



International
Organization for
Standardization



Universidad Santo Tomas

PILOT PROJECT ISO – ICONTEC: “THE ECONOMIC BENEFITS OF STANDARDIZATION”

Summary of ISO methodology results to measure the economic benefits of standardization by applying it to a Colombian Company.

Final Report -
Results

FINAL REPORT
PILOT PROJECT ISO – ICONTEC: “THE ECONOMIC BENEFITS OF
STANDARDIZATION” – COLOMBIA

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(MASTER IN QUALITY AND INTEGRAL MANAGEMENT)

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“In memory of Mr. Fernando Aya Duarte, whose dedication and commitment to standardization outweigh the economic benefits identified in this study, that were, largely the result of their management and leadership in GERFOR

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1. OBJECTIVES AND ORGANIZATION OF THE PILOT PROJECT

1.1 GENERAL OBJECTIVE

To allow the interested parties, both from private sector and public sector, to appreciate the economic and social impact of the technical standards and raise awareness of responsible politicians and business leaders about the benefits of implementing technical standards.

1.2 SPECIFIC OBJECTIVES

- To understand the value of using standards in the organization and the importance of participating in activities related to standardization.
- To understand how technical standards affect the key processes of the organization's value chain.
- To quantify the economic impact of technical standards in the organization.

1.3 DURATION OF THE STUDY

- Starting date: August 30, 2010
- Ending date: March 30, 2011

1.4 PARTICIPANTS

- ICONTEC - Instituto Colombiano de Normas Técnicas y Certificación (Colombian Institute of Standardization and Certification)
- Universidad Santo Tomas de Aquino (USTA) with the Educational Agreement with ICONTEC (Master in Quality and Integral Management) and the Faculty of Economics.

2. INTRODUCTION TO THE SELECTED ORGANIZATION

2.1 PRESENTATION AND TRACK-RECORD OF THE ORGANIZATION

GERFOR is a Colombian multinational company, leader in the production and commercialization of PVC and CPVC piping and fittings that is part of the petrochemical sector among the classification of plastics and synthetic fibers.

GERFOR owes its name to the first letters of the name and surname of the founder and president Mr. Germán Forero Rodríguez.

The headquarters located in Colombia focus its processes in only one plant located at 600 meters from Autopista Medellín Km. 2 (way Bogotá – Medellín), entering by the village called Parcelas in the Municipality of Cota, very close to Bogotá.

This Colombian company started operations in 1967 commercializing metallic sets of faucets and fittings; in 1972 it began the production of parts for faucets. By the end of that decade the company started to manufacture plastic faucets and PVC fittings, but it was not until 1985 that it started the production of its first PVC piping. In the following years, coherently with its main objective of customer satisfaction, the company developed a wide product portfolio under the most strict quality technical standards.

GERFOR is now consolidated as a multinational company with presence in different countries of Latin America and product exports to more than 10 destinations in America. The company is focused on the expansion in the various Latin American markets which is considered the starting point to extend its coverage of the world market.¹

Due to this track-record and its ability to deliver maximum quality for all its products, GERFOR is today the main Colombian industrial group within the sector, leader in the production and commercialization of:

- PVC and polyethylene piping and fittings for the industries of construction, sewerage and aqueduct nets and telecommunication systems.
- Plastic and metallic household faucets.
- PVC covers
- Solvent cement

These four main products are classified in turn in the following families:²

FITTINGS

- Fittings for CPVC piping (hot water).
- Fittings for Conduit piping.
- Fittings for pressure piping.
- Fittings for sanitary piping.

¹<http://www.gerfor.com/gerforSigloXXI.html>

² Quality Manual P.V.C Gerfor S.A – MN0040000-22 , p 9-10.

- Fittings for sewerage piping
- Fittings for duct piping

PIPING

- PVC corrugated piping to protect underground drainage systems and sewerage.
- PVC corrugated piping to protect telephone and electric conductors.
- Closed profile smooth end sewerage piping. Closed belled profile sewerage piping
- CPVC piping (hot water).
- Polyethylene piping.
- PVC belled pressure piping.
- PVC pressure piping with smooth end.
- Irrigation piping.
- Sanitary and ventilation piping.
- Conduit piping.
- Solid telephone duct piping.
- Corrugated telephone and electric duct piping.

SETS OF FAUCETS

- Household faucets for lavatories
- Household faucets for sinks
- Household faucets for wash basins
- Household faucets for gardens and showers

SOLVENT CEMENT

- PVC solvent cement.
- CPVC solvent cement.

PLASTIC COVERS

- Tiles and sheets (PVC covers)

GERFOR's long tradition in developing and applying standards as a competitive factor is the main reason that has motivated the participation of this organization in the development of this pilot study. Having been involved in the development of technical standards for the piping sub-sector for more than twenty years, GERFOR keeps an active participation in the Colombian technical committee for standardization 91 (piping, ducts and plastic fittings), which has been chaired by GERFOR for some periods of time. The company participates in other technical committees of interest, as shown in Table 3, and its quality management system is certified with ISO 9001. All GERFOR's production is based on product technical standards, and the company has quality certifications for most of its pipe lines (see section 3).

2.2 ROLE AND POSITION OF THE ORGANIZATION IN THE MARKET

GERFOR's income was around 105 million dollars in 2009, and the company has 850 employees in the Colombian plant.

GERFOR is consolidating as a multinational company and is present in a significant part of Latin America, as indicated below:

- CENTROAMERICANA DE PVC, S.A., this plant was opened in 1998 in the city of Guatemala, for the Central American market;
- CENTROAMERICANA DE PVC. S.A. DE C.V., this was opened in 2004 as a distribution center for El Salvador;
- CENTROAMERICANA DE PVC S.A. DE C.V., distribution center for Honduras; and
- P.V.C. GERFOR PERÚ S.A.C, created to promote commercialization in South America and opened in 2010.

97% of GERFOR's sales are realized in Colombia, where customers are grouped in three sectors: infrastructure, construction and irrigation, and 3% abroad (Venezuela, Ecuador, Chile, Bolivia, Panamá, Costa Rica, Guatemala, Salvador, Honduras and Puerto Rico).

The company holds about 26% of the national market for its three product lines: 75% of PVC pipes, 12% of faucets and 12% of tiles.

The most important product line (PVC pipes and fittings) covers three main market segments: construction (which represents 45% of sales), infrastructure (aqueduct and sewerage in governmental projects) (40%) and irrigation (15%). The latter is considered by GERFOR the segment with higher potential

GERFOR manages a total of approximately 350 national suppliers, the most relevant of which are shown in Table 1.

Table 1. Most relevant national suppliers

Raw material suppliers	Product supplied
Ajover S.A.	High impact polystyrene
	Polystyrene glass
Andiquimica Ltda.	Calcium stearate
	Lubrex wax
Carboquimicos S.A.S	Polystab E-4005
	Polylub 70
Conquimica S.A.	Methyl ethyl ketone
	Cyclohexanone
Colquimicos S.A.	Pigments
Clariant Colombia S.A.	Pigments

Raw material suppliers	Product supplied
Fomag S.A.	Polyethylene wax
Inproquim	Methyl ethyl ketone
	Cyclohexanone
	Ethanol
Mexichem Resinas Colombia S.A.S	PVC resin
Omya Andina S.A.	Calcium carbonate
Polímeros Técnicos	Abscrom able
	Acetal pom
Producciones Químicas S.A.	Calcium stearate
Prominerales S.A.	Calcium carbonate
Propilco S.A.	Polypropylene
Reciend S.A.	Lestarflex
Scapel	Finastat 9500

Source: GERFOR information

The company also manages about 48 international suppliers, the most relevant of which are shown in Table 2.

Table 2. More relevant international suppliers

International supplier	Type of product
Advance	Raw material
Amerilubes	Raw material
Arkema	Raw material
Dow	Raw material
Dupont	Raw material
Hubei	Raw material
Kompanie Ultramar	Raw material
Mexichem	Raw material
Mitsui - China	Raw material
Petroquímica de Venezuela	Raw material
Policyd	Raw material
Reagens	Raw material
Rohm and Hass Chemicals	Raw material
Sunwise	Raw material
Shintech	Raw material
Tronox	Raw material
Yunatin	Raw material

GERFOR information

The main GERFOR's competitors in Colombia are Aliaxis, PAVCO and Tigre:

- Aliaxis is a strategic ally of Durman (Company from Costa Rica founded in 1959), and it is also a worldwide leading company in construction systems, especially piping, fittings, and plastic valves; this company operates in 39 countries with 11 500 employees and worldwide annual sales of 2,347 million dollars.
- PAVCO is a company leader in Colombia in the production and commercialization of geosynthetics (a range of polymeric products) for civil engineering and of plastic pipe systems. The company, founded in 1962 in Bogotá is now part of Mexichem, the largest conglomerate of chemical and petrochemical companies in Latin America.
- Tigre is a Brazilian company with more than 70 years in the piping and fittings sector; currently it is operating in 10 countries, and it reaches more than 40 countries with exports; in Colombia this company is located since 2008.

The competitive position of GERFOR in the Colombian market during the past 3 years can be summarized as follows (by product line):

:

- Piping and fittings: GERFOR is number two in the national market after the market leader PAVCO, and has kept its share (between 20% and 30%) during the past three years.
- Faucets: GERFOR ranked in the fourth place with its brand Inalgrifos, and has kept a stable share during the period 2007 - 2009.
- Tiles: GERFOR, represented by its brand Terfor/Luminit, is number two, after the leader Ajoever which controls over 50% of the market is number two following the market leader Ajoever.

3. ATTITUDE OF THE ORGANIZATION TOWARDS STANDARDIZATION

3.1 ATTITUDE OF GERFOR'S MANAGEMENT AND PERSONNEL TOWARDS STANDARDIZATION

GERFOR can be classified as a leader regarding its attitude vs. technical standards. The company is a serious implementor of technical standards and contributes to their development and improvement through an active participation in the relevant standardization technical committees.

The company is not simply an operational user of applicable technical standards but takes strategic advantage from them, seeing standards as fundamental commercial tools to gain access to market.

Technical standards are part of the company's daily activities and both processes and personnel rely on them. Standards are applied for daily work by most of GERFOR's business functions, including notably procurement, engineering, production, and marketing and sales. .

GERFOR is a member of the standardization technical committee No. 91 of ICONTEC "Plastic piping, ducts and fittings". This participation helps the company in simplifying the process for research and development of new products, in pursuing a better approach to serve its customers and to interact with governmental entities, and in taking advantages from early access to information such as that related to technical regulations.

GERFOR also participates in the following standardization technical committees: occupational health, industrial safety, ceramic and refractory products for construction use, geosynthetics, raw materials for plastic industry, non-ferrous metals, and hydraulic and sanitary installations. See Table 3.

Table 3. Standardization Technical Committees in which GERFOR is registered

Committee code	Committee name	Committee scope*	Reason for GERFOR's participation
9	OCCUPATIONAL HEALTH. GENERAL	Standardization in the field related to occupational health. This includes the general guidelines to promote workers' health, protection against risks due to the presence of harmful agents in the workplace, which involve the joint of the three disciplines: occupational or industrial health, occupational or industrial safety and occupational or work medicine.	Important matter within the business management.
16	INDUSTRIAL SAFETY	Standardization in the field of occupational and industrial hygiene in the companies, as well as the maintenance and improvement of the	Important matter within the business management.

Committee code	Committee name	Committee scope*	Reason for GERFOR's participation
		workers' health conditions within a general system of professional risks. It includes terminology, sampling, test methods and specifications for equipment and products for respiratory, visual and hearing protection, and the use of equipment and cloths intended to protect people against risks that are consequence of their work.	
43	CERAMIC AND REFRACTORY PRODUCTS FOR CONSTRUCTION USE	Standardization related to ceramic tiles and their decorative complements used as sheeting of walls and floors. Adhesives and surface treatments used for installing ceramic and refractory products. China vitrified fixtures and its sanitary fittings. Refractory products, ceramic dinner services.	Because this is a product that is part of its portfolio.
61	GEOSYNTHETICS	Standardization related to manufacture, test methods, installation, quality control and terminology of geotextiles, geomembranes, geonets, geogrids and geoblocks.	Because this is a product that is part of its portfolio.
77	RAW MATERIALS FOR PLASTIC INDUSTRY	Standardization of raw materials used in manufacturing plastic products. It covers specifications for inputs, analysis methods, nomenclature and related vocabulary.	Due to its use in the process of Inbound Logistics
91	PLASTIC PIPING, DUCTS AND FITTINGS	Standardization for piping, valves and fittings intended to transport fluids or content cables, and manufacture of all types of plastic materials including reinforced plastics. It also includes pipes, valves, coupling fittings, specifications and tests for manufacturing compounds and plastic piping, requirements related to chemical, mechanical and physical properties, test methods, vocabulary and installation practices.	Because this is a product that is part of its portfolio.
110	NON-FERROUS METALS	Standardization of non-ferrous materials as zinc, copper, aluminum and the alloys thereof. It includes definitions, requirements, sampling, specifications and acceptance tests.	Because they are part of the raw materials used in manufacturing one of its products (faucets).
127	MECHANICAL AND ELECTROMECHANICAL ELEMENTS	Standardization of mechanical and electromechanical elements used in the installation of fluid distribution systems, excepting fuel gases, as well as elements deemed critical in the manufacture and installation of elements composing the system.	Because this is a product that is part of its portfolio (valves)

Committee code	Committee name	Committee scope*	Reason for GERFOR's participation
161	HYDRAULIC AND SANITARY INSTALLATIONS	Standardization of hydraulic and sanitary installations in buildings, and hydraulic installations for fire fighting. It includes fittings, valves and supplementary equipment used in the installation process.	Because this is a product that is part of its portfolio.
10	QUALITY MANAGEMENT SYSTEMS	Standardization in the generic field of quality management, including quality systems, quality assurance and generic supporting technologies.	Important matter within the business management.

* It corresponds to that published on the web page of Icontec/Standardization Technical Committees.

Source: Team of the pilot project ICONTEC-USTA

3.2 GERFOR'S HISTORY IN USING STANDARDS FOR MANAGING ITS BUSINESSES (PROCESSES), SUPPLIERS AND CUSTOMERS

GERFOR's history in standard use began with the implementation of product technical standards. As mentioned before, GERFOR develops all its products under Colombian technical standards and GERFOR's products are certified with the following product standards:

1. NTC 382 Plastic. Poly (vinyl chloride) (PVC) pressure rated pipes (SDR series).
2. NTC 2295 Joints with flexible elastomeric seals for plastic pipes used for pressure water transportation.
3. NTC 1630 Poly (vinyl chloride) (PVC) pipes and elbows to lodge and protect underground electric and telephonic conductors.
4. NTC 1087 Poly (vinyl chloride) (PVC) waste and vent pipe.
5. NTC 979 Plastics. Unplasticized poly (vinyl chloride) (PVC-u) pipes and bends for conduits housing and protecting.
6. NTC 1339 Pipe fittings of poly (vinyl chloride) (PVC) schedule 40
7. NTC 1341 Poly (vinyl chloride) (PVC) waste and vent fittings.
8. NTC 576 Solvent cement for poly (vinyl chloride) (PVC) plastic piping systems.
9. NTC 1062 Chlorinated poly (vinyl chloride) (CPVC), plastic hot and cold-water distribution systems.
10. NTC 3317 Plastics. Poly (vinyl chloride) (PVC) pipes for irrigation systems.
11. NTC 3363 Plastics. Rigid and corrugated poly (vinyl chloride) (PVC) pipes and elbows, having smooth inner wall, for enclose and protect underground electrical and telephone wires.
12. NTC 3722-1 Structured wall piping and fittings for non--pressure underground drainage and sewerage. Part 1. Metric series.

13. NTC 5442. Structured wall piping and fittings for non--pressure underground drainage and sewerage. Part 1. Metric series.
14. NTC 5070 Poly (vinyl chloride) (PVC) closed profile gravity pipe and fitting based on controlled inside diameter.

Piping manufacturing, commercialization and use are also ruled by various technical regulations for which it also has the corresponding certifications.

Some of these resolutions include certified standards (10 in total), which are totally referenced or only some of their requirements are referenced. The following table shows this list:

Table 4. Certified standards referenced in technical regulations

Resolution	Issued by	Standards according to which GERFOR is certified	Requirement
Resolution number 1166 of June 20, 2006	Ministry of Environment, Housing and Territorial Development	NTC 1087	Poly (Vinyl Chloride) (PVC) Waste and Vent Pipe shall meet the requirements and test method to determine the chemical strength stated section 5.7.
		NTC 1341	Poly (Vinyl Chloride) (PVC) Waste and Vent Fittings shall be submitted to the specific requirement of chemical strength stated in section 5.2.
Resolution 1127 of 2007	Ministry of Environment, Housing and Territorial Development	NTC 1087	Poly (Vinyl Chloride) (PVC) Waste and Vent Pipe shall meet the requirements and test method to determine the chemical strength.
		NTC 1341	Poly (Vinyl Chloride) (PVC) Waste and Vent Fittings shall be submitted to the specific requirement of chemical strength.
		NTC 1087	Rigid Poly (vinyl chloride) (PVC) waste water pipes.
		NTC 1341	Rigid Poly (vinyl chloride) (PVC) fittings for sanitary pipes.
		NTC 3722-1	Structured wall piping and fittings for non--pressure underground drainage and sewerage. Part 1. Metric series
		NTC 5070	Poly (vinyl chloride) (PVC) closed profile gravity pipe and fitting based on controlled inside diameter.
		NTC 382	Plastic. Poly (vinyl chloride) (PVC) pressure rated pipes (SDR series).
		NTC 1339	Pipe fittings of poly (vinyl chloride) (PVC) Schedule 40.
		NTC 2295	Joints for plastic pressure pipes using flexible elastomeric seals.
Resolution 180398 of April 7,	Ministry of Mines and Energy	NTC 1630	Poly (vinyl chloride) (PVC) pipes and elbows to lodge and protect underground electric and telephonic conductors.

Resolution	Issued by	Standards according to which GERFOR is certified	Requirement
2004		NTC 3363	Plastics. Rigid and corrugated poly (vinyl chloride) (PVC) pipes and elbows, having smooth inner wall, for enclose and protect underground electrical and telephone wires.
		NTC 979	Plastics. Unplasticized poly (vinyl chloride) (PVC-U) pipes and bends for conduits housing and protecting.

GERFOR additionally implemented the Colombian technical standard NTC-ISO 9002:1994 for quality assurance, being awarded by ICONTEC in 1998 with the Quality Assurance Certificate No. 156-1 for the scope “Manufacturing and Commercialization of PVC piping and Fittings and Household Faucets. Manufacturing and Commercialization of PVC Solvent Cement”. Since then it has maintained the certification through the renewals listed below, where it has also done the transition of the NTC-ISO 9001 versions:

- November 28, 2001, certification renewal and updating to version NTC-ISO 9001:2000.
- September 22, 2006, certification renewal.
- September 20, 2009, certification renewal and updating to version NTC-ISO 9001:2008 and scope extension to “Manufacturing and Commercialization of PVC Pipes and Fittings, CPVC Piping and Fittings, Polyethylene Pipes, Household Plastic and Metallic Faucets, PVC Solvent Cement and PVC Covers”.

Currently GERFOR is implementing the standards NTC-ISO 14001: 2004 and NTC-OHSAS 18001:2007, with aim to seek certification according to these standards.

These certifications have allowed the company to compete in the construction, infrastructure and irrigation channels; in the same way these certifications support the positioning of the company as a leading brand in the Colombian market for fluid management solutions, as it can assure that its products meet the highest quality levels.

In order to maintain the quality parameters of the products manufactured by the company, quality internal audits and systematic inspections are carried out by the Conformity area.

4. ANALYSIS OF THE VALUE CHAIN

4.1 ANALYSIS OF THE VALUE CHAIN OF THE INDUSTRY – PETROCHEMICAL-PLASTIC AND SYNTHETIC FIBER SECTOR

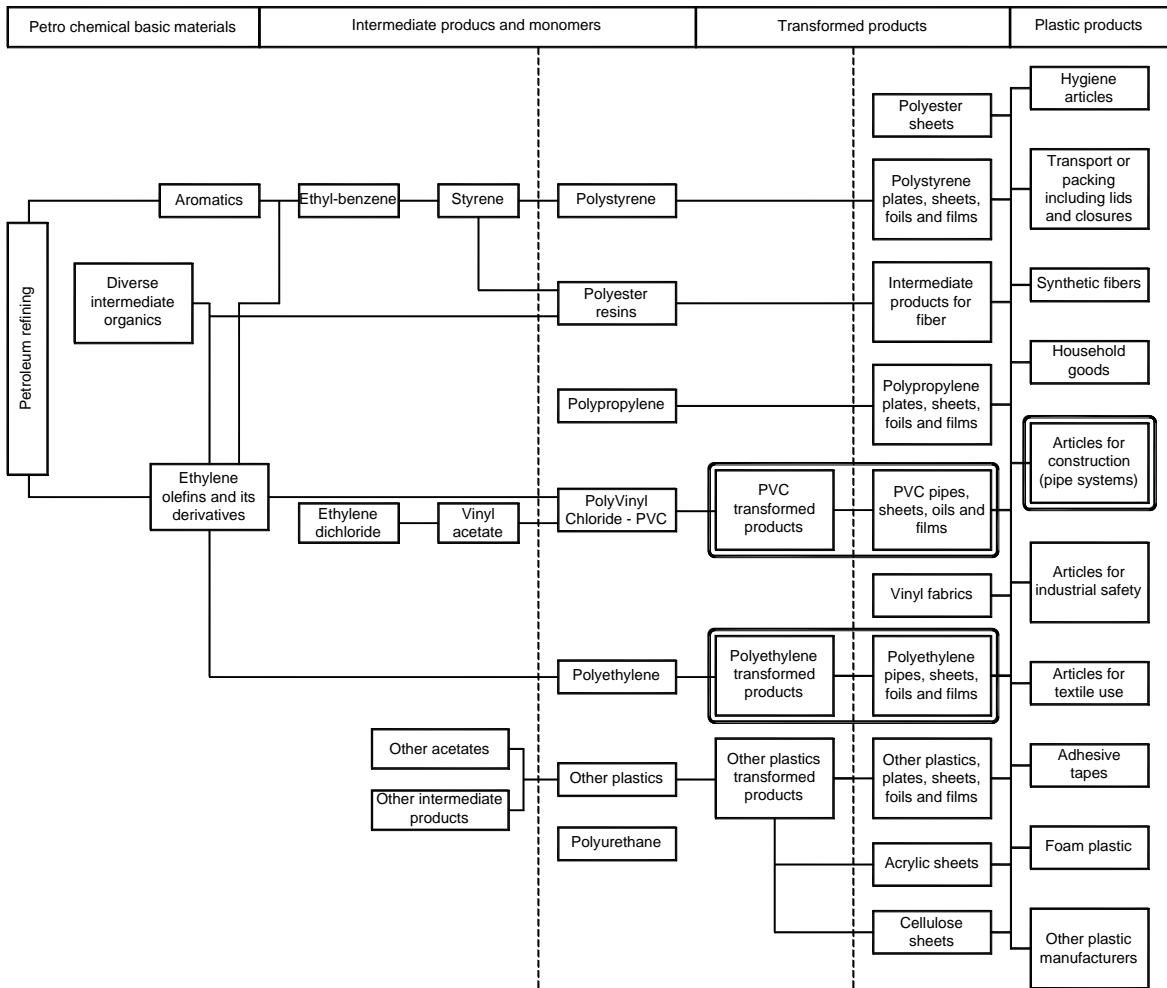
4.1.1 IDENTIFICATION OF THE VALUE CHAIN

As mentioned above, GERFOR is part of the value chain of the petrochemical-plastic and synthetic fibers sector; this chain covers a wide range of industries found in a wide range from gas exploitation and refining of crude to the production of basic petrochemical raw materials (aromatics and olefins), production of intermediate inputs (polyethylene, poly (vinyl chloride), polypropylene, resins, etc), and production of transformed and finished plastic goods. The offer of these final plastic products is addressed to industrial activities of infrastructure, construction, agriculture and final consumption (automotive spare parts, toys and household goods).

The petrochemical-plastic and synthetic fibers chain is characterized by differences in the productive process of the various companies, which operate in a highly competitive market composed mainly of small and medium enterprises. Most of the production of these companies is addressed to the internal and retail market and they are not particularly involved in standardization. The leading companies, on the contrary, have a proactive attitude toward technical standards, because these contribute to open doors to foreign markets and allow to reach strategic markets such as construction and agriculture.

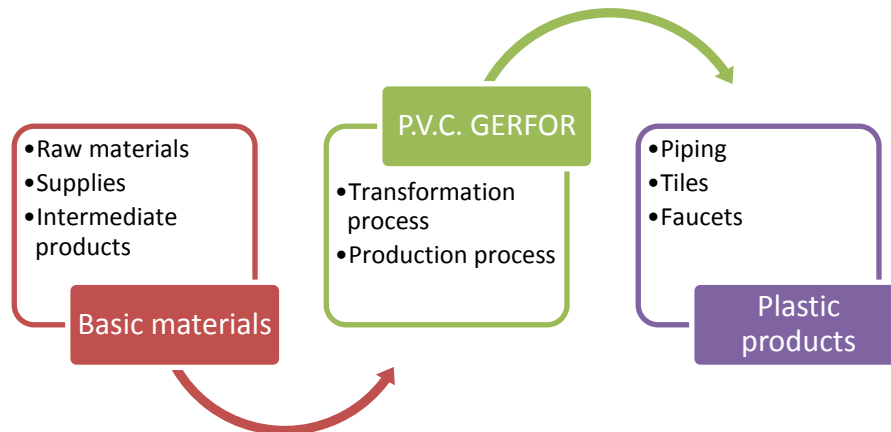
Among the latter, GERFOR can be considered a leading company in the creation and adaptation of new products and new industrial lines, in the segment of transformed and finished plastic products – see Figure 2 and Figure 3, which highlights the links between the various segments of the sector's productive chain..

Figure 2. Simplified structure of the petrochemical-plastic



Source: Adaptation of *Análisis de Cadenas Productivas*, book - *Cadenas Productivas Estructura, comercio internacional y protección* – published by the Departamento Nacional de Planeación in 2004.

Figure 3. Segment of the sector's value chain where GERFOR is located



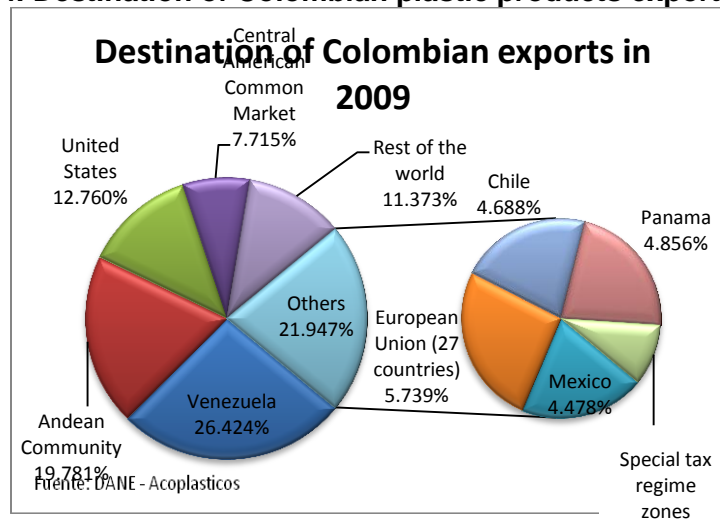
Source: Team of the pilot project ICONTEC-USTA

4.1.2 BALANCE OF TRADE OF THE PETROCHEMICAL-PLASTIC SYNTHETIC FIBERS SECTOR

Main destinations of Colombian plastic products exports in 2007 – 2009 were: Venezuela, the Andean Community, the United States, Central American Common Market, Mexico, European Union, Chile, Panama and special tax regime zones in Colombia.

Among these, the top importers were: Venezuela with a share of 31.8% in 2007, 30.2% in 2008 and 26.4% in 2009; the Andean Community with 16.2% in 2007, 18.4% in 2008 and 19.8% in 2009; and the United States with 14.7% in 2007, 13.2% in 2008 and 12.8% in 2009. (See Figure 4).

Figure 4. Destination of Colombian plastic products exports in 2009



Source: DANE - Acoplásticos

These figures highlight the importance of the regional market of Latin America and the Caribbean, which represents 73.7% of total exports of basic chemicals,, 81.6% of other chemicals, 92% of synthetic and artificial fibers, 69% of plastic products, 90 % of textile products weaving, 87% of footwear, and 75% of electrically isolated cables.

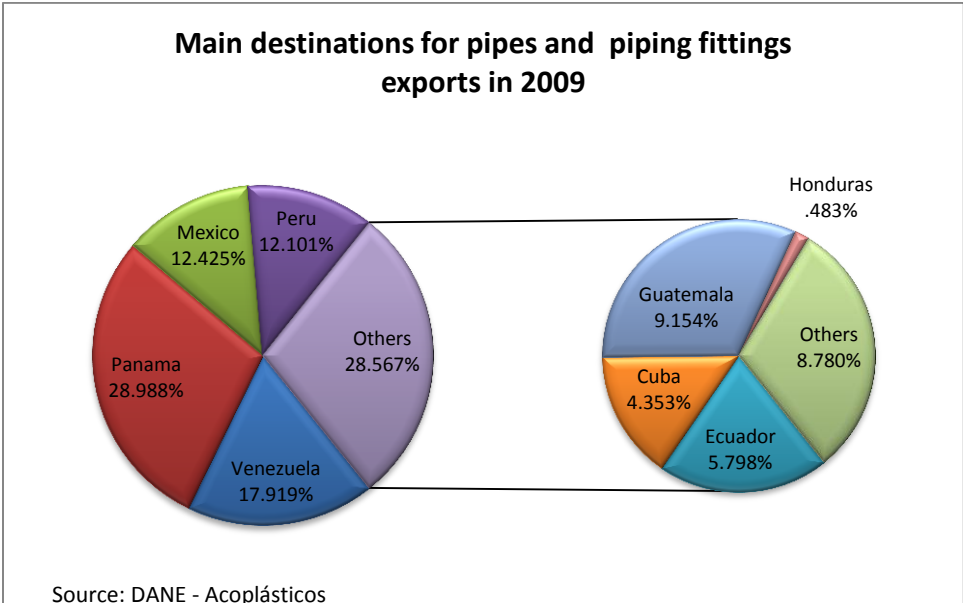
4.1.3 BALANCE OF TRADE OF THE PLASTIC PIPING SUB-SECTOR

In 2008 the plastic piping sub-sector contributed to the national economy approximately with a share of 4,2% of the Gross Domestic Product (GDP) that was of 3,42 thousand million dollar. In 2010, exports from this sector accounted for 1,5% of the total country exports, with an 18,23% increase over 2009.

Pipes and piping fittings imports were 26.4 million dollars in 2007, 37.7 million dollars in 2008 and 37.3 million dollars in 2009; the main suppliers were the United States with 41% average of the total imports, Germany with 10.7%, Chile with 9.9% and China with 4.4%.

Exports of plastic piping and fittings moved from 42.3 million dollars in 2007 to 52.0 million dollars in 2008 and back to 40.1 million dollars in 2009; during 2007 the main recipient was Venezuela, representing 45.8% of total exports; in 2008 and 2009 the main recipient was Panama with 34.7% and 29.0% respectively. (Figure 5).

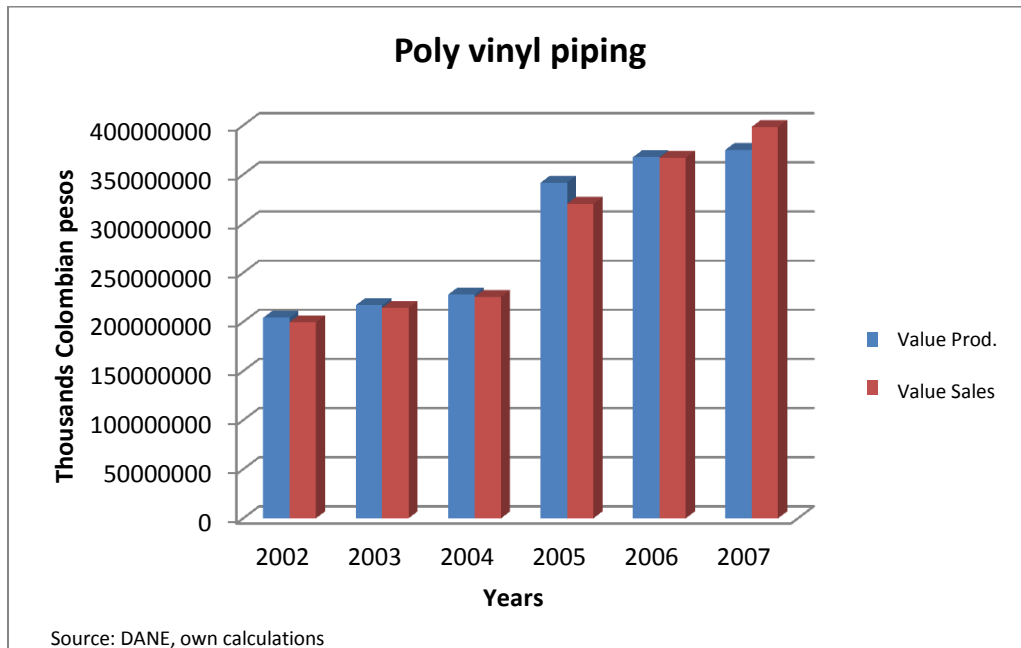
Figure 5. Main destinations of pipes and piping fittings exports in 2009



In the period 2002 – 2007 poly (vinyl chloride) piping represented the main production in Colombia, and poly (vinyl chloride) fittings for piping and other plastic materials were the most exported products.

Production and sales of poly (vinyl chloride) piping during this period are presented in Figure 6.

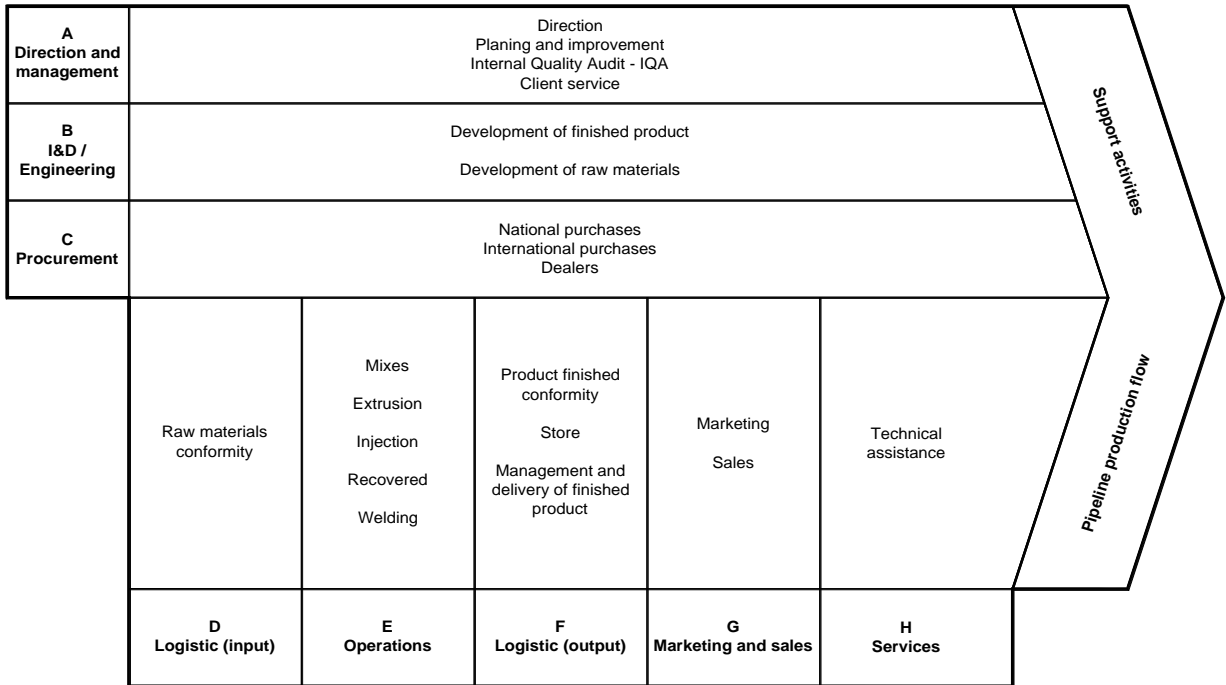
Figure 6. Production and sale of poly (vinyl chloride) piping



4.2 ANALYSIS OF THE VALUE CHAIN OF THE COMPANY

In order to analyze the value chain of GERFOR, the traditional model was used with the nine business functions, taken from the research methodology, but adapted to the various processes of GERFOR according to the field interviews. Basic functions and the relation to the company's processes are shown in Figure 7.

Figure 7. GERFOR's value chain



Source: Team of the pilot project ICONTEC-USTA

Table 5 shows the activities of the value chain processes for GERFOR, which are within the scope of the pilot project assessment.

Table 5. GERFOR's value chain processes

Business function	Process	Objective	Related activities	Comments, applicable standards
Direction and Administration	Management	To ensure that the implemented quality management system is suitable, adequate and effective and its effectiveness is continuously improved.	<ul style="list-style-type: none"> • Training to the whole organization. • Definition and communication of the customer's needs. • The objectives of QMS processes and the provisions to achieve an effective 	The key technical standard for this function is NTC-ISO 9001:2008 Quality Management Systems, Requirements.

Business function	Process	Objective	Related activities	Comments, applicable standards
			<p>communication within the organization.</p> <ul style="list-style-type: none"> • Identification of the resources needed for the processes. 	
	Planning and improvement			<p>The key technical standard for this function is NTC-ISO 9001:2008 Quality Management Systems, Requirements.</p>
	Quality internal audits	<p>To ensure the conformity with the requirements of the standard NTC-ISO-IEC 17025 in the testing laboratory of PVC GERFOR and determine the conformity of the Quality Management System with the provisions planned in the standard NTC-ISO 9001:2008 and other requirements set by the organization.</p>	<ul style="list-style-type: none"> • Execution of the internal audits. • Reporting of audit findings. • Definition of causes and action plan for the CARs generated. 	<p>These are based on NTC-ISO 19011</p>
Direction and administration	Customer service	<p>To satisfy the customer's needs regarding the fulfillment of sale orders, products, amounts, prices and places for delivery according to the agreed conditions.</p>	<ul style="list-style-type: none"> • Cause analysis • Goods assignment • Schedule for pending production • Definition of actions • Execution of actions. 	<p>The key technical standard for this function is NTC-ISO 9001:2008 Quality Management Systems, Requirements.</p>

Business function	Process	Objective	Related activities	Comments, applicable standards
R&D / Engineering	Development of finished product	Planning and control of the design and development of new products and modification of current products by revision, verification and validation of each stage optimizing the manufacture resources.	<ul style="list-style-type: none"> • Product design. • Development of machinery and/or tools. 	The activities are carried out under the specifications of international technical standards (ISO, IEC and OIML), regional standards (EN), associations standards (ASTM, ASME, AASHTO, UL and NEMA) national standards (NTC, BS, DIN, NCM, COVENIN, NTE and NTP),
	Development of raw materials	Homologation of new raw materials, formulations fulfilling the Price and quality requirements set by the organization; definition and establishment of the specifications to be meet by raw materials to be used in the production process.	<ul style="list-style-type: none"> • Execution of tests in the development production, comparative and conformity tests. • Identification of the applicable technical standards, both national and international. • Generation of the first EMP proposal. 	
Procurement	National procurement	To ensure the supply of critical raw materials and inputs bought at national level, on the date required by the specifications, using reliable suppliers. To establish the provisions for the execution of critical services.	<ul style="list-style-type: none"> • Definition of the purchase order. • Follow up to the PO confirmation, print the PO and ensure the receipt of this by the supplier. • Elaborate, define and confirm the service order. 	The main technical standard applied in this process is NTC-ISO 9001:2008.
	International procurement	To carry out international purchases and dispatches of equipment, raw material and spare parts needed to the activities of the company according to the external and	<ul style="list-style-type: none"> • Communicate to the supplier • Coordinate the dispatch of the imports. • Send the packing list to the store for audit preparation and verification. 	

Business function	Process	Objective	Related activities	Comments, applicable standards
		internal rules.		
	Suppliers	To develop critical suppliers for services, inputs and raw materials that conforms to the technical and economic specifications of the company.	<ul style="list-style-type: none"> • Evaluation of the first service or the first samples. • Includes: registration, tests, initial selection. 	The main technical standard applied in this process is NTC-ISO 9001:2008.
Inbound logistics	Conformity of raw materials and inputs	To ensure that critical raw materials and consumables acquired are conform to the specifications or requirements set by the company.	<ul style="list-style-type: none"> • Sampling. • Comparison of certificates vs. EMP. • Administration of certificates by supplier, tests carried out. • Calculation of indicators. 	See Annex A
Operations	Mixes	To produce PVC compounds timely and according to the production requirements that allows the efficient manufacturing of conforming products.	<ul style="list-style-type: none"> • Receipt and administration of raw materials. • Manufacturing of Masterbatch • Manufacturing of compound. • Delivery of materials to the plants according to the requirements. 	Colombian technical standards and technical regulations
	Extrusion	To manufacture PVC piping, profiles, tiles, sheets, polyethylene piping, bells and bends fulfilling the specifications and using the manufacture resources in a suitable manner.	<ul style="list-style-type: none"> • Supply compound to the machines. • Extrude the compound. • Transform the compound in PVC piping, profiles, tiles, sheets, polyethylene piping, bells and bends. • Identify, package and report the manufactured product. 	
	Injection	To manufacture PVC fittings for the construction sector and plastic parts that constitute the faucets meeting	<ul style="list-style-type: none"> • Supply the compound and other polymeric materials to the machines. • Inject the 	

Business function	Process	Objective	Related activities	Comments, applicable standards
		the specifications and using the manufacture resources in a suitable manner.	<ul style="list-style-type: none"> • compound and other polymeric materials • Transform the compound in PVC fittings and semi-elaborated products for faucets. • Identify, package and report the manufactured product. 	
Operations	Recovery	To administer with precise and timely information the material generated by the plants from the receipt to the delivery, maximizing the use of material without adversely affecting the product specifications and using the manufacture resources in a suitable manner.	<ul style="list-style-type: none"> • Receipt, treatment and delivery of materials and weighing according to the specified conditions. 	Colombian technical standards and technical regulations
	Welding	To manufacture PVC solvent cement (welding), CPVC, cleaner and Guatemala glue in all its presentations for the construction meeting the specifications and using the manufacture resources in a suitable manner.	<ul style="list-style-type: none"> • Prepare the mix according to the reference to be manufactured. • Supply the mix to the packaging unit determined by the program. • Package the references required. • Identify, package and report the manufactured product. 	
Outbound logistics	Conformity of finished product	To verify the fulfillment of the requirements related to the in-process product and the finished product. Ensure the reliability of the	<ul style="list-style-type: none"> • Establish methods and instructions for trials and tests. • Conduct tests according to the IT set. 	Colombian technical standards for product.

Business function	Process	Objective	Related activities	Comments, applicable standards
		data provided.		
Outbound logistics	Store	To ensure rationalization, reliability of inventories and product preservation in order to timely supply the different areas of the company.	<ul style="list-style-type: none"> • Physical receipt • Suitable turnover of finished products (FP). • Keep the FP inventory updated. 	Colombian technical standards for product.
	Administration and distribution of finished product	To conduct a proper administration of inventory regarding preservation, turnover, location and availability by implementing effective practices for readiness to ensure invoicing, dispatch, delivery and follow up to goods, meeting the product requirements, amount and times and properly using the available resources.	<ul style="list-style-type: none"> • Receipt and storage of finished product. • Readiness of finished product. • Request and listing of vehicles. • Payment of freights. • Invoicing. • Entry and filling of vehicles. 	
Marketing and sales	Marketing	To ensure long term commercial relations with customers through the design and execution of strategies improving the positioning of the brand and the consumers loyalty.	<ul style="list-style-type: none"> • Elaborate the execution proposal. • Execution of the marketing plan. • Contracting of suppliers. • Execution of the customer satisfaction survey. 	The main technical standard applied in this process is NTC-ISO 9001:2008.
Marketing and sales	Sales	To fulfill the sale objectives and satisfy the customer needs.	<ul style="list-style-type: none"> • Execution of the sales program. • Implementation of work plans with the marketing process. • Establish the customer criteria to request the development of new products. 	

Business function	Process	Objective	Related activities	Comments, applicable standards
Services	Technical assistance	To provide pre and post sale support to the portfolio of GERFOR Group. To train and advise customers and other interested parties about the products and their proper use. To conduct preventive follow up to the works using the different products of the Group.	<ul style="list-style-type: none"> • Receipt and document the complaint. • Conduct training activities. • Visits to the works. 	The main technical standard applied in this process is NTC-ISO 9001:2008.

Source: GERFOR – Team of the pilot project ICONTEC-USTA

4.3 VALUE DRIVERS

The value drivers of GERFOR, are described in Table 6 and correspond to: distribution channels, customer service, product quality, production capacity and process efficiency; they are related to the company's strategy, which is based on selling exclusively through indirect sales channels, supported by the offering of high quality products, at competitive prices and with higher level of service as opposed to the competitors.

Table 6. GERFOR's value drivers

Value drivers	Description	Related processes
Distribution channels	GERFOR has strategically defined that all its sales will be carried out through distributors. This is considering a differentiating factor of the company against the competition	<ul style="list-style-type: none"> • Management • Logistics: administration and distribution of finished product. • Store • Planning and improvement.
Customer service	Excellence in all the customer service processes, starting when a transaction is generated.	<ul style="list-style-type: none"> • Management • Logistics: customer service • Marketing and sales • Technical assistance
Perceived product quality	This involves not only the intrinsic product quality but also its presentation (cleanliness, color, brightness) and modality of delivery, aiming at improving the customers' perception of product quality. This approach has allowed	<ul style="list-style-type: none"> • Management • Product research and development: a) development of finished product and b) development of raw materials • Mixes • Extrusion

Value drivers	Description	Related processes
	<p>breaking the access barriers to markets as construction and infrastructure, and gaining share in these markets.</p> <p>This also involves improving brand recognition (re-focusing on single brand, etc.)</p>	<ul style="list-style-type: none"> • Injection • Recovered • Welding • Human management: a) selection and b) training and welfare • Quality internal audits • Procurement and suppliers: a) national procurement, b) international procurement and c) suppliers • Metrology • Conformity: a) conformity of raw materials and inputs b) FP conformity • Planning and improvement
Production ability	<p>Ability to execute customer orders on time and at competitive price. It also involves continual product innovation allowing to maintain a complete³ product portfolio for its customers.</p>	<ul style="list-style-type: none"> • Management • Maintenance • Procurement and suppliers: a) national procurement, b) international procurement and c) suppliers • Mixes • Extrusion • Injection • Recovered • Welding • Planning and improvement
Process efficiency	<p>Essential to support GERFOR – applying advanced technology to achieve higher quality along with cost and time reduction.</p>	<ul style="list-style-type: none"> • Management • Maintenance • Procurement and suppliers: a) national procurement, b) international procurement and c) suppliers • Mixes • Extrusion • Injection • Recovered • Welding • Quality internal audits • Logistics: administration and distribution of finished product. • Planning and improvement

Source: GERFOR

³ Being able to supply a full product range is particularly important for a company that operates exclusively through indirect sales channels.

5 ASSESSMENT SCOPE IN THE PILOT PROJECT

The business functions in GERFOR's value chain included in this assessment are those which combine significant use of technical standards with high correlation with the company's value drivers (see Table 6), i.e. Production and Marketing and Sales.

In the development of the project several other GERFOR's business functions were interviewed: Direction and Administration, Research and Development – R&D, Procurement, Inbound Logistics, Operations, Output Logistics and Marketing and Sales. For these functions interesting qualitative and semi-quantitative considerations about the impact of standards have been derived.

Table 7 sets the correlation among business functions, process and/or sub-processes contained in the functions, and the value drivers in order to show in a general way the management performed by GERFOR.

Table 7. GERFOR's correlation of business, process and/or sub-process and value drivers

Business function (value chain)	Process and/or sub-process	Value drivers				
		Distribution channels	Customer service	Perceived quality product	Production capacity	Process efficiency
Direction and Administration	Management	X	X	X	X	X
	Planning and improvement	X		X	X	X
	Logistics: customer service		X			
	Quality internal audits			X		X
R&D / Engineering	Research and development of products: development of product			X		
	Research and development of products: development of raw materials			X		
Procurement	Procurement and suppliers: national procurement			X	X	X
	Procurement and suppliers:			X	X	X

	national procurement					
	Procurement and suppliers: suppliers			X	X	X
Inbound Logistics	Conformity: conformity of raw materials and inputs			X		
Operations	Mixes			X	X	X
	Extrusion			X	X	X
	Injection			X	X	X
	Recovery			X	X	X
	Welding			X	X	X
Outbound Logistics	Conformity: conformity of finished product			X		
	Store	X				
	Logistics: Administration and distribution of finished product	X				X
Marketing and Sales	Marketing		X			
	Sales		X			

Own elaboration, team of the pilot project ICONTEC-USTA.

6 USE OF STANDARDS BY THE ORGANIZATION: STANDARDS USED IN THE VALUE CHAIN OF THE ORGANIZATION

In Annex A, the technical standards used by GERFOR are listed in correlation with the business functions identified in the value chain and that were described in the previous section within the scope of this assessment.

7 SELECTION OF OPERATIONAL INDICATORS TO MEASURE THE IMPACTS OF TECHNICAL STANDARDS

The definition of operational indicators, to measure the impacts of technical standards was performed by developing table 8 that describes:

- the business functions selected within the assessment scope,
- the activities undertaken in GERFOR in relation to each function,
- the value drivers that are applied to each function,
- the standards used by each function, and
- the operational indicators to measure the impact of the standards with their corresponding definition.

Data of impacts of standards were collected/estimated directly by the Managers and the Directors at GERFOR, and calculated on the basis of operational indicators available in the organization.

Table 8. Operational indicators to measure the impact of the standards.

Business function	Processes	Related activities	Value drivers	Standards used	Impact of the standards on the activities	Operational indicators	Indicator result (dollars)	Gross profit (dollars) 2010	% EBIT	Value in dollars
Operations	Mixes	<ul style="list-style-type: none"> Receiving and administration of raw materials. Manufacture of Masterbatch Manufacture of the composite. Delivery of the materials to the plants as per the requirements. 	Perceived product quality Production capacity Process efficiency	See Annex A	Better quality management: Process improvement of product lines where quality management practices have been implemented based on the standards.	Operation control: Decrease in the excess of weight due to the process quality management. Variation in dollars between 2009 and 2010.	1 328 650	14 369 164	9,25%	1 328 650
	Extrusion	<ul style="list-style-type: none"> Provide the composite to the machines. Extrude the composite. Transform it into PVC piping, profiles, tiles, sheets, polyethylene piping, bells and bends. Identify, package and report the manufactured product. 								
	Injection	<ul style="list-style-type: none"> Supply the compound and other polymeric materials to the machines. Inject the compound and other polymeric materials Transform the compound in PVC fittings and semi-elaborated products for faucets. Identify, package and report the manufactured product. 								
	Recovered	<ul style="list-style-type: none"> Receipt, treatment and delivery of materials and weighing according to the specified conditions. 								
	Welding	<ul style="list-style-type: none"> Prepare the mix according to the reference to be manufactured. Supply the mix to the packaging unit determined by the program. Package the references requested. Identify, package and report the manufactured product. 								

Business function	Processes	Related activities	Value drivers	Standards used	Impact of the standards on the activities	Operational indicators	Indicator result (dollars)	Gross profit (dollars) 2010	% EBIT	Value in dollars
Marketing and sales	Marketing and sales	<ul style="list-style-type: none"> • Elaborate the execution proposal. • Execution of the marketing plan. <ul style="list-style-type: none"> • Contracting of suppliers. • Execution of the survey. 	Distribution channels Customer service	See Annex A	Higher sales: Sales are higher due to the customer trust in standardized products and services and standards enable access to more demanding markets (construction companies, etc.).	Sales: Sales derived from contracts for which compliance to standards was not obligatory for contracting but was considered essential to gain the sale. (Including ISO 9001 specially).	33 267 042	14 369 164	47%	6 723 269
TOTAL									56,25%	8 051 919

8 CALCULATION OF THE ECONOMIC BENEFITS OF THE STANDARDS

8.1 Calculation of the indicator “operation control – overweight”

GERFOR’s production process indicators (consolidated every month), were taken as the basis for calculation. . Data analyzed correspond to the annual average of overweight in kilograms.

These values were multiplied by the average value of raw material for 2010 in order to get a standardized monetary value for comparison. The difference between 2009 and 2010 was then determined, observing cost savings due to the decrease of the overweight average value. A decrease that, according to the opinion of GERFOR’s experts, is attributable to operations improvement deriving from its quality management system based on ISO 9001.

This value was then expressed as percentage of the company’s EBIT.

8.2 Calculation of the sale indicator

The marketing and sales function of GERFOR identified for 2010 the total sales derived from contracts for which compliance to standards was not compulsory for contracting but was considered essential to win the sale (including, especially, ISO 9001 certification).

This value was then expressed as percentage of the EBIT.

The values in dollars are presented in the table below for 2008, 2009 and 2010.

Table 9 Sales distribution

SALE ANALYSIS	YEAR 2008	YEAR 2009	YEAR 2010
• Sale percentage derived from contracts for which compliance to product standards was compulsory	32.044.379	38.377.267	36.975.192
	45%	53%	53%
• Sale percentage derived from contracts for which the compliance to standards was not compulsory for contracting but was considered essential to win the sale	39.328.664	34.018.861	33.267.043
	55%	47%	47%
TOTAL SALES	71.373.043	72.396.128	70.242.234
	100%	100%	100%

Source: GERFOR

9 QUALITATIVE AND SEMI-QUANTITATIVE CONSIDERATIONS

Within the business functions of GERFOR's examples were found where the benefits derived from using standards were evidenced, but for which it was not possible to obtain the detailed data needed to perform the corresponding quantitative economic analysis. For this reason they are included as qualitative or semi-quantitative examples identified within the frame of the economic benefits of standards.

9.1 R&D / ENGINEERING

a) Design of new products - "piping for irrigation"

In 2009 a new product was designed and developed without the basis of an existing technical standard to be applied.

Design and development were quite complex and required several adjustments to solve problems related to sizes, elastomeric seals, and other aspects. After making progress in the project, problems were identified that had to be corrected. In a subsequent phase a technical standard was identified for this type of piping, whose initial application would have avoided several problems. Likewise, the design had also to be adjusted.

GERFOR experts estimate that without available technical standards the product design lasted **10** times more than the average time and the corresponding cost was **5** times higher, as explained below.

Normally, the cost of the design and development activities for new products is:

Table 10. Design costs

ITEM	DESCRIPTION	ANNUAL – PROJECT USD
1	Labor	300 000
2	Materials	150 000
	Total	450 000

Source: GERFOR

The average duration and the project composition, normally correspond to:

Table 11. Design times

ACTIVITIES	% total time	Duration
Average time of the project	100	120
Design and development of specifications	25	30

Source: GERFOR

In average 90 projects are performed per year.

If we use the basic figures outlined above (300 000 USD per year for labor and approximately 90 projects per year), this means that the average cost for monthly labor per project is **3 333 dollars**. A project requiring 10 times more work involves expenses of **33 333 dollars for labor** (and possibly higher cost also for equipment and services, but this was not determined).

Of course, a higher number of projects based on customized specifications would also have impact on the general ability of GERFOR related to projects under execution: **approximately 9 projects** comparable to the one considered before would be enough to saturate the resources of the unit (against 90 projects actually run).

b) Plastic tiles – waste

The development of improvement plans within the frame of the quality management system implemented based on ISO 9001 has allowed significant savings. A specific example was identified in the production process of plastic tiles (line of tile with profile type zinc), where a reduction of the waste rate from 15% to 3% was achieved thanks to redesign. This generated a production increase from 220 Kg/h to 440 Kg/h.

9.2 PROCUREMENT – INBOUND LOGISTICS / Conformity of raw material and inputs

GERFOR divides its purchases in two groups: raw materials and consumables. The former are those with higher volume and value and, in general, they have technical standards supporting procurement.

Consumables, on the contrary, are purchased in lower volumes and represent only 5% of the total cost of goods, and many of them do not have technical standard supporting procurement.

Through interviews it was determined that the time used to review consumables and raw materials is distributed as follows: 60% of the total review time is dedicated to consumables and 40% to raw materials.

The reasons why the verification of consumables requires more resources are:

- Product specifications are written starting with little or no information, so more time is needed for investigation.
- More time for interaction with suppliers is required (to clarify the requirements).
- Products need to be tested because general test protocols are missing.

This provides an idea of the labor associated savings when standard elements are ordered. In the next example provided by GERFOR, the times needed for inspection of PVC resin with and without technical standard are compared:

PVC resin inspection.

Using technical standard: the raw material inspector verifies the fulfillment of the requirements in the internal specification that has been created by using the applicable NTC and ISO technical standards, and by quality protocols or certificates sent by the supplier for each lot submitted.

Estimated time:

1. Comparison of the certificate with the specification: **15 minutes**

Without using technical standard: the raw material inspector removes a sample from each lot received and carries out the analysis that allows verifying the conformity of raw material.

Estimated time:

1. Analysis of the K value: **2 hours**
2. Analysis of volatile material: **1 hour and 30 minutes**
3. Apparent density: **30 minutes**

Total inspection time using technical standard: 15 minutes

Total inspection time without using technical standard: 4 hours

Labor cost for inspection using technical standard: US \$0.57

Labor cost for inspection without using technical standard: US \$ 9

Review of inputs and raw materials without standards generates a labor cost overrun.

9.3 PRODUCTION

a) Complaints due to defective products

Regarding the cost of complaints before the implementation of technical standards an example was found concerning the profiled piping under NTC 5070 where approximately US\$ 58 000 had to be paid due to quality problems, while the process was being standardized with the technical standard.

In relation to the production improvements by the implementation of corrective actions for complaints (NTC ISO 9001:2008), one example is a quality problem that required the payment of approximately US\$11 000; to date this has not occurred again.

b) Scrap

Based on the production indicators for 2009 and 2010 related to the scrap average percentage, it could be deduced that the results were practically the same from one period to another in spite of the increase in product lines. The results of the scrap indicators for each year are showed below:

Table 12 Scrap

	2009	2010	Variation
SCRAP	21,52 %	21,65 %	0,60 %

10 EVALUATION OF RESULTS

10.1 VALUE OF TECHNICAL STANDARDS FOR GERFOR,

As mentioned in section 3.1 of this report and as verified through the development of this study, technical standards are part of the company's daily activities and both processes and personnel rely on them. Standards are applied for daily work by most of GERFOR's business functions, including notably procurement, engineering, production, marketing and sales.

However, the strategic value of technical standards for GERFOR is concerns the continual improvement of operations and, above all, the essential contribution to sales and market access: compliance to standards is often essential to close deals and constitutes for GERFOR an element of competitive advantage.

10.2 KEY ASSUMPTIONS IN THE STUDY AND SOME UNCERTAINTIES IN RELATION TO THE QUANTIFICATION RESULTS

- There are no significant or dramatic changes in technology or production volumes for the period evaluated (three years).
- The whole behavior of the production indicators has been taken as an average of the values for the different process lines of GERFOR.

10.3 HOW TO FURTHER INCREASE THE IMPACT OF TECHNICAL STANDARDS IN GERFOR

- To consider technical standards applicable to other functions and activities of the company and not only those related to products, in order to further improve effectiveness and efficiency of some activities (for example: supply chain management, NTC-28000).
- To develop the financial indicators of the quality management using guidelines as those set in the standard NTC-ISO 10014:2006 Quality management -- Guidelines for realizing financial and economic benefits.
- To keep baseline measurements and costs against the implementation of the environmental management system and the occupational health and industrial safety management system.
- To integrate the quality, environmental and occupational health and safety management systems in order to unify measurements, costs and quantifications.
- To promote the implementation of standards, in particular those for quality management and supply chain management, by GERFOR's distributors as an element of qualification of the whole GERFOR's sales and customer service network. This could be particularly important to achieve a new element of competitive advantage

- To create models allowing analyzing cost and profits per product, product line, plant and GERFOR group in order to record, assess, infer and plan the economic impact of the standards implemented at each level.

10.4 RECOMMENDATIONS TO IMPROVE THE ISO METHODOLOGY

10.4.1 Work preparation

All those involved in the project development should attend a *practical workshop* to reach a deeper level in stages such as information collection. To understand matters as the potential types of impacts by each chain element is fundamental in order to guide the work.

Likewise, it is fundamental to present to the project leaders in the selected organizations the summarize methodology, its stages and objectives so that they can also organize and prepare their information and even guide the data collector in a better way.

10.4.2 Knowledge of the “Value Chain” model

The description on the methodology in relation to the value chain is not enough detailed to make easier the location of the organization’s activities, therefore it is recommended to supplement it at this level. Specifically, matters such as quality management and metrology, which are strongly impacted by the standards, are not easily found in the value chain, if the explanations of the methodology are considered. Likewise, the description could make reference to the identification of processes that generally the organizations already have as important sources of information in order to define this value chain.

As reference we suggest to consider explanations such as those presented in the book “Competitive Advantage” by Michael Porter, which we present in annex C. The intention is to make easier the interpretation and application of the methodology to the particularities of all possible types of organizations.

10.4.3 Selection of the organization

Although the methodology allows determining the economic benefit of standards, this will be easier to apply if in the selected organization there is a strong measurement culture that, preferable, includes the management of activity price setting. Therefore, it is important to make this clarification for the application of the methodology so that it is assured in the company.

10.4.4 Information to be provided by and to the organization (previously)

The methodology needs to include also basic information to be provided to the organization, with a prior study that shows at first hand which is the basic information that will be required in order to make easier its collection or early preparation. Besides, if

possible, it should include a list of the minimum information to be sent previously and that shall be ready for the interview stage.

Likewise, in coordinating the interviews it is advisable to send previously some data that is useful to have available in order for the interviewees to have the higher amount of information, collected in-situ, and to make clear immediately the doubts regarding it, if necessary.

The following topics should be taken into account regarding the information to be previously required:

a) Organization

- Organizational profile
- Description of its activities and processes
- Main suppliers and raw materials purchased.

b) Technical standards

- Main standards applied to each activity or processes

c) Management indicators:

- Minimum age of five years (*taking into account that the analysis is done for a minimum period of the last three years in order to be able to identify the variability*).
- Trends of the management indicators for the main activities, easily available for consultation (if possible, data before and after the adoption of technical standards).
- Quantification of complaints and main causes.

d) Financial data

- EBIT for the last five years
- Procurement of raw materials
- Operational incomes discriminated by each type of product or service.
- Annual results of financial indicators (if any)
- Activity price setting (if any)

Regarding the organization's information for the interview stage an interview plan and the following previous recommendation should be provided:

a) About the personnel to be interviewed.

- Request that their time in the company be three years at least.
- The interviewees should include those responsible for or leaders of the activities or processes, with knowledge on the strategic approach of the company.

b) About the information to be consulted:

- The results of the management indicators of the area, activity or process should be available, as possible.

- To invite an officer from the financial area that provides support in quantification matters and those responsible for the processes.
- To collect previously cases related to the company's evolution (if possible failure or success cases where standards have been a key factor).
- Activity price setting (if any)

10.4.5 Consideration on the quantification of the standards benefit

Where significant organizational changes occur between one analysis period and another such as unification, closing or opening of plants, substantial technological changes, etc., it is not possible to compare among periods and valuable information is lost. Mechanisms to analyze these cases should be considered.

The methodology should present information related to the treatment of cases that could be identified in relation to negative economic benefits.

In cases where cost overruns are generated due to the standard use, which are already identified and controlled by the organizations, it is not possible to assign these values as EBIT percentage and shall be simply reported as semi-quantitative cases losing some times their relevance.

10.4.6 Report

The circulated report should include the impact map of the standards and their prioritization since this stage is fundamental to show the direct relation between the impact and the standards.

10.4.7 Language

In order to make easier the understanding and application of the methodology it is advisable that, besides the official languages, ISO considers the translation of the final adjusted version and its application tools into other languages (as Spanish, Arab, etc) of significant use in developing countries, where the need to create awareness about the importance of standards is pressing.

10.4.8 Statistical information

Due to the particular and specific nature of the study, another point of view considers that this should be seen as a medium and long term exercise constituted by a stage for capturing the appropriate information followed by a stage for processing and analyzing that information that allow recording from the implementation of a new standard to its real relation with the economic benefit for the company. This because we observe that the exercise shall make several inferences under supposed scenarios, which generates that the results spectrum is wide.

10.5 NEXT STEPS IN THE APPLICATION OF THE ISO METHODOLOGY

The next step in the application of the methodology, in the case of Colombia, will be its application to a service company in the tourism sector, which has quality mark and quality management system.

Finally, this methodology and experience should be the basis to develop a standard addressed to the organizations about the guidelines to measure the economic benefit of the standards, or the updating of the standard NTC-ISO 10014:2006 Quality management -- Guidelines for realizing financial and economic benefits.

11. CONCLUSIONS

11.1 GENERAL CONCLUSIONS

- Through the development of this study it was verified that the technical standards are part of the company's daily activities and both processes and personnel rely on them. Standards are applied for daily work by most of GERFOR's business functions, including notably procurement, engineering, production, marketing and sales.
- However, the strategic value of technical standards for GERFOR is concerns the **continual improvement of operations** and, above all, **the essential contribution to sales and market access**: compliance to standards is often essential to close deals and constitutes for GERFOR an element of competitive advantage.
- Specifically, it was determined that the economic contribution of the standards on the EBIT corresponds to a percentage of 56,25% equivalent to US \$ 8 051 919 for 2010 – this also represent 7,7% of the total company's turnover
- Additionally, in processes as product design and development, non-availability of standards at the beginning of the process may generate cost overheads of 5 times the average cost of the activity, and an increase in time up to 10 times. Similarly, in the activities related to the inspection of raw materials and consumables it is identified that time used to verify non-standardized products is about 60% of the total time, just due to the lack of standards.
- Taking into account that GERFOR has been applying standards since its origin, it is difficult to establish a baseline without standards against which to measure and identify the benefits, if any, due to the technical standards.
- Significant impacts of the technical standards were determined in some activities of GERFOR that correspond to specific cases, which, in general, are not valued by the organizations. Therefore, this information was only reported at qualitative or semi-quantitative level.

11.2 KEY RECOMMENDATIONS FORT HE NEXT STEPS IN USING THE METHODOLOGY

- It is fundamental to present to the project leaders in the selected organizations the detailed methodology, its stages and objectives so that they can also organize and prepare their information and even guide the data collector in a better way.
- The description of the methodology regarding the value chain may be supplemented to make easier the location of the organization's activities.

- The methodology needs to include also basic information to be provided to the organization, with a prior study that shows at first hand which is the basic information that will be required in order to make easier the information collection or early preparation. Besides, if possible, it should include a list of the minimum information to be sent previously and that shall be ready for the interview stage. Likewise, in coordinating the interviews it is advisable to send previously the questionnaire in order for the interviewees to have the higher amount of information, collected in-situ, and to make clear immediately the doubts regarding it, if necessary.
- The methodology should include how to consider and analyze data among periods in which significant organizational changes occur.
- The report should include the impact map of the standards and their prioritization since this stage is fundamental to show the direct relation between the impact and the standards.
- In order to make easier the understanding and application of the methodology it is advisable that, besides the official languages, ISO considers the translation of the final adjusted version and its application tools into other languages (as Spanish, Arab, etc) of significant use in developing countries, where the need to create awareness about the importance of standards is pressing.
- Even though the methodology allows determining the economic benefits of the standards, it only will be useful if in the organizations there is a strong measurement culture.
- This methodology and experience should be the basis to develop a standard addressed to the organizations about the guidelines to measure the economic benefit of the standards (regardless it is on management, product, testing), similar to the standard NTC-ISO 10014:2006 Quality management -- Guidelines for realizing financial and economic benefits.
- The methodology starts from the premise that the application of standards generates a positive economic benefit, which is not necessarily true. In many cases it is more economical to produce without quality than with quality. The methodology should present information related to the treatment of these cases that could be identified.
- In cases where cost overruns are generated due to the standard use, which are already identified and controlled by the organizations, it is not possible to assign these values as EBIT percentage and shall be simply reported as semi-quantitative cases losing some times their relevance.
- The team work constituted in the selected organization should include a representative of the financial area who supports the data collection and interpretation.

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ANNEX A

USE OF STANDARDS IN GERFOR'S PROCESS

Business Function	Process	Code of the standard		Title
DIRECTION AND ADMINISTRATION	MANAGEMENT	NTC ISO	9001	QUALITY MANAGEMENT SYSTEMS. REQUIREMENTS.
	PLANNING AND IMPROVEMENT	NTC ISO	9001	QUALITY MANAGEMENT SYSTEMS. REQUIREMENTS.
	INTERNAL AUDITS	NTC ISO	9001	QUALITY MANAGEMENT SYSTEMS. REQUIREMENTS.
		NTC ISO IEC	17025	GENERAL REQUIREMENTS FORT HE COMPETENCE OF TESTING AND CALIBRATION LABORATORIES.
		NTC	19011	GUIDELINES FOR QUALITY AND/OR ENVIRONMENTAL MANAGEMENT SYSTEMS AUDITING
	LOGISTICS: CUSTOMER SERVICE	NTC ISO	9001	QUALITY MANAGEMENT SYSTEMS. REQUIREMENTS.
R&D / ENGINEERING	RESEARCH AND DEVELOPMENT	NTC ISO	9001	QUALITY MANAGEMENT SYSTEMS. REQUIREMENTS.
		NTC	382	PLASTIC. POLY (VINYL CHLORIDE) (PVC) PRESSURE RATED PIPES (SDR SERIES).
		NTC	576	SOLVENT CEMENT FOR POLY (VINYL CHLORIDE) (PVC) PLASTIC PIPING SYSTEMS.
		NTC	979	PLASTICS. UNPLASTICIZED POLY (VINYL CHLORIDE) (PVC-U) PIPES AND BENDS FOR CONDUITS HOUSING AND PROTECTING.
		NTC	1062	CHLORINATED POLY (VINYL CHLORIDE) (CPVC), PLASTIC HOT AND COLD-WATER DISTRIBUTION SYSTEMS.
R&D / ENGINEERING	RESEARCH AND DEVELOPMENT	NTC	1087	POLY (VINYL CHLORIDE) (PVC) WASTE AND VENT PIPE.
		NTC	1088	PLASTICS. RIGID PVC CORRUGATED SHEETING.
		NTC	1339	PIPE FITTINGS OF POLY (VINYL CHLORIDE) (PVC) SCHEDULE 40.

Business Function	Process	Code of the standard		Title
		NTC	1341	POLY (VINYL CHLORIDE) (PVC) WASTE AND VENT FITTINGS.
		NTC	1630	POLY (VINYL CHLORIDE) (PVC) PIPES AND ELBOWS TO LODGE AND PROTECT UNDERGROUND ELECTRIC AND TELEPHONIC CONDUCTORS.
		NTC	2295	JOINTS FOR PLASTIC PRESSURE PIPES USING FLEXIBLE ELASTOMERIC SEALS.
		NTC	3317	PLASTICS. POLY (VINYL CHLORIDE) (PVC) PIPES FOR IRRIGATION SYSTEMS.
		NTC	3363	PLASTICS. RIGID AND CORRUGATED POLY (VINYL CHLORIDE) (PVC) PIPES AND ELBOWS, HAVING SMOOTH INNER WALL, FOR ENCLOSE AND PROTECT UNDERGROUND ELECTRICAL AND TELEPHONE WIRES.
		NTC	160	CIVIL ENGINEERING AND ARCHITECTURE. ASBESTOS-CEMENT CORRUGATED SHEETS FOR COVERING AND SHEETING.
		NTC	369	PLASTICS. RIGID POLY (VINYL CHLORIDE) (PVC) COMPOUNDS AND CHLORINATED POLY (VINYL CHLORIDE) (CPVC) COMPOUNDS
R&D / ENGINEERING	RESEARCH AND DEVELOPMENT	NTC	865	METAL CONTAINERS WITH GAUGE SHEET 0,37 mm AND LESS.
		NTC	920	VITREOUS CHINA PLUMBING FIXTURES.
		NTC	1000	METROLOGY. INTERNATIONAL SYSTEM OF UNITS
		NTC	1500	COLOMBIAN PIPEWORK CODE.
		NTC	1622	CHEMICAL PRODUCTS. SODIUM SILICATE FOR INDUSTRIAL PURPOSES.
		NTC	1644	PLUMBING SUPPLY FITTINGS.
		NTC	1748	PLASTICS. POLY (VINYL CHLORIDE) (PVC) SEWER PIPES AND FITTINGS (PIPES TYPE PSM, PIPE OF LARGE DIAMETERS AND FITTINGS).
		NTC	1762	SPECIFICATION FOR COPPER ALLOY GLOBE, GLOBE STOP AND CHECK, CHECK AND GATE VALVES.
		NTC	1831	TECHNICAL DRAWINGS -GEOMETRICAL TOLERANCE -TOLERANCE OF FORM, ORIENTATION, LOCATION AND RUN-OUT. GENERALITIES, DEFINITIONS, SYMBOLS, INDICATIONS ON DRAWINGS.
		NTC	1901	STANDARD SPECIFICATION FOR FLOAT VALVES.

Business Function	Process	Code of the standard		Title
		NTC	1908	MANUALLY OPERATED GAS VALVES FOR APPLIANCES, APPLIANCES CONNECTOR VALVES AND HOSE END VALVES.
		NTC	1991	MECHANICS. FLOATS FOR VALVE-OPERATING.
		NTC	4843	MECHANICS. FLOATS FOR VALVE-OPERATING.
R&D / ENGINEER ING	RESEARCH AND DEVELOPMENT	NTC	3363	PLASTICS. RIGID AND CORRUGATED POLY (VINYL CHLORIDE) (PVC) PIPES AND ELBOWS, HAVING SMOOTH INNER WALL, FOR ENCLOSE AND PROTECT UNDERGROUND ELECTRICAL AND TELEPHONE WIRES.
		NTC	4393	METHOD FOR ESTIMATING THE QUALITY OF EXTRUDED POLY (VINYL CHLORIDE) (PVC) PIPE BY THE HEAT REVERSION TECHNIQUE.
		NTC	2536	ELASTOMERIC SEALS (GASKETS) FOR JOINING PLASTIC PIPE.
		NTC	2534	JOINTS FOR DRAIN AND SEWER PLASTIC PIPES USING FLEXIBLE ELASTOMERIC SEALS.
		NTC	2635	CHEMICAL PRODUCTS FOR INDUSTRIAL USE. SEALING COMPOUNDS FOR JOINT PIPES AND ACCESSORIES FOR NATURAL GAS AND LIQUEFIED PETROLEUM GAS.
		NTC	2728	DIAPHRAGM GAS METERS.
		NTC	2826	MECHANICAL DEVICES. GENERAL PROVISIONS FOR GAS VOLUME METERS.
		NTC	3384	MECHANICAL THERMOSTATS FOR GAS-BURNING APPLIANCES.
		NTC	3527	TEST GASES, TEST PRESSURES AND GAS APPLIANCES CATEGORIES.
		NTC	3538	MECHANICAL DEVICES. MANUALLY OPERATED GAS METALLIC VALVES FOR USE IN GAS PIPING, GAS HAVING WORKING GAGE PRESSURE FROM 6,8 kPa (1 psi) TO 861 kPa (125 psi).
R&D / ENGINEER ING	RESEARCH AND DEVELOPMENT	NTC	3628	PERFORMANCE REQUIREMENTS FOR ANTI-SIPHON FILL VALVES FOR WATER CLOSET TANKS.
		NTC	3694	PLASTICS. POLYETHYLENE -PE- PLASTIC TUBING.

Business Function	Process	Code of the standard		Title
		NTC	3722-2	STRUCTURED WALL PIPING AND FITTINGS FOR NON-PRESSURE UNDERGROUND DRAINAGE AND SEWERAGE PART 2: INCH-BASED SERIES.
		NTC	3740	MANUALLY OPERATED METALLIC GAS VALVES, FOR USE IN PIPING SYSTEM UP TO 0,069 BAR -1 psi.
		NTC	3827	PLASTICS. TAPER PIPE THREADS 60Ø FOR THERMOPLASTIC PIPE AND FITTINGS.
		NTC	4404	POLY (VINYL CHLORIDE) (PVC) PLASTICS PIPE FITTINGS, SCHEDULE 80.
		NTC	4585	POLYETHYLENE PIPES FOR WATER SUPPLY - SPECIFICATIONS. METRIC SERIES.
		NTC	4694	FIBER-CEMENT CORRUGATED SHEETS FOR COVERING AND SHEETING.
		NTC	4764	PIPE AND FITTINGS OF POLY (VINYL CHLORIDE) OF PROFILE OPENED WITH OR WITHOUT REINFORCEMENT FOR SEWAGE SYSTEM.
		NTC	4846	PLASTIC TOILET -WATER CLOSET- SEATS.
		NTC	4897-1	PLASTICS PIPING SYSTEMS FOR HOT AND COLD WATER. POLYPROPYLENE (PP) PART 1. GENERAL.
		NTC	4897-2	PLASTICS PIPING SYSTEMS FOR HOT AND COLD WATER. POLYPROPYLENE (PP). PART 2. PIPES.
		NTC	4897-3	PLASTICS PIPING SYSTEMS FOR HOT AND COLD WATER. POLYPROPYLENE (PP) PART 3. FITTINGS.
R&D / ENGINEERING	RESEARCH AND DEVELOPMENT	NTC	4897-5	PLASTIC PIPING SYSTEMS FOR HOT AND COLD WATER. POLYPROPYLENE (PP). PART 5. FITNESS FOR PURPOSE OF THE SYSTEM.
		NTC	4897-7	PLASTICS PIPING SYSTEMS FOR HOT AND COLD WATER. POLYPROPYLENE (PP). PART 7: CONFORMITY ASSESSMENT.
		NTC	5008	STANDARD SPECIFICATION FOR ELECTRODEPOSITED COATINGS OF COPPER PLUS NICKEL PLUS CHROMIUM AND NICKEL PLUS CHROMIUM.
		NTC	5070	POLY (VINYL CHLORIDE) (PVC) CLOSED PROFILE GRAVITY PIPE AND FITTING BASED ON CONTROLLED INSIDE DIAMETER.
		NTC	5416	AUTOMATIC COMPENSATING VALVES FOR INDIVIDUAL SHOWERS AND TUB/SHOWER COMBINATIONS.
		NTC	5441	FLEXIBLE UNDER PRESSURE WATER CONNECTORS.

Business Function	Process	Code of the standard		Title
		NTC	5456	TRIM FOR WATER-CLOSET BOWLS, TANKS, AND URINALS.
		NTC	5609	THERMOPLASTIC ACCESSIBLE AND REPLACEABLE PLASTIC TUBE AND TUBULAR FITTINGS.
		ASTM D	1414	STANDARD TEST METHODS FOR RUBBER O-RINGS
		ASTM D	1415	STANDARD TEST METHOD FOR RUBBER PROPERTY-INTERNATIONAL HARDNESS.
		ASTM D	1785	STANDARD SPECIFICATION FOR POLY (VINYL CHLORIDE) (PVC) PLASTIC PIPE, SCHEDULES 40,80, AND 120.
		ASTM D	2235	STANDARD SPECIFICATION FOR SOLVENT CEMENT FOR ACRYLONITRILE-BUTADIENE-STYRENE (ABS) PLASTIC PIPE AND FITTINGS.
		ASTM D	2240	STANDARD TEST METHOD FOR RUBBER PROPERTY-DUROMETER HARDNESS.
R&D / ENGINEERING	RESEARCH AND DEVELOPMENT	ASTM D	2241	STANDARD SPECIFICATION FOR POLY(VINYL CHLORIDE) (PVC) PRESSURE-RATED PIPE (SDR SERIES)
		ASTM D	2444	STANDARD TEST METHOD FOR DETERMINATION OF THE IMPACT RESISTANCE OF THERMOPLASTIC PIPE AND FITTINGS BY MEANS OF A TUP (FALLING WEIGHT)
		ASTM D	2466	STANDARD SPECIFICATION FOR POLY(VINYL CHLORIDE) (PVC) PLASTIC FITTINGS, SCHEDULE 40
		ASTM D	2565	STANDARD PRACTICE FOR XENON-ARC EXPOSURE OF PLASTICS INTENDED FOR OUTDOOR APPLICATIONS.
		ASTM D	2665	STANDARD SPECIFICATION FOR POLY (VINYL CHLORIDE) (PVC) PLASTIC DRAIN, WASTE, AND VENT PIPE AND FITTINGS.
		ASTM D	2683	STANDARD SPECIFICATION FOR SOCKET-TYPE POLYETHYLENE FITTINGS FOR OUTSIDE DIAMETER CONTROLLED POLYETHYLENE PIPE AND TUBING.
		ASTM D	2737	STANDARD SPECIFICATION FOR POLYETHYLENE (PE) PLASTIC TUBING.
		ASTM D	2846	STANDARD SPECIFICATION FOR CHLORINATED POLY (VINYL CHLORIDE) (CPVC) PLASTIC HOT-AND COLD-WATER DISTRIBUTION SYSTEMS.

Business Function	Process	Code of the standard		Title
		ASTM D	2949	STANDARD SPECIFICATION FOR 3.25-IN. OUTSIDE DIAMETER POLY(VINYL CHLORIDE) (PVC) PLASTIC DRAIN, WASTE, AND VENT PIPE AND FITTINGS
		ASTM D	3311	STANDARD SPECIFICATION FOR DRAIN, WASTE, AND VENT (DWV) PLASTIC FITTINGS PATTERNS
		ASTM F	477	STANDARD SPECIFICATION FOR ELASTOMERIC SEALS (GASKETS) FOR JOINING PLASTIC PIPE.
R&D / ENGINEERING	RESEARCH AND DEVELOPMENT	ASTM F	794	STANDARD SPECIFICATION FOR POLY(VINYL CHLORIDE) (PVC) PROFILE GRAVITY SEWER PIPE AND FITTINGS BASED ON CONTROLLED INSIDE DIAMETER
		ASTM F	1498	STANDARD SPECIFICATION FOR TAPER PIPE THREADS 60° FOR THERMOPLASTIC PIPE AND FITTINGS
		ASTM F	1803	STANDARD SPECIFICATION FOR POLY (VINYL CHLORIDE) (PVC) CLOSED PROFILE GRAVITY PIPE AND FITTINGS BASED ON CONTROLLED INSIDE DIAMETER.
		BS	21	BRITISH STANDARD SPECIFICATION FOR PIPE THREADS FOR TUBES AND FITTINGS WHERE PRESSURE-TIGHT JOINTS ARE MADE ON THE THREADS (METRIC DIMENSIONS).
		BS	4203-1	EXTRUDED RIGID PVC CORRUGATED SHEETING
		BS	4203-2	EXTRUDED RIGID PVC CORRUGATED SHEETING
		ISO	161-1	THERMOPLASTICS PIPES FOR THE CONVEYANCE OF FLUIDS- NOMINAL OUTSIDE DIAMETERS AND NOMINAL PRESSURES
		ISO	228-1	PIPE THREADS WHERE PRESSURE-TIGHT JOINTS ARE NOT MADE ON THE THREADS.
		ISO	265-1	PIPES AND FITTINGS OF PLASTICS MATERIALS-FITTINGS FOR DOMESTIC AND INDUSTRIAL WASTE PIPES-BASIC DIMENSIONS: METRIC SERIES
		ISO	580	PLASTICS PIPING AND DUCTING SYSTEMS-INJECTION-MOULDED THERMOPLASTICS FITTINGS- METHODS FOR VISUALLY ASSESSING THE EFFECTS OF HEATING
R&D /	RESEARCH AND	ISO	727-1	FITTINGS MADE FROM UNPLASTICIZED POLY(VINYL CHLORIDE) (PVC-U)

Business Function	Process	Code of the standard		Title
ENGINEERING	DEVELOPMENT			CHLORINATED POLY VINYL CHLORIDE (PVC-C) OR ACRYLONITRILE/BUTADIENE/STYRENE (ABS) WITH PLAIN SOCKETS FOR PIPES UNDER PRESSURE
		ISO	3302-1	RUBBER- TOLERANCES FOR PRODUCTS PART 1: DIMENSIONAL TOLERANCES.
		ISO	3633	PLASTICS PIPING SYSTEMS FOR SOIL AND WASTE DISCHARGE (LOW AND HIGH TEMPERATURE) PARTE 2
		ISO	4422-1	PIPES AND FITTINGS MADE OF UNPLASTICIZED POLY (VINYL CHLORIDE) (PVC-U) FOR WATER SUPPLY - SPECIFICATIONS
		ISO	4422-2	PIPES AND FITTINGS MADE OF UNPLASTICIZED POLY (VINYL CHLORIDE) (PVC-U) FOR WATER
		ISO	4422-3	PIPES AND FITTINGS MADE OF UNPLASTICIZED POLY (VINYL CHLORIDE) (PVC-U) FOR WATER
		ISO	11922-1	THERMOPLASTICS PIPES FOR THE CONVEYANCE OF FLUIDS - DIMENSIONS AND TOLERANCES.
		ISO	21138-1	PLASTICS PIPING SYSTEMS FOR NON-PRESSURE UNDERGROUND DRAINAGE AND SEWERAGE - STRUCTURED - WALL PIPING SYSTEMS OF UNPLASTICIZED POLY(VINYL CHLORIDE)(PVC-U), POLYPROPYLENE (PP) AND POLYETHYLENE (PE) PART: 1.
R&D / ENGINEERING	RESEARCH AND DEVELOPMENT	ISO	21138-2	PLASTICS PIPING SYSTEMS FOR NON-PRESSURE UNDERGROUND DRAINAGE AND SEWERAGE - STRUCTURED - WALL PIPING SYSTEMS OF UNPLASTICIZED POLY(VINYL CHLORIDE)(PVC-U), POLYPROPYLENE (PP) AND POLYETHYLENE (PE) PART: 2.
		ISO	21138-3	PLASTICS PIPING SYSTEMS FOR NON-PRESSURE UNDERGROUND DRAINAGE AND SEWERAGE - STRUCTURED - WALL PIPING SYSTEMS OF UNPLASTICIZED POLY(VINYL CHLORIDE)(PVC-U), POLYPROPYLENE (PP) AND POLYETHYLENE (PE) PART: 3
		ASME	A 112.18.1	PLUMBING SUPPLY FITTINGS.
		ASME	A 112.18.6	FLEXIBLE WATER CONNECTORS

Business Function	Process	Code of the standard		Title
		ASME	A 112.19.2	VITREOUS CHINA PLUMBING FIXTURES AND HYDRAULIC REQUIREMENTS FOR WATER CLOSETS AND URINALS
		ASME/ ANSI	B1.8	STUB ACME SCREW THREADS
		ANSI/ ASME	B1.20.1	PIPE THREADS, GENERAL PURPOSE (INCH)
		ASME	B16.44	MANUALLY OPERATED METALLIC GAS VALVES FOR USE IN ABOVEGROUND PIPING SYSTEMS UP TO 5 PSI.
		DIN	16961-1	THERMOPLASTICS PIPES AND FITTINGS WITH PROFILED OUTER AND SMOOTH INNER SURFACES.
		DIN	16961-2	THERMOPLASTICS PIPES AND FITTINGS WITH PROFILED OUTER AND SMOOTH INNER SURFACES
		DIN	2999	PIPE THREADS FOR TUBES AND FITTINGS
		DIN	4060	PIPE JOINT ASSEMBLIES WITH ELASTOMERIC SEALS FOR USE IN DRAINS AND SEWERS
		DIN	8061	UNPLASTICIZED POLYVINYL CHLORIDE PIPES.
		DIN	53715	DETERMINATION OF WATER CONTENT OF PLASTICS BY THE KARL FISCHER METHOD.
		UNE-EN- ISO	8256	PLASTICS. DETERMINATION OF TENSILE- IMPACT STRENGTH.
R&D / ENGINEER	RESEARCH AND DEVELOPMENT	UNE-EN- ISO	12061	PLASTIC MATERIAL CHANNEL SYSTEMS. THERMOPLASTIC FITTINGS. IMPACT STRENGTH TEST METHOD.

Business Function	Process	Code of the standard		Title
ING		UNE-EN-ISO	527-1	PLASTICS. DETERMINATION OF TENSILE PROPERTIES. PART 1: GENERAL PRINCIPLES.
		UNE-EN-ISO	527-2	PLASTICS. DETERMINATION OF TENSILE PROPERTIES. PART 12: TESTING CONDITIONS FOR PLASTICS USED IN MOULDING AND EXTRUSION.
		UNE-EN-ISO	61386-1	PIPE SYSTEMS FOR CABLE CONDUCTION- PART 1: GENERAL REQUIREMENTS.
		UNE-EN-ISO	61386-23	PIPE SYSTEMS FOR CABLE CONDUCTION- PART 23 SPECIFIC REQUIREMENTS – FLEXIBLE PIPES SYSTEMS.
		DIN	49018-1	CONDUITS AND FITTINGS FOR ELECTRICAL INSTALLATION; FLEXIBLE CORRUGATED AND NON-FLAMMABLE CONDUITS OF INSULATING MATERIAL AND COUPLERS FOR MEDIUM AND LIGHT PRESSURE LOADS.
		DIN	49018-2	CONDUITS AND FITTINGS FOR ELECTRICAL INSTALLATION; FLEXIBLE CORRUGATED AND NON-FLAMMABLE CONDUITS OF INSULATING MATERIAL WITH PLAIN MANTLE FOR HEAVY PRESSURE LOADS.
		AASHTO	M304-03	POLY (VINYL CHLORIDE) (PVC) PROFILE WALL DRAIN PIPE AND FITTINGS BASED ON CONTROLLED INSIDE DIAMETER
		UL	1660	LIQUID-TIGHT FLEXIBLE NON-METALLIC CONDUIT
		NCH	397	THERMOPLASTIC PIPES FOR FLUID CONDUCTION – EXTERNAL DIAMETERS AND RATE PRESSURES.
		NCH	700	WATER – HOUSE FAUCETS AND VALVES – REQUIREMENTS.
R&D / ENGINEERING	RESEARCH AND DEVELOPMENT	NCH	731	WATER – HOUSEHOLD FAUCETS AND VALVES – SPECIFICATIONS.
		NCH	769	PLASTICS – DETERMINATION OF WATER ABSORPTION AND WATER SOLUBLE RAW MATERIALS.
		NCH	815	RIGID POLY (VINYL CHLORIDE) (PVC) PIPES – TEST METHODS.

Business Function	Process	Code of the standard		Title
		NCH	1294	PLASTIC PIPES – DIMENSIONS MEASUREMENT.
		NCH	1635	RIGID POLY (VINYL CHLORIDE) (PVC) PIPES FOR DOMICILE SEWERAGE SANITARY INSTALLATIONS.
		NCH	1649	PLASTIC PIPES – DETERMINATION OF LONGITUDINAL HEAT SHRINKAGE.
		NCH	1721	JOINTS AND FITTINGS FOR RIGID POLY (VINYL CHLORIDE) (PVC) PIPES FOR PRESSURE FLUID CONDUCTION.
		NCH	1753	PLASTIC MATERIAL MOULDED FITTINGS TO USE UNDER PRESSURE – STRESS RELIEVE TEST.
		NCH	1779	JOINTS AND FITTINGS FOR RIGID PVC PIPES FOR HOUSE SEWERAGE SANITARY INSTALLATIONS.
		NCH	1787	RIGID POLY (VINYL CHLORIDE) (PVC) PIPES AND FITTINGS – JOINT WATER TIGHTNESS TEST.
		NCH	1788	RIGID POLY (VINYL CHLORIDE) (PVC) PIPES AND FITTINGS – TEMPERATURE REQUIREMENTS TEST.
		NCH	1799	RIGID POLY (VINYL CHLORIDE) (PVC) PIPES AND FITTINGS – IMPACT TEST WITH SPECIMEN.
		NCH	1997	PLASTIC PRODUCTS - MARKING
		NCH	2015	SELF- EXTINGUISHING PLASTIC FLEXIBLE PIPES FOR ELECTRIC RACEWAYS.
		NCH	2018-1	PIPES FOR ELECTRIC INSTALLATIONS – PART 1: GENERAL REQUIREMENTS.
		R&D / ENGINEERING	RESEARCH AND DEVELOPMENT	NCH
NEMA TC	9			FITTINGS FOR PVC PLASTIC UTILITIES DUCT FOR UNDERGROUND INSTALLATION
COVENIN	518-1			POLY (VINYL CHLORIDE) (PVC) – PIPES FOR UNDER PRESSURE WATER CONDUCTION. PART 1: METRIC SERIES.

Business Function	Process	Code of the standard		Title
		COVENIN	518-2	POLY (VINYL CHLORIDE) (PVC) – PIPES FOR UNDER PRESSURE WATER CONDUCTION. PART 2: IMPERIAL SERIES.
		COVENIN	848	RIGID POLY (VINYL CHLORIDE) (PVC) CONNECTIONS FOR PRESSURE INSTALLATIONS.
		COVENIN	2041	HIGH DENSITY POLYETHYLENE (HDPE) CONNECTIONS.
		COVENIN	1978	RIGID POLY (VINYL CHLORIDE) (PVC) – DETERMINATION OF HEAT STRENGTH.
		COVENIN	3641-1	RIGID POLY (VINYL CHLORIDE) (PVC-U) EB AND DB PIPES FOR ELECTRIC AND COMMUNICATION CABLES. REQUIREMENTS. PART 1: SERIES BASED ON METRIC UNIT SYSTEM.
		COVENIN	3641-2	RIGID POLY (VINYL CHLORIDE) (PVC-U) EB AND DB PIPES FOR ELECTRIC AND COMMUNICATION CABLES. REQUIREMENTS. PART 2: IMPERIAL UNITS.
		COVENIN	3642-1	RIGID POLY (VINYL CHLORIDE) (PVC-U) EB AND DB PIPES CONNECTIONS FOR ELECTRIC AND COMMUNICATION CABLES. REQUIREMENTS. PART 1: SERIES BASED ON METRIC UNIT SYSTEM.
R&D / ENGINEERING	RESEARCH AND DEVELOPMENT	COVENIN	3642-2	RIGID POLY (VINYL CHLORIDE) (PVC-U) EB AND DB PIPES CONNECTIONS FOR ELECTRIC AND COMMUNICATION CABLES. REQUIREMENTS. PART 2: IMPERIAL UNITS
		INEN	1328	PLASTIC PIPING – RIGID PVC FITTINGS FOR PRESSURE – BASIC DIMENSIONS.
		INEN	1329	PLASTIC PIPING – RIGID PVC FITTINGS FOR SANITARY USE BASIC DIMENSIONS.
		INEN	1373	PLASTIC PIPING – RIGID PVC PRESSURE PIPING.
		INEN	1374	PLASTIC PIPING – RIGID PVC PIPING FOR SANITARY USE IN GRAVITY SYSTEMS.
		NTP	399.006	POLY (VINYL CHLORIDE) (PVC) SMOOTH WALL PIPES FOR RACEWAYS INSTALLATION – REQUIREMENTS.
		NTP	399.002	POLY (VINYL CHLORIDE) UNPLASTICIZED (PVC-U) PIPES FOR CONDUCTION OF FLUIDS UNDER PRESSURE – REQUIREMENTS AND TEST METHODS.
NTP	399.003	POLY (VINYL CHLORIDE) UNPLASTICIZED PIPES (PVC-U) FOR DRAINAGE HOUSE INSTALLATIONS. REQUIREMENTS AND TEST METHODS.		

Business Function	Process	Code of the standard		Title
		NTP	399.007	POLY (VINYL CHLORIDE) UNPLASTICIZED (PVC-U) SMOOTH WALL PIPES FOR ELECTRIC RACEWAYS INSTALLATION. TEST METHODS.
		NTP	399.019	POLY (VINYL CHLORIDE) UNPLASTICIZED (PVC-U) CONNECTIONS FOR PRESSURE FLUID CONDUCTION MANUFACTURED BY INJECTION.
R&D / ENGINEERING	RESEARCH AND DEVELOPMENT	NTP	399.086	PVC DUCTS AND FITTINGS FOR TELECOMMUNICATION INSTALLATIONS.
		NTP	399.162-1	THERMOPLASTIC PIPES AND CONNECTIONS WITH SHAPED EXTERNAL SURFACE AND SMOOTH INTERIOR. DIMENSIONS.
		NTP	399.162-2	THERMOPLASTIC PIPES AND CONNECTIONS WITH SHAPED EXTERNAL SURFACE AND SMOOTH INTERIOR. DELIVERY TECHNICAL CONDITIONS.
		NTP	399.166	POLY (VINYL CHLORIDE) UNPLASTICIZED (PVC-U) PIPES FOR PRESSURE FLUID CONDUCTION WITH THREADED JOINT. REQUIREMENTS.
		NTP	399.168	POLY (VINYL CHLORIDE) (PVC) PIPES AND CONNECTIONS SERIES 10, MANUFACTURED WITH CLOSED PROFILE FOR SEWERAGE USE CONTROLLED BY THE INNER DIAMETER.
		NTP	399.090	SOLVENT CEMENT FOR POLY (VINYL CHLORIDE) UNPLASTICIZED (PVC-U) PIPES AND CONNECTIONS.
		NTP	399.163	PLASTIC PIPING SYSTEM FOR NON-PRESSURED UNDERGROUND DRAINAGE AND SEWERAGE.
		ITINTEC	399.072	CHLORINATED POLY (VINYL CHLORIDE) (CPVC) PIPES, FITTINGS, CEMENTS AND ADHESIVES FOR HOT WATER.
		ITINTEC	311.229	DETERMINATION OF PLASTIC STRENGTH TO CHEMICAL REAGENTS.
PROCUREMENT	PROCUREMENT AND SUPPLIERS	NTC ISO	9001	QUALITY MANAGEMENT SYSTEMS. REQUIREMENTS.
		NTC ISO	9001	QUALITY MANAGEMENT SYSTEMS. REQUIREMENTS.
INBOUND LOGISTICS	CONFORMITY: CONFORMITY OF RAW MATERIALS AND INPUTS	NTC	369	PLASTICS. RIGID POLY (VINYL CHLORIDE) (PVC) COMPOUNDS AND CHLORINATED POLY (VINYL CHLORIDE) (CPVC) COMPOUNDS
		NTC	2536	ELASTOMERIC SEALS (GASKETS) FOR JOINING PLASTIC PIPE.
		NTC	2790	ADHESIVES. TEST METHOD OF VISCOSITY DETERMINATION.
		NTC	865	METAL CONTAINERS WITCH GAUGE SHEET 0,37 mm AND LESS.

Business Function	Process	Code of the standard		Title
		NTC	920	VITREOUS CHINA PLUMBING FIXTURES.
		NTC	1622	CHEMICAL PRODUCTS. SODIUM SILICATE FOR INDUSTRIAL PURPOSES.
		NTC	1991	MECHANICS. FLOATS FOR VALVE-OPERATING.
		NTC	2790	ADHESIVES. TEST METHOD OF VISCOSITY DETERMINATION.
		NTC-ISO	2859-1	SAMPLING PROCESS FOR ATTRIBUTE INSPECTION. PART 1: SAMPLING PLANS DETERMINED BY QUALITY ACCEPTANCE LEVEL FOR LOT BY LOT INSPECTION.
		NTC	2273	PVC COMPOUNDS. CALCIUM SEPARATE
		NTC	3576	PLASTICS. TEST METHOD FOR DETERMINING THE INDEX OF FLUIDITY (MELT FLOW RATES) OF THERMOPLASTIC POLYMERS BY EXTRUSION PLASTOMETER.
		NTC	407	STEARIC ACID FOR INDUSTRIAL USE. DETERMINATION OF FREE ACID CONTENT.
		NTC	872	POLYETHYLENE PLASTIC MOLDING AND EXTRUSION MATERIALS.
		NTC	467	STANDARD TEST METHOD FOR RUBBER PROPERTY - DUROMETER HARDNESS.
INBOUND LOGISTICS	CONFORMITY: CONFORMITY OF RAW MATERIALS AND INPUTS	NTC	955	PLASTICS. TEST METHOD FOR APPARENT DENSITY, BULK FACTOR AND POURABILITY OF PLASTICS MATERIALS.
		NTC	2395	PLASTICS. COVERED CALCIUM CARBONATE FOR PVC PIPES.
		NTC	3257	TEST METHOD FOR OBTAINING HYDROSTATIC DESIGN BASIS FOR THERMOPLASTIC PIPE MATERIALS.
		NTC	2935	PLASTICS. POLYETHYLENE MATERIALS FOR TUBES AND FITTING.
		NTC	664	POLYOLEFIN PIPES AND FITTINGS. DETERMINATION OF CARBON BLACK CONTENT BY CALCINATION AND PYROLYSIS. TEST METHOD AND BASIC SPECIFICATION.
		NTC-ISO	9000	QUALITY MANAGEMENT SYSTEMS- FUNDAMENTALS AND VOCABULARY.
		NTC-ISO	9004	QUALITY MANAGEMENT SYSTEMS. GUIDELINES FOR PERFORMANCE IMPROVEMENTS.
	MIXES	NTC ISO	9001	QUALITY MANAGEMENT SYSTEMS. REQUIREMENTS.

Business Function	Process	Code of the standard		Title
OPERATIONS	EXTRUSION	NTC ISO	9001	QUALITY MANAGEMENT SYSTEMS. REQUIREMENTS.
		NTC	382	PLASTIC. POLY (VINYL CHLORIDE) (PVC) PRESSURE RATED PIPES (SDR SERIES)
		NTC	2295	JOINTS FOR PLASTIC PRESSURE PIPES USING FLEXIBLE ELASTOMERIC SEALS.
		NTC	1630	POLY (VINYL CHLORIDE) (PVC) PIPES AND ELBOWS TO LODGE AND PROTECT UNDERGROUND ELECTRIC AND TELEPHONIC CONDUCTORS.
		NTC	1087	POLY (VINYL CHLORIDE) (PVC) WASTE AND VENT PIPE.
		NTC	979	PLASTICS. UNPLASTICIZED POLY (VINYL CHLORIDE) (PVC-U) PIPES AND BENDS FOR CONDUITS HOUSING AND PROTECTING.
OPERATIONS	EXTRUSION	NTC	576	SOLVENT CEMENT FOR POLY (VINYL CHLORIDE) (PVC) PLASTIC PIPING SYSTEMS.
		NTC	1062	CHLORINATED POLY (VINYL CHLORIDE) (CPVC), PLASTIC HOT AND COLD-WATER DISTRIBUTION SYSTEMS.
		NTC	3317	PLASTICS. POLY (VINYL CHLORIDE) (PVC) PIPES FOR IRRIGATION SYSTEMS.
		NTC	3363	PLASTICS. RIGID AND CORRUGATED POLY (VINYL CHLORIDE) (PVC) PIPES AND ELBOWS, HAVING SMOOTH INNER WALL, FOR ENCLOSE AND PROTECT UNDERGROUND ELECTRICAL AND TELEPHONE WIRES.
		NTC	3722-1	STRUCTURED WALL PIPING AND FITTINGS FOR NON--PRESSURE UNDERGROUND DRAINAGE AND SEWERAGE. PART 1. METRIC SERIES.
		NTC	5070	POLY (VINYL CHLORIDE) (PVC) CLOSED PROFILE GRAVITY PIPE AND FITTING BASED ON CONTROLLED INSIDE DIAMETER.
	INJECTION	NTC ISO	9001	QUALITY MANAGEMENT SYSTEMS. REQUIREMENTS.
		NTC	1339	PIPE FITTINGS OF POLY (VINYL CHLORIDE) (PVC) SCHEDULE 40.
		NTC	1341	POLY (VINYL CHLORIDE) (PVC) WASTE AND VENT FITTINGS.
		NTC	5442	STRUCTURED WALL PIPING AND FITTINGS FOR NON--PRESSURE UNDERGROUND DRAINAGE AND SEWERAGE. PART 1. METRIC SERIES.

Business Function	Process	Code of the standard		Title
		NTC	2295	JOINTS FOR PLASTIC PRESSURE PIPES USING FLEXIBLE ELASTOMERIC SEALS.
	RECOVERED	NTC- ISO	9001	QUALITY MANAGEMENT SYSTEMS. REQUIREMENTS.
OPERATIONS	WELDING	NTC- ISO	9001	QUALITY MANAGEMENT SYSTEMS. REQUIREMENTS.
		NTC	576	SOLVENT CEMENT FOR POLY (VINYL CHLORIDE) (PVC) PLASTIC PIPING SYSTEMS.
	MAINTENANCE	NTC- ISO	9001	QUALITY MANAGEMENT SYSTEMS. REQUIREMENTS.
OUTBOUND LOGISTICS	CONFORMITY: CONFORMITY OF FINISHED PRODUCT	NTC- ISO	9001	QUALITY MANAGEMENT SYSTEMS. REQUIREMENTS.
		NTC	382	PLASTIC. POLY (VINYL CHLORIDE) (PVC) PRESSURE RATED PIPES (SDR SERIES).
		NTC	576	SOLVENT CEMENT FOR POLY (VINYL CHLORIDE) (PVC) PLASTIC PIPING SYSTEMS.
		NTC	979	PLASTICS. UNPLASTICIZED POLY (VINYL CHLORIDE) (PVC-U) PIPES AND BENDS FOR CONDUITS HOUSING AND PROTECTING.
		NTC	1062	CHLORINATED POLY (VINYL CHLORIDE) (CPVC), PLASTIC HOT AND COLD-WATER DISTRIBUTION SYSTEMS.
		NTC	1087	POLY (VINYL CHLORIDE) (PVC) WASTE AND VENT PIPE.
		NTC	1088	PLASTICS. RIGID PVC CORRUGATED SHEETING.
		NTC	1339	PIPE FITTINGS OF POLY (VINYL CHLORIDE) (PVC) SCHEDULE 40.
		NTC	1341	POLY (VINYL CHLORIDE) (PVC) WASTE AND VENT FITTINGS.
		NTC	1630	POLY (VINYL CHLORIDE) (PVC) PIPES AND ELBOWS TO LODGE AND PROTECT UNDERGROUND ELECTRIC AND TELEPHONIC CONDUCTORS.
		NTC	2295	JOINTS FOR PLASTIC PRESSURE PIPES USING FLEXIBLE ELASTOMERIC SEALS.
		NTC	3317	PLASTICS. POLY (VINYL CHLORIDE) (PVC) PIPES FOR IRRIGATION SYSTEMS.
OUTBOUND	CONFORMITY: CONFORMITY OF	NTC	3363	PLASTICS. RIGID AND CORRUGATED POLY (VINYL CHLORIDE) (PVC) PIPES AND ELBOWS, HAVING SMOOTH INNER WALL, FOR ENCLOSE AND PROTECT

Business Function	Process	Code of the standard		Title
LOGISTICS	FINISHED PRODUCT			UNDERGROUND ELECTRICAL AND TELEPHONE WIRES.
		NTC	3410	SOCKET-TYPE POLYETHYLENE FITTINGS FOR OUTSIDE DIAMETER CONTROLLED POLYETHYLENE PIPE AND TUBING.
		NTC	3694	PLASTICS. POLYETHYLENE -PE- PLASTIC TUBING.
		NTC	3722-1	STRUCTURED WALL PIPING AND FITTINGS FOR NON--PRESSURE UNDERGROUND DRAINAGE AND SEWERAGE. PART 1. METRIC SERIES.
		NTC	4455	SOLVENT CEMENT FOR CHLORINATED POLY (VINYL CHLORIDE) (CPVC) PIPING AND FITTING SYSTEMS.
		NTC	4585	POLYETHYLENE PIPES FOR WATER SUPPLY - SPECIFICATIONS. METRIC SERIES.
		NTC	4908	POLYETHYLENE PIPING SYSTEMS FOR PROTECTING FIBER OPTIC CABLES. SINGLE AND MULTIPIPES.
		NTC	5070	POLY (VINYL CHLORIDE) (PVC) CLOSED PROFILE GRAVITY PIPE AND FITTING BASED ON CONTROLLED INSIDE DIAMETER.
		NTC	5442	STRUCTURED WALL PIPING AND FITTINGS FOR NON--PRESSURE UNDERGROUND DRAINAGE AND SEWERAGE. PART 1. METRIC SERIES.
		NTC	539	DRINKING WATER SYSTEM COMPONENTS. HEALTH EFFECTS.
		NTC	595	TEST METHOD FOR TENSILE PROPERTIES OF PLASTICS.
		NTC	718	CONDITIONING PLASTICS FOR TESTING.
OUTBOUND LOGISTICS	CONFORMITY: CONFORMITY OF FINISHED PRODUCT	NTC	1000	METROLOGY. INTERNATIONAL SYSTEMS OF UNITS.
		NTC	1027	PLASTICS. DETERMINATION OF THE EFFECTS OF LIQUID CHEMICALS, INCLUDING WATER IN PLASTIC MATERIALS.
		NTC	1125	DETERMINATION OF THE IMPACT RESISTANCE OF THERMOPLASTIC PIPE AND FITTINGS BY MEANS OF A TAP -FALLING WEIGHT.
		NTC	2534	JOINTS FOR DRAIN AND SEWER PLASTIC PIPES USING FLEXIBLE ELASTOMERIC SEALS.

Business Function	Process	Code of the standard		Title
		NTC	2983	DETERMINATION OF ADEQUACY OF FUSION OF EXTRUDED POLY (VINYL CHLORIDE) (PVC) PIPE AND MOLDED FITTINGS BY ACETONE IMMERSION.
		ISO	3127	THERMOPLASTICS PIPES - DETERMINATION OF RESISTANCE TO EXTERNAL BLOWS - ROUND-THE-CLOCK METHOD
		NTC	3254	DETERMINATION OF EXTERNAL LOADING CHARACTERISTICS OF PLASTICS PIPE BY PARALLEL PLATE LOADING.
		NTC	3358	DETERMINING DIMENSIONS OF THERMOPLASTIC PIPE AND FITTINGS.
		NTC	3578	THERMOPLASTICS PIPES FOR THE CONVEYANCE OF FLUIDS. RESISTANCE TO INTERNAL PRESSURE.
		NTC	3579	DETERMINATION OF SHORT-TIME HYDRAULIC FAILURE PRESSURE OF PLASTIC PIPE TUBING AND FITTINGS.
		NTC	3706	PRACTICE FOR MAKING SOLVENT-CEMENTED JOINTS WITH POLY (VINYL CHLORIDE) (PVC) PIPE AND FITTINGS.
		NTC	3721	PLASTICS. STRUCTURED-WALL PIPING AND FITTINGS FOR NON-PRESSURED UNDERGROUND DRAINAGE AND SEWERAGE. TEST METHODS.
OUTBOUND LOGISTICS	CONFORMITY: CONFORMITY OF FINISHED PRODUCT	NTC	3827	PLASTICS. TAPER PIPE THREADS 60° FOR THERMOPLASTIC PIPE AND FITTINGS.
		NTC	4214	THERMOPLASTIC PIPES. DETERMINATION OF CREEP RATIO.
		NTC	4215	THERMOPLASTIC PIPES. DETERMINATION OF RING STIFFNESS.
		NTC	4218	PLASTICS. UNPLASTICIZED POLY (VINYL CHLORIDE) (PVC-U) PIPES - DICHLOROMETHANE TEST.
		NTC	4451-1	THERMOPLASTICS PIPES LONGITUDINAL REVERSION. PART 1. DETERMINATION METHODS.
		NTC	5213	THERMOPLASTIC PIPES. DETERMINATION OF THE RESISTANCE TO EXTERNAL IMPACT. ROUND THE CLOCK METHOD.
		NTC	5425	SPECIFICATION FOR ORIENTED POLY (VINYL CHLORIDE), PVCO, PRESSURE PIPE.
		NTC	5494	PLASTICS. STANDARD TEST METHOD FOR TIME-TO-FAILURE OF PLASTIC PIPE UNDER CONSTANT INTERNAL PRESSURE.

Business Function	Process	Code of the standard		Title
		NTC	9001	QUALITY MANAGEMENT SYSTEMS. REQUIREMENTS.
		NTC	10012	MEASUREMENT MANAGEMENT SYSTEMS. REQUIREMENTS FOR MEASUREMENT PROCESS AND MEASURING EQUIPMENT.
		NTC-ISO	17025	GENERAL REQUIREMENTS FOR THE COMPETENCE OF TESTING AND CALIBRATION LABORATORIES
		NTC	332	PIPE THREADS, GENERAL PURPOSE (INCH).
		NTC	539	DRINKING WATER SYSTEM COMPONENTS. HEALTH EFFECTS.
OUTBOUND LOGISTICS	CONFORMITY: CONFORMITY OF FINISHED PRODUCT	NTC	1062	CHLORINATED POLY (VINYL CHLORIDE) (CPVC), PLASTIC HOT AND COLD-WATER DISTRIBUTION SYSTEMS.
		NTC	1156	PRACTICE FOR OPERATING SALT SPRAY (FOG) APPARATUS.
		NTC	1339	PIPE FITTINGS OF POLY (VINYL CHLORIDE) (PVC) SCHEDULE 40.
		NTC	1341	POLY (VINYL CHLORIDE) (PVC) WASTE AND VENT FITTINGS.
		NTC	1500	COLOMBIAN PIPEWORK CODE.
		NTC	1644	PLUMBING SUPPLY FITTINGS.
		NTC	1901	STANDARD SPECIFICATION FOR FLOAT VALVES.
		NTC	2728	DIAPHRAGM GAS METERS.
		NTC	3538	MECHANICAL DEVICES. MANUALLY OPERATED GAS METALLIC VALVES FOR USE IN GAS PIPING, GAS HAVING WORKING GAGE PRESSURE FROM 6,8 kPa (1 psi) TO 861 kPa (125 psi).

Business Function	Process	Code of the standard		Title
		NTC	3628	PERFORMANCE REQUIREMENTS FOR ANTI-SIPHON FILL VALVES FOR WATER CLOSET TANKS.
		NTC	3740	MANUALLY OPERATED METALLIC GAS VALVES, FOR USE IN PIPING SYSTEM UP TO 0,069 BAR -1 psi.
		NTC	3827	PLASTICS. TAPER PIPE THREADS 60Ø FOR THERMOPLASTIC PIPE AND FITTINGS.
		NTC	4846	PLASTIC TOILET -WATER CLOSET- SEATS.
		NTC	5302	PLUMBING WASTE FITTINGS.
		NTC	5441	FLEXIBLE UNDER PRESSURE WATER CONNECTORS.
		NTC	5456	TRIM FOR WATER-CLOSET BOWLS, TANKS, AND URINALS.
		NTC-ISO	9000	QUALITY MANAGEMENT SYSTEMS- FUNDAMENTALS AND VOCABULARY.
		NTC-ISO	9001	QUALITY MANAGEMENT SYSTEMS. REQUIREMENTS.
		NTC-ISO	9004	QUALITY MANAGEMENT SYSTEMS. GUIDELINES FOR PERFORMANCE IMPROVEMENTS.
		ASME	A112.19.2	VITREOUS CHINA PLUMBING FIXTURES AND HYDRAULIC REQUIREMENTS FOR WATER CLOSETS AND URINALS
		GTC	123	INSTALLATION AND STORAGE CONDITIONS FOR COLD WATER METERS.
	STORE	NTC- ISO	9001	QUALITY MANAGEMENT SYSTEMS. REQUIREMENTS.
	LOGISTICS: ADMINISTRATION AND DISTRIBUTION OF FINISHED PRODUCT.	NTC- ISO	9001	QUALITY MANAGEMENT SYSTEMS. REQUIREMENTS.
MARKETIN	MARKETING	NTC- ISO	9001:	QUALITY MANAGEMENT SYSTEMS. REQUIREMENTS.

Business Function	Process	Code of the standard		Title
G AND SALES	SALES	NTC- ISO	9001	QUALITY MANAGEMENT SYSTEMS. REQUIREMENTS.

SOURCE: GERFOR

ANNEX B

OFFICERS INTERVIEWED AT GERFOR

#	Name of the interviewee	Job position	Process to which he/she belongs	Function covered during the interview
1	JOSE MARIA ESCOVAR	General Manager	Management	Direction and Administration
2	ALBA MARINA TORRES	Director of Customer Service	Customer Service	Direction and Administration
3	DIANA CAROLINA LEON	Head of Organization and Methods	Quality Internal Audits	Direction and Administration
4	MARCO ANTONIO PÉREZ	Project Manager	Research and Development	R&D / Engineering
5	JUDITH BUITRAGO	Head of Purchase	Purchase	Procurement
6	LUISA FERNANDA QUINTERO	Responsible for exports and imports	Purchase	Procurement
7	CATALINA LIZARAZO	Verification of raw material and critical inputs	Conformity of raw material and inputs	Inbound Logistics
8	JUAN FERNANDO JARAMILLO	Manufacture Manager	Operations	Operations
9	GLORIA ACEVEDO	Logistics Manager	Logistics	Outbound Logistics
10	WELDER VANEGAS	Head of Finished Product and Distribution	Administration and distribution of finished product	Outbound Logistics
11	FREDDY ACHURI	Head of Conformity	Conformity of finished product	Outbound Logistics
12	MAURICIO BAYTER	Head of Sales	Sales	Marketing and Sales
13	FELIPE VÉLEZ	Director of Marketing	Marketing	Marketing and Sales

ANNEX C

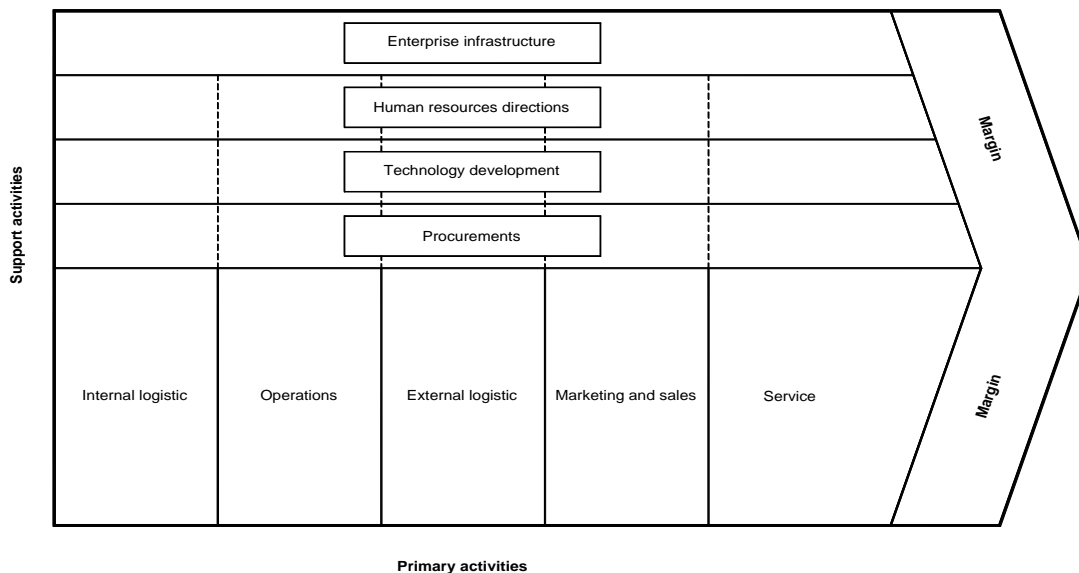
“...THE VALUE CHAIN (Michael Porter)

The firm is a set of activities with the aim to design, manufacture, commercialize, deliver and support its product. It can be represented by means of the value chain (figure C1). The value chain and the way how it performs the individual activities reflect its history, strategy, approach in establishing the strategy and the economy on which such activities are based.

The suitable level to build the value chain corresponds to the activities carried out in a particular industry (the business unit). At industrial or sectoral level the value chain becomes very extensive since it can overshadow important competitive advantage sources. Frequently, the value chains of the competitors are two equal ones, although the members of one same industry have similar chains. The value chain of one firm in one industry may vary a little in some elements of its product line, the customers, geographical regions or distribution channels. However, those belonging to these sub-sets are closely related and may appear only within the context of the business unit chain.

From the point of view of the competence, the value is what people are willing to pay for what is offered. The value is measured by the total incomes, which reflects the price charged for the product and the units that can be sold. A firm is profitable if its value exceeds the cost of creating its product.

Figure C1. Generic value chain



Every value activity uses purchased inputs, human resources (labor and administrators) and some kind of technology in order to perform its function. It also uses and generates information: data related to the customer (receiving of sale orders), performance parameters (tests) and statistics on

the product failures. It also can originate financial assets (as inventory and receivables) or liabilities (accounts payable).

The value activities are divided into two main sets: primary activities and support activities. The former, which appear in the lower part of Figure C1, are those involved in the physical creation of the product, its sale and transfer to the customer, as well as the post-sale support. In one firm, they can be divided into the five generic categories of Figure 7. The support activities back the primary activities and vice versa, in offering inputs, technology, human resources and various global functions. The dotted lines show that procurement, technology development and human resources management can be associated with certain primary activities and simultaneously they support the whole chain. The infrastructure is not related to any primary activity but it provides support.

Identification of the activities related to values

In order to identify the value activities it is necessary to isolate those of net technological and strategic nature. The value activities hardly ever match the countable classifications. These (for example manufacture cost, general expenses and direct labor) group activities with different technologies and separate the costs that are part of the same activity.

PRIMARY ACTIVITIES

As shown in Figure C1, there are five generic categories of primary activities needed to compete in an industrial sector. Each one can be divided into sub-activities well defined that depend on the industry and the strategy of the firm:

- *Inbound logistics. It includes activities related to receipt, storage and distribution of product inputs: material handling, storage, inventory control, vehicle scheduling and returns to suppliers.*
- *Operations. Activities by which inputs are transformed into the end product: machining, packaging, assembly, equipment maintenance, testing, press and plant operations.*
- *Outbound logistics. Activities by which the product is obtained, stored and distributed among customers: storage of finished products, material handling, operation of delivery vehicles, sale order processing and scheduling.*
- *Marketing and sales. Activities by which means are created that allow the customer to buy the product and allow the company to induce him to do it: advertising, promotion, sales force, quotations, channels selection, relations between channels and price setting.*
- *Service. Activities by which a service is provided that improves or preserves the product value, installation, repair, training, supply of parts and product adjustment.*

For a distributor, the inbound and outbound logistics are the most important. For a service company that provides services at its premises (a restaurant or a retailer), outbound logistics may not exist and the operations may be the most important category. For a bank that provides loans to companies, marketing and sales constitute the key of the competitive advantage; this is based on the efficiency of the staff visiting potential customers and on the way the loans are grouped and their

price is set. For a manufacturer of high speed copiers the service is the main source of competitive advantage. But in any firm, the categories of primary activities will be present somehow.

SUPPORT ACTIVITIES

They are divided in four categories and as the primary activities each category is subdivided in various activities specific to a particular industry.

- *Procurement.* Function to buy inputs that will be used in the value chain, not themselves. For example: raw materials, inputs and other consumable components, as well as assets as machinery, laboratory equipment, office equipment and buildings.
- *Technology development.* Every activity related to values includes technology, practical procedures, methods or technology integrated to the process equipment. Technologies used in most of the companies are very varied: they go from those that serve to prepare documents and transport goods to those that become incorporated to the product itself. Technology development can also adopt many modalities from basic investigation and product design to means investigation, design of process equipment and maintenance methods.
- *Human resource management.* This function is constituted by the activities related to recruitment, hiring, training, development and all kinds of compensation to the personnel.
- *Infrastructure of the firm.* It consists of several activities including general management, planning, finances, accountability, legal matters management, govern affairs and quality management.
- *Infrastructure* sometimes is deemed a mere “general expense”, but it can constitute a very important source of competitive advantage. Thus, in a telephone company, to negotiate and maintain constant relations with the regulatory bodies may be the most decisive activity for the competitive advantage.

TYPES OF ACTIVITIES

In each primary or support activity category there are three types affecting the competitive advantage in a different manner:

- *Direct activities.* These activities take part in creating value to the buyer such as: assembly, machining of parts, operation of sale force, advertising, product design, and recruitment.
- *Indirect activities.* These activities allow continuous maintenance, scheduling, facilities operation, sale force management, research management, record keeping by the suppliers.
- *Quality assurance.* This assures the quality of other activities: supervision, inspection, testing, assessment, verification, adjustments and rework. Quality assurance is not synonym of quality management since many value activities favor the quality.

Every company performs the former activity categories. The three categories are observed not only in the primary activities but also in the support activities. For example, in the technology

development the laboratory equipment involves direct activities and the management of this function is an indirect activity.

Activities related to quality assurance predominate in almost every sector of the organization, although this is hardly ever recognized. Testing and inspection are linked to numerous primary activities. Those of quality assurance outside operations are frequently less evident, but they also predominate. They cumulative cost is often substantial, as demonstrated by the attention that is lately paid to the quality cost. These activities often affect the cost or the effectiveness of other activities and the way in which the later are carried out affects in turn the need for and the type of these activities. The possibility of simplifying or eliminating the need for them by better performing other activities is the origin of the idea that the quality can be for "free".⁴

The above mentioned taking into account that the document explaining the methodology only defines the value chain in the following terms "Chain of one organization's activities". A concept for analyzing the internal structure of one organization by ungrouping it in the basic functions, and on the main activities of the organization. Functions are divided in main functions and support functions. Functions are located in a sequence that reflects the basic process of one organization's operation.

Although the concept of the value chain has been originally developed for the analysis of companies ("value chain of the company"), its use can, with some adaptations, be applied to other type of organizations.

The concept of value chain is also extended to the whole supply chain and the distribution nets ("value chain of the industry").⁵

It is also mentioned the chain adaptation in terms of the business function names: infrastructure of the company, human resource management and technology development..."

⁴ PORTER Michael E. Competitive Advantage (Revised edition) – Creating and sustaining superior performance. Fourth reprinting. México. Compañía Editorial Continental. 2005. p. 34-44.

⁵ Economic Benefits of Standards, Methodology Guide, version 1, February 2010. ISO and Roland Berger.P.75