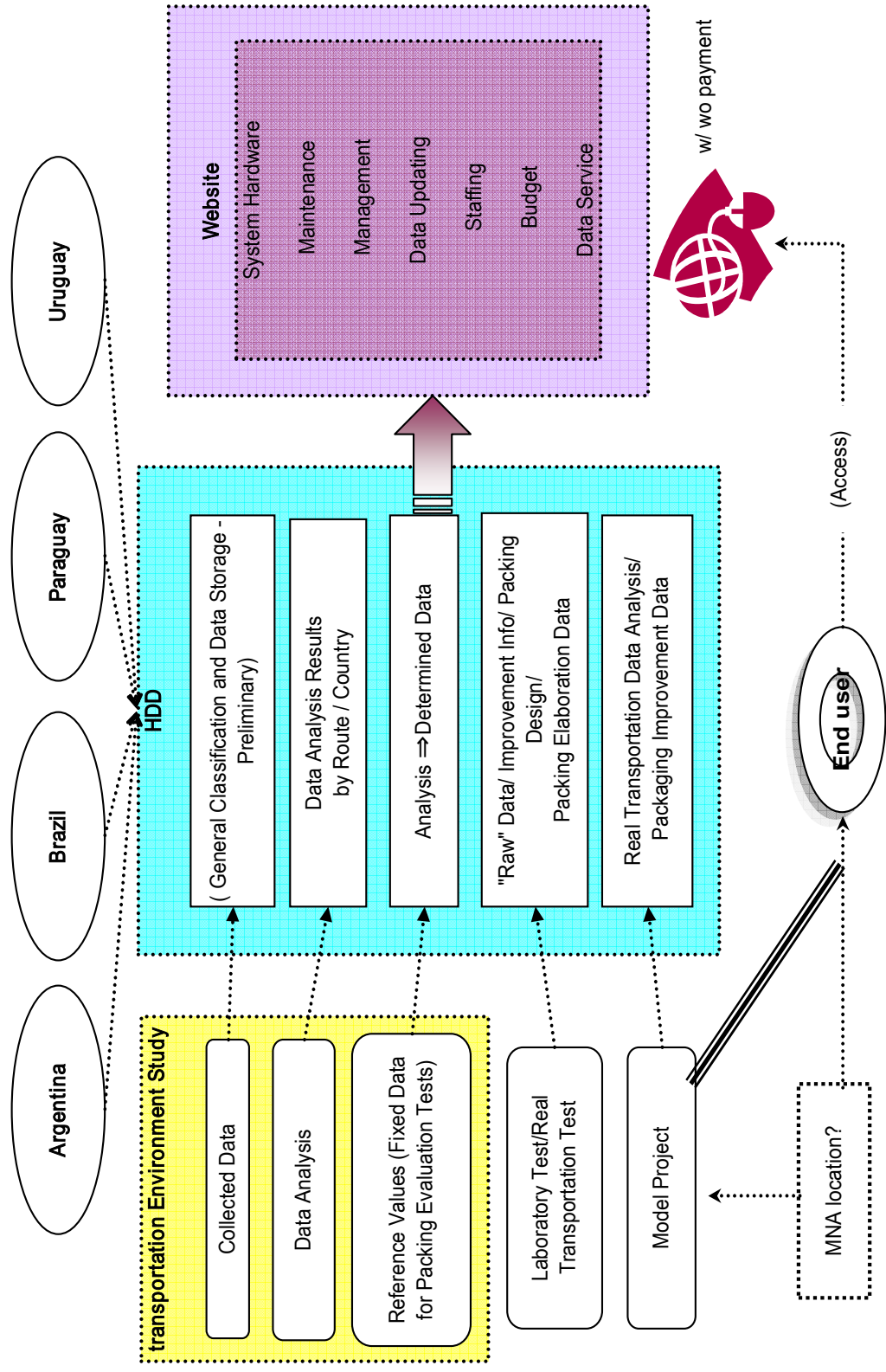
All the above data and related information were described in the General Summary (preliminary) (See Chapter 5), and were stored in a hard disk drive (HDD) ¹, taking into account that the project activities go on in each of the MERCOSUR countries. The stored information includes: “raw” data from real transportation surveys and laboratory tests; data analysis output for each of the routes and countries; reference values’ determination supporting data (for packaging re-design) and its fabrication; data analysis output for real transportation survey during the model project and improved packaging data.

Considering that above data will be shared all over MERCOSUR region and opened to the public, data management for DB and the methodology of services to be provided are top relevant.

In order to allow the start up of the website (to access the information), and to determine the required database format for this purpose, the entity to be responsible for the system and hardware management (including renewal of equipment), staffs, data service and budget administration has to be assigned. This is the utmost importance as the first step that will allow MERCOSUR private end users accessing the DB, and it will also be a challenge for the transportation packaging and container improvement.

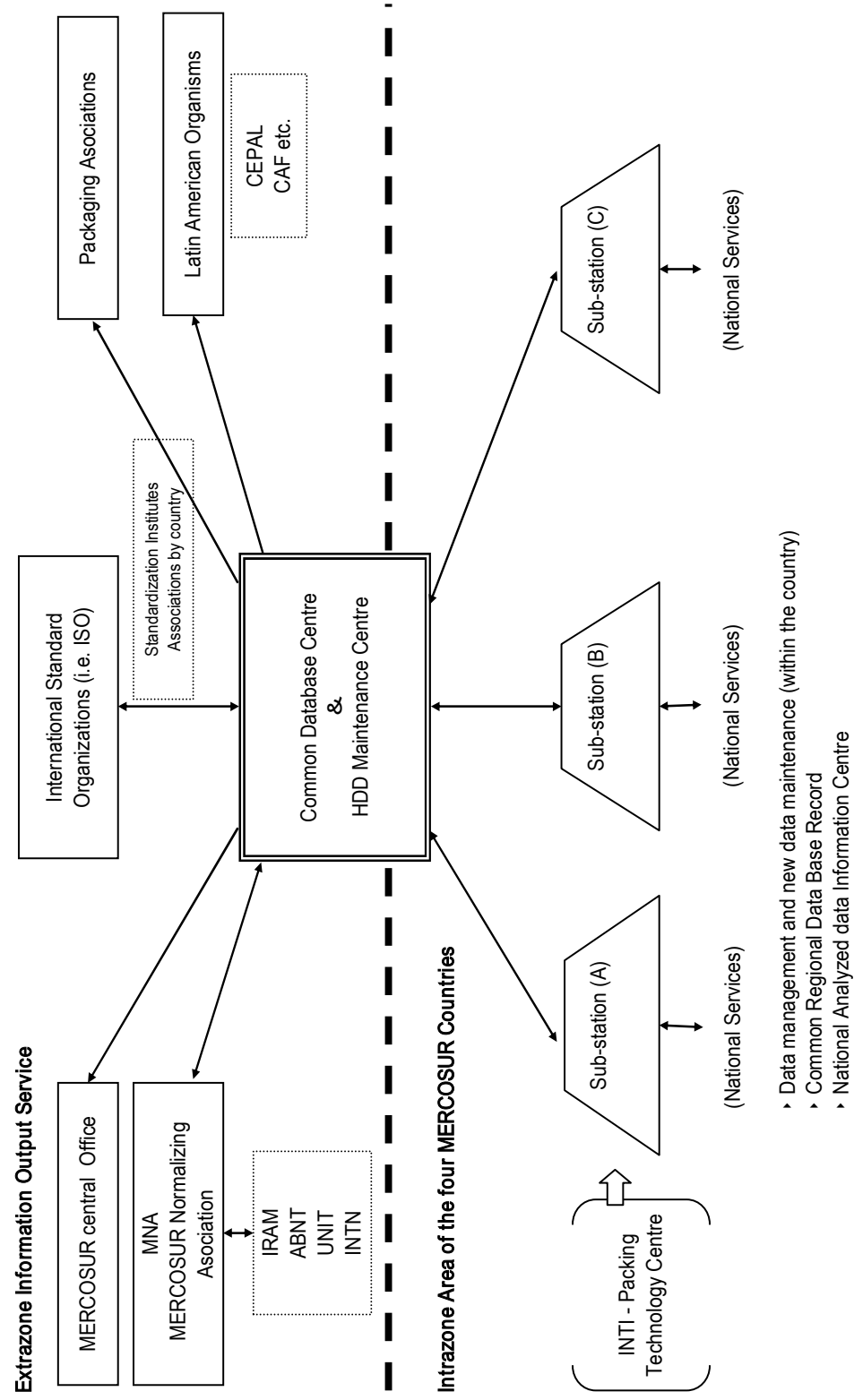
All above concepts are shown in Fig.10-3 schematically: “Common Database Centre Organization structure, HDD Maintenance Centre” including MERCOSUR DB Information Service and its extension to extra-block regions. A sub-station will be installed in each of the countries, and data emission will be performed by means of a satellite system. In the future, this Centre will be interconnected to other related organizations worldwide as shown Fig. 10-4.

¹ Note: There are four HDDs, one for each of the MERCOSUR countries.



Source: JICA Study Team

Fig. 10-5 Structure and Integration of Database



Source: JICA Study Team

Fig. 10-6 Organization Chart for the MERCOSUR Database Regional Centre

10.3.3 Proposal to request the approval to MERCOSUR Standard Association (AMN) and actions aiming the establishment of MERCOSUR Common Standards (Guideline)

During the development of this Study, the counterpart institutes of the 4 member countries and the cooperating companies collaborated in the preparation of the proposal of MERCOSUR Common Standards (Guideline).

In the occasion of the Third Joint Meeting of the four MERCOSUR countries on July 2006 in Montevideo (Uruguay), the meeting was held among members of the JICA Mission, the four countries' counterparts and the person in charge of the AMN Central Office to interchange ideas about the ways of developing the establishment of the proposed Standard.

As result of that meeting, the JICA Study Team made the following statements about future implementation of the standards:

- (1) To reconfirm that the institutes from each of the four countries' counterpart institutes will undertake the administration / management of the MERCOSUR Common Standards (Guideline) related to packaging Technologies.
- (2) As some of the counterpart institutes and local AMN representatives <in some cases> have different policies, it is recommended to implement country-level coordination.
- (3) The request of application to the AMN, for the approval of establishment of Standards in the MERCOSUR, shall be submitted as per the Procedure described in paragraph 6.3.2 of the Report. However, the participation of private companies association by sectors will be top relevant.
- (4) Above request shall be submitted in accordance with the AMN request forms. Notwithstanding it is very important to declare in the form the necessity of organizing the "Packaging Sector Committee (CSM)" within the AMN structure.
- (5) Once the request has been submitted, the AMN will answer within a time stated on the regulations. During this waiting time, and in order to reinforce the action of the CSM, a presentation shall be prepared to support the hypothesis under which the approval of the submitted standards will lead to the improvement of transportation and exportation competitiveness to a top worldwide benchmark level.
- (6) The official approval of the submitted standards by the AMN is the first step in the enforcement in each country member, based upon the priorities of common regional standards. Furthermore, this will allow enlarging the number of standards to be applied to other products besides dairy products and home appliances.
- (7) The AMN Secretariat and the Sector Committee are holding periodical meetings, as per MERCOSUR agreement. They can hand over the proposals (particularly the ones related to packaging technologies) to a higher level, because they are related to the

MERCOSUR Work Sub-group (SGT).

- (8) This Study on packaging technology improvement for product distribution within MERCOSUR is relevant not only regarding the information gathered therein, but also because of its technical aspects. Therefore, we recommend the consideration of a systemizing process and its legal application, in the near future.
- (9) The AMN will hand over the submitted standards to the MERCOSUR SGT, to receive the final approval and proceed to their enforcement at a regional level. At this point, the standards will be evaluated at an international level, and will become an alternative for the international discussion about regional data.
- (10) Finally, there are some projects for improving transportation competitiveness in progress in South America region: IIRSA plan (South American Regional Integration Initiative) through the IDB (Inter-American Development Bank); also through the EPA (Economic Partnership Agreement) / FTA and Market Approach APEC, etc. All these projects point out the importance of the packaging technology regulations for transportation.



Source: JICA Study Team

Fig. 10-7 Diagram of the Approval Process of Standards, from Each Country up to AMN

10.3.4 Recommended Actions to be taken by the Counterparts and the Private Sector

For the performance of this JICA Study, the support of the cooperating companies was essential, mainly in the product-related areas. Figure 10-8 shows the conclusions regarding the coordinated work performance between counterpart's institutes and private ones. There are some differences among the four MERCOSUR countries, considering international trading aspects and industrial infrastructure, so that we recommend basically a planning of development process focused on these differences in order to achieve future progress.

The JICA mission recommends the construction of a real link between counterpart's and private institutions in order to allow the official establishment of the MERCOSUR Packaging Standards, as well as the establishment of a new Containers and Packaging Sector Committee.

The JICA Study's development verification in each of the four countries will be considered as follows:

(1) ARGENTINA

The Packaging Association of the private sector and the INTI of the government sector coexist and have interrelationship in this country. The organizational structure of INTI's executive board committee is established and functioned with emphasis on cooperation between the government and private sectors. The technological improvement of the transportation packaging field, which was implemented with participation of manufacturing sector as a priority area for the JICA Development Study, was informed to the INTI's executive board committee beforehand as well as the progress reports. Therefore, it is expected to establish further active cooperative relationship for the continuous technological development of packaging with a very broad base.

Land transportation media is very important in such an extended territory, and have to be considered in the future. A growth in transportation activities will stimulate exportation competitiveness as well as South American unification, and an approach to the Pacific Ocean will widen the range of exported products by means of export packaging technologies improvement.

(2) BRAZIL

The Packaging Association represents the private sector, like in Argentina. Brazil is one of the few world most extended continental countries, and they have historically supported the maintenance of the terrestrial infrastructure. Product transportation damage reduction is a matter to be solved urgently, because Brazilian production is highly diversified and it is scattered all over the country.

INT, INMETRO and CETEA, which are the counterpart's institutions for this JICA Study, agreed with the country higher organisms to promote future development on the basis of mutual and periodical cooperation.

Despite the manufacturing facilities, distribution centers and transportation routes are widely spread due to the country's dimensions, material manufacturers agreed to apply the recommended improvement into their plants, independently from their investment plans. The land transportation packaging technology improvements still outstanding in Brazil are countless, considering either the study target products (home appliances) or other market products. It is urgent to create a system based upon sharing this Study process, and to use the databases as an instrument to handle the technologies of the Packaging Association (that unifies counterpart's and private institutions).

(3) PARAGUAY

Dairy products are one of the most relevant products of the Paraguayan manufacturing industry, and they have been chosen as target products for this JICA Study. Human resources have been developed along this Study, thanks to the close cooperation of counterpart's institutions and cooperating companies.

There is no Packaging Association-alike entity because of local industrial Regulations. Therefore, a unified system shall be organized among the Commerce Chambers, the Export Promotion Sector (Ministry for Commerce and Industry) and Private Institutions in order to develop transportation packaging technologies. The reason for this is that Paraguay is already exporting its products to Brazil, Bolivia and Peru, and this system will be very supportive for land and river transportation activities.

Temperature, humidity and pressure have to be considered as product conservation variables when manufactured food products are transported well above sea level in summer, and particularly to the country's northwest zone. Therefore, the development of a system where the counterpart institute (INTN) undertakes the management of standards involving above variables is of great importance.

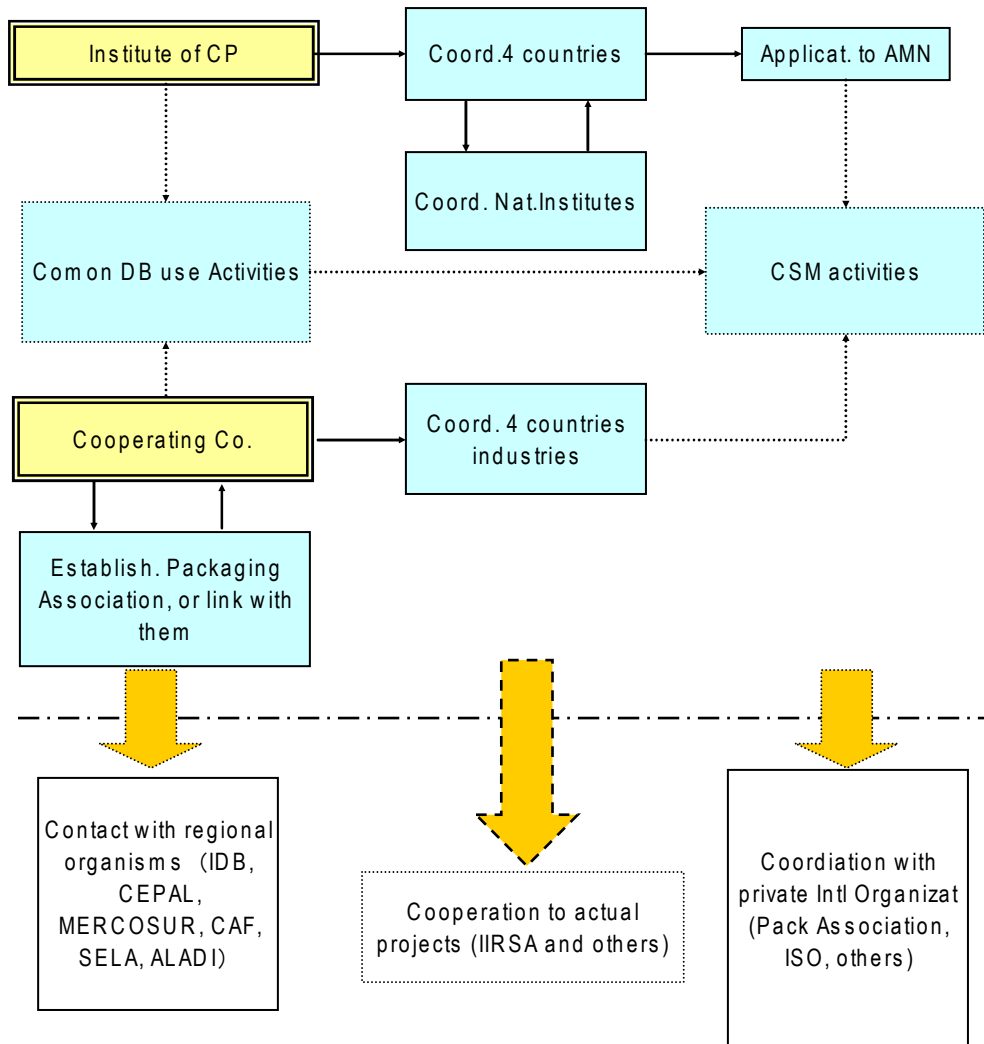
(4) URUGUAY

The core of the Uruguayan industrial structure is cattle breeding, and consequently dairy products are of main productive relevance, like in Paraguay. The forest sector is now growing in importance as a productive industry, thanks to the subsidies given to the sector since long time ago. The JICA Study showed the results of improvements made on primary packaging of dairy product.

Further development will be performed through the common database of counterpart's and private institutions, based on the Chamber of Commerce, because there is no Packaging

Association-like entity in Uruguay. Notwithstanding this we recommend that the new group unifying the packaging technology section and the plastics section should be placed inside the counterpart's institution. We have to point out that the counterpart's packaging technology section does not have enough equipment, and they are receiving test samples from the private sector. This situation is being handled in equipment shortage for packaging material testing. Therefore, these facilities need to be refurbished.

Below we detail the forest sector development process as a subject of national industry expansion. The counterpart's institution is expectant to develop national cardboard as packaging material. Therefore, forest products would be used as packaging material in the future, and ecological consequences have to be considered.



Source: JICA Study Team

Fig. 10-7 Counterpart's Institutions and Private Sector Actions

Poster for the Public Seminar of Results of the Study

**SEMINARIO PUBLICO de RESULTADOS
ESTUDIO de MEJORAMIENTO de TECNOLOGIA
de ENVASES y EMBALAJES
en el MERCOSUR**



**19 de enero 2007 8:30 a 13:00 horas
Salon "Los Jardines" (entrepiso)**

INSTITUCIONES PARTICIPANTES

 <p>INTI Instituto Nacional de Tecnología Industrial Argentina</p>	 <p>INT Instituto Nacional de Tecnología Brasil</p>
 <p>INMETRO Instituto Nacional de Metrología, Normalización y Calidad Industrial Brasil</p>	 <p>CETEA Centro de Tecnología de Embalajes Brasil</p>
 <p>INTN Instituto Nacional de Tecnología, Normalización y Metrología Paraguay</p>	 <p>LATU Laboratorio Tecnológico de Uruguay Uruguay</p>