Philippine Metals

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Department of Science and Technology
Metals Industry Research and Development Center

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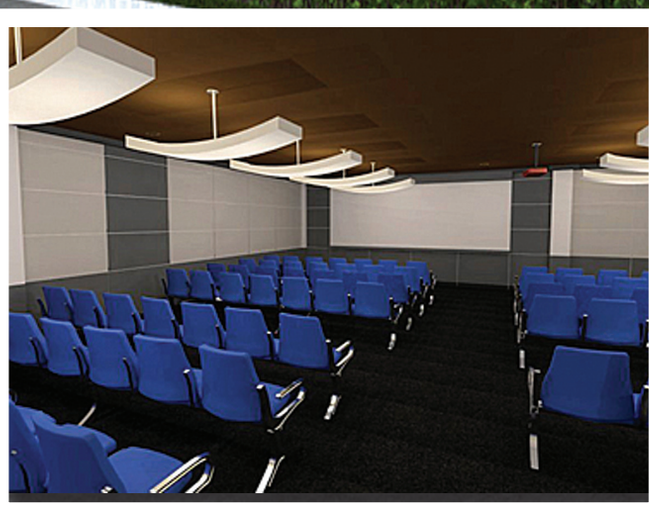

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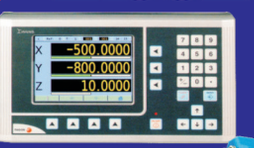

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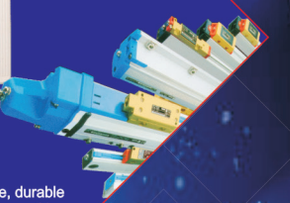

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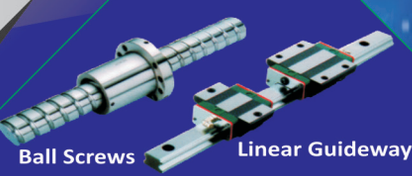

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"Philippine Metals" is the official technical and economic news media of the Metals Industry Development Center (MIDC) replacing the Metals Newsletter which was discontinued last year. The new quarterly bulletin, like its predecessor, will bring into focus the latest economic and technological developments in the metals industry here and abroad as well as the activities of the MIDC which includes research, metals testing, training, engineering, and industrial management services. R.A. 4724 creating the MIDC expressly provides that information services be one of the principal functions of the Center. The publication of the Philippine Metals by the MIDC will be a partial fulfilment of this function.

Dr. Antonio V. Arizabal
Director, 1975 - 1982
METALS INDUSTRY
DEVELOPMENT CENTER

Preface, Philippine Metals, Vol. 1 No. 1, January, 1971.

Established after the signing of Republic Act No. 4724 on June 18, 1966, the Metals Industry Development Center's (MIDC) key role was to build ties between the government and the industry so as to initiate advancement of the metals, engineering and allied industries of the country. The Philippine Metals is originally the Center's official technical and economic news media. The very first issue of this quarterly publication was released on January 1971.

The MIDC went through an event-filled journey. RA No. 6428 signed in 1972 reorganized and renamed the MIDC to become the Metals Industry Research and Development Center (MIRDC). A succession of Executive Orders and Presidential Decree transferred the MIRDC from the National Science and Development Board to the Ministry of Trade and Industry, and eventually back to the Department of Science and Technology. The Philippine Metals was there through all these changes to keep the public-private ties strong through continued information sharing.

MIRDC discontinued the publication of the Philippine Metals in 1982, but even so, the MIRDC still remains true to its mandate of supporting the growth and global competitiveness of the M&E industries. Part of the Center's rich history is its transformation into a regular government agency attached to the DOST after the issuance of EO No. 494, dated December 6, 1991.

To this very day, the MIRDC offers S&T services in terms of R&D, Metalworking, Metalcasting, Analysis and Testing, Industrial Training, Technical Consultancy, and Technical Information Dissemination. The revival of the Philippine Metals publication is an important move of the Center toward strengthening its information dissemination in order to reach out to more individuals and organizations involved in the M&E industries. This will be an annual publication that will feature local and foreign economic and technological developments in the industry along with other updates relative to the undertakings of the MIRDC.

The Philippine Metals will be our tool in carrying out our mandate. Along with the revival of this publication is the Center's deep commitment to drive the M&E industries to robustness and continued progress.

Robert O. Dizon
Officer-in-Charge
METALS INDUSTRY RESEARCH
AND DEVELOPMENT CENTER

Contents

TRAINING PROGRAM ON CNC MACHINE TOOL PROGRAMMING & OPERATION

TARGET PARTICIPANTS:

- 800 trainees

QUALIFICATION OF APPLICANT:

Must be either a:

- High school graduate WITH matching course from TESDA or TESDA-accredited training institutions,
- Vocational/trade course GRADUATE (preferably Mechanical Technology or related course), or
- Completed at least two years studies in college (preferably engineering course).

Applicants with basic knowledge and skills in conventional machining (turning or milling) and basic computer operation are preferred.

DURATION OF PROGRAM:

62-day training program

- Part I-Basic and Common Competencies (20 days)
- Part II-Core Competency (22 days)
- Part III-Industry Immersion (20 days)

TRAINING VENUE:

- MIRDC or at the facilities of Partner Support Organizations

STIPEND:

- Php 300.00 daily allowance for unemployed participants to defray their cost of living while undergoing training under the project

TRAINING FEE:

- Free for unemployed participants
- Minimal fee of Php 10,000.oo only for employed participants

DOST GIA Project

Project Title:

"Human Resource Intervention for Sustainable Growth and Competitiveness of the M&E Sector: Development and Implementation of Appropriate Training Curriculum Design for CNC Machine Tool Programming and Operations"

Project Objective:

To address the "brain drain" of CNC machinists that has negatively impacted on the metals and engineering industries.

Requirements:

- Must accomplish a Personal Information Sheet (Forms available at the Industrial Training Section, MIRDC, at selected DOST Regional Offices, or download at MIRDC website)
- Transcript of Records or True Copy of Grades
- Diploma/Certification
- Barangay Clearance
- Community Tax Certificate
- Medical Certificate
- 2x2 orPassport Size Photo

Service Contract:

3 years service in the Philippines after the training

For further inquiries, please feel free to contact MIRDC at tel. nos. (02) 837-0764, (02) 839-1720 or 837-0431 to 38 locals 464 to 467 or email at mirdc_training1@yahoo.com; or selected DOST Regional Offices.

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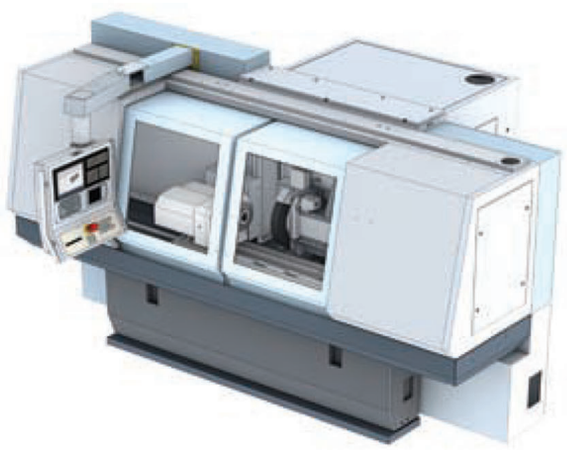

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Answers for industry.

THE PHILIPPINE METALS AND ENGINEERING: 2013 STATE OF THE INDUSTRY

Tarhata M. MARIANO,[*1] Restituto Felipe R. GABUYA,[*2] Eldina B. PINCA,[*3] Rea C. CASTRO,[*4] Corazon S. CAPARROS[*5]

The Philippines turns to its local metals and engineering industries for major contributions in economic development. Comprised of various sectors – metalcasting, tool and die, machining, electroplating, heat treatment, forging, and welding – the country's M&E industries serves a wide spectrum of sectors, both upstream and downstream. M&E firms are found concentrated mainly in the National Capital Region (NCR) and in Region IVA where environmental regulations permit the conduct of manufacturing activities. These M&E firms are dominated mostly by independent small shops, particularly in the welding and machining sector. Majority of the entire respondents are established as sole proprietorship. Compared with the MIRDC 2004 study, the 2012 study on the electroplating sector showed an improving statistics of those who were in jobbing and eventually ventured into manufacturing. Employment distribution is also showing improvement over the years since more production personnel are hired now. Data also reveal that the industry is dominated by cottage enterprises with a P100,000.00 worth of capitalization. These enterprises are coming mostly from the welding sector. The micro and small enterprises, on the other hand, are represented mostly by the machining sector. Economic conditions influence the performance of the M&E industries. The various sectors have remained active players in the import-export field. Unavailability of resources to acquire expensive technologies is one reason why the local industries have difficulties in catching up with foreign competitors. In spite of the cost, the country still resorts to importation of equipment, making repair and maintenance very expensive and time-consuming. Other challenges to the industry include: high cost and low quality of raw materials; limited market; shortage of technical personnel; and an investment climate that badly needs shaping up. Roadmaps have already been created for the local M&E industries. Opportunities, as well as threats, were identified. It is in how the involved sectors will take advantage of these opportunities that the industry will be able to overcome the obstacles and come out successful.

Introduction

The Metals and Engineering Industry (M&E Industry) plays an important role in the economic development of the country. The industry, comprised of small, independent firms, cuts across various industries and caters to different sectors. Although it remained small in size, contributing a very small fraction in the country's GDP, the industry has survived many transformations and challenges in the country and in the entire Asia as well. Asia has undergone changes over the last 5 decades[1] that directly or indirectly affected the industry.

Throughout the transformation, the rise of the manufacturing sector in Asia has changed the pace of the economic development of the country. Manufacturing opportunities indirectly drive the M&E industry. Changing global trends provide a source for developing countries to join the value chain by filling gaps as players move up. Bombarded with challenges that have been plaguing firms over the years, the M&E industry remained standing, offering new opportunities as it grows or slows down together with the manufacturing industry and global economy. It was on this backdrop that a study was conducted to highlight the status of the industry. This study aims to give an overview of the status of the M&E industry and how it fared after global economic crisis hit the developed countries. A review of the seven sectors of the M&E industry in the Philippines was conducted and a summary of the recent developments and issues was prepared. The study is divided into: Industry Characteristics; Industry Performance; and Industry Challenges.

Data used in this study are based on the profiling conducted on selected sectors from 2010 to 2012 and labelled as "MIRDC Profiling, 2012" and the studies conducted on Tool and Die and Machining, the rest are sourced from the internet (National Statistics Office website, etc).

I. Industry Characteristics

The M&E industry will remain a contributor to the development of the economy of the Philippines. The sectors that comprise the M&E industries are interrelated - some compete with each other, while others serve as support industry of another.

Industry Nature and Uses

The tool and die industry uses general and specialized metal cutting technology to fabricate dies, molds and toolings to convert materials into a required shape. The common products

1 "Beyond Factory Asia: Fuelling Growth in a Changing World", ADB Background Paper, 2013.

(This is a review of the status of the Metals and Engineering Industry by conducting a study on the following sectors: Metalcasting, Tool and Die, Machining, Electroplating, Heat Treatment, Forging and Welding.)

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are dies[2], molds[3] and tools[4] . Molds are shaping implements for glass, metal, rubber and plastic components. These products are used on die casting, blow molding or sheet stamping. Dies and molds are found at the forefront of the shaping and fabrication industries; providing a material an intermediate or final shape. The molds are used as stand-alone while the dies are used as an attachment to a machine. One of the typical machines used in the industry are computer numerically controlled (CNC) cutting machines.

The machining industry caters to the requirements of different sectors such as construction, automotive and transport, appliances, packaging, fabrication and repair of machines. The machining industry service is necessary on dimensions and finishes that require tight tolerances. The industry is primarily involved in the transformation of metals such as steel, cast iron and non-ferrous materials like aluminium, copper and zinc into products like hand tools, agricultural and industrial machineries and parts, motor vehicles component and appliances parts and other machineries.

Forging is a manufacturing process where metal is pressed, pounded or squeezed under great pressure into high strength parts[5]. Forging differs from the casting or foundry process as the metals used to make forged parts are not melted and poured. The forging process can create parts that are stronger than those manufactured by other metalworking processes. Forged products are used in various industries such as the automotive, mining, metalworking, construction, and shipping sectors.

Metalcasting is the process of forming a shaped metal component by pouring the desired molten alloy into a mold containing a cavity of the desired shape. It is an upstream industry following the primary process of mining the mineral ores and extracting the metal from them. The sector serves as the source of raw materials within the engineering industry and provides machinery, toolings, and parts used in other industries like agriculture, housewares, chemical/petrochemical, water/sewerage, medical/dental, machinery, mining, cement, electronics, automotive, and defense/armaments.

Electroplating is a process in which electric current is carried across an electrolyte wherein a thin, smooth, metallic deposit is produced over a metal base (The Philippine Electroplating Industry, 1990). In the industry, electroplating operations is a process that coats an object with layers of metal to improve the resistance to wear and corrosion, change the appearance, control friction or impart new physical properties or dimensions (ICF International , 2007). Metals used in coatings include zinc, copper, brass, chromium, nickel, gold, silver, cadmium, and lead. In most countries like Australia, most of electroplating is done in small factories and workshops and categorized into three (3) types of electroplating business: one that provides heavy coatings of hard metals (chromium) to machine parts; light coatings for personal and domestic items such as jewelry, ornaments, hobby items, motor parts and electronic components; and small and specialized industry that uses plating in the production of electronic circuit boards[6].

Heat treating is the heating and cooling operations performed on metals to change their properties such as strength, hardness, elongation, abrasion and fatigue resistance. The industry is important to industrial sectors especially the materials processing technology.

A welding shop provides assistance in the design and fabrication of prototype or research projects and specialty items; repair or replace all interior and exterior metals as needed due to damage, tear or wear; repair, reconstruct or fabricate kitchen or medical equipment; and install rigging beams and walkways to aid in gaining or improving access[7]. It is also a facility where metals or non-metals are joined through heating in suitable temperatures with or without the application of pressure, or by the application of pressure alone, with or without the use of a filler material[8].

Industry Distribution

M&E operations are located around the country but most of the companies are heavily concentrated in areas with high industrial activities. Two (2) regions of notable concentration are the National Capital Region (NCR) which is the commercial, industrial and financial district capital of the Philippines; and Region IV, known as the one of the largest contributors to the country's Gross Domestic Product (GDP) and a manufacturing hub where most production firms are located. Data available from the 2009 study and the 2012 profiling show that most of the firms have located their shops in industrial areas, a decision which could probably be attributed to the manufacturing activities and the environmental regulations that allow such activities to be conducted in the said areas.

Industry Size

The business structures of the M&E firms are categorized into five:

2 Examples of dies are simple, compound and progressive.

3 Molds are implements or instruments used for forging, plastic injection or blow molding, die casting glass blog molding.

4 Example of tools is jigs and fixtures used for cutting and shaping materials.

5 U.S. Forging Industry Association, https://www.forging.org/forging-facts#1

6 Australia's Commission for Occupational Safety and Health

7 www.plantops.umich-educ/maintenanc e/shops/welding

8 Philippine Welding Industry Study 1994

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*5 *Administrative Officer V,*
Metals Industry Research and Development Center
Bicutan, Taguig City, Philippines

Table 1. Business Structures of M&E Firms

Business Structure	Tool and Die*	Machining*	Welding	Electro plating	Heat Treatment	Metal casting	Forging	Total
Sole Proprietorship	22	771	544	29	8	10	1	1385
Corporation	90	144	45	22	23	36	4	364
Partnership	6	28	11	2	3	1	0	51
Government	2	12	2	1	1	1	0	19
Cooperative	1	0	0	0	0	0	0	1
No Data	0		32	3	1	2	0	38
Total	121	955	634	57	36	50	5	1858

*Source: MIRDC Industry Profiling, 2012; *2009 Machining and 2006 Tool and Die Study*

sole proprietorship; corporation; partnership; government-owned; and cooperative. Out of the 1,858 firms, 1,385 are sole proprietorship and 364 are corporate-owned. The rest are distributed as follows: partnership – 51, cooperative –1, no answer – 38.

Based on the figures gathered from the industry study, the M&E industry is dominated by independent small shops particularly those in the welding and machining sector. A closer look in each sector summarizes the following:(1) the tool and die sector has eighty percent of its firms that are classified as independent shops, while the rest are categorized as captive and in-house shops; (2) the machining sector consists largely of independent shops, offering services to manufacturing firms. The remaining thirty percent are captive shops; and (3) out of the total surveyed welding firms in 2012, sixty-eight percent are independent shops and only one percent is exclusively owned by large manufacturing firms. Another one percent offers their services to the academe or institutions where technical trainings/ seminars are conducted.

Both the electroplating and heat treatment sectors present almost the same pattern: almost thirty-six percent of the firms surveyed are into manufacturing while the thirty-three percent of electroplating and twenty-eight percent of heat treatment engages into jobbing operations. The twenty-two percent and fourteen percent of firms of heat treatment and electroplating are both into manufacturing and jobbing, respectively. Compared to the 2004 study, the 2012 study on electroplating reveals a significant increase in the number of firms engaging on manufacturing, reducing the firms offering jobbing from 71% to 33%. The numbers of firms that are focused on jobbing and manufacturing operations are almost equal and no captive[9] operation firms were reported.

Figure 1. Distribution of Employees for the M&E Industry, 2012

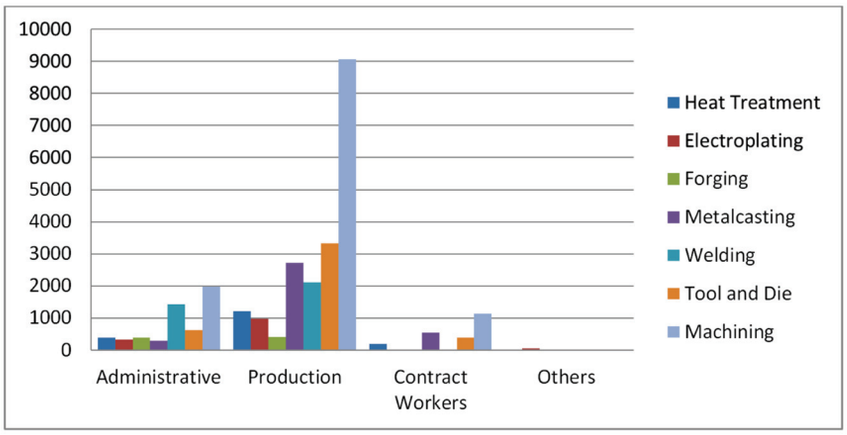


Table 2. Classification of Investment

Capitalization, Php	Classification
1 to 100,000.00	Cottage
100,001 to 1,000,000	Micro
1,000,001 to 10,000,000	Small
10,000,001 to 40,000,000	Medium
Greater than 40,000,000	Large

Employment Distribution

The employment distribution in the different sectors has improved over the years. There are more production personnel now and some even have contract workers. This indicates the growing demand for technical workers for the industry.

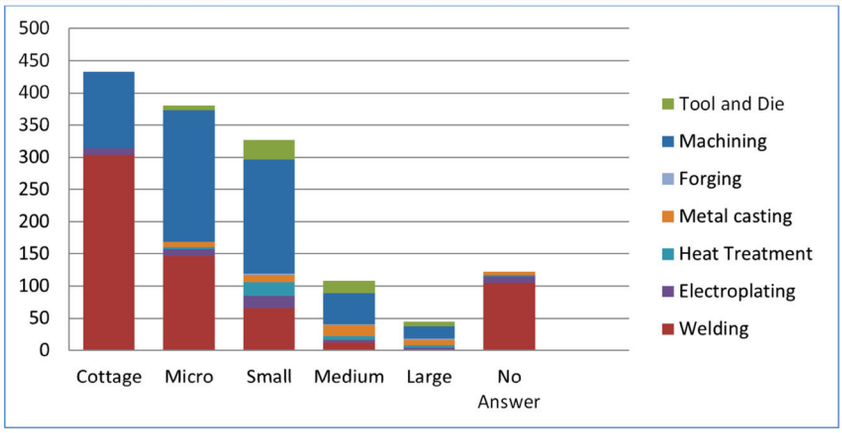
Industry Capitalization

The M&E industry is a mix of capital-intensive and non-capital intensive firms. Using the Department of Trade and Industry bracketing in terms of capitalization, the investment is categorized as follows:

Figure 2 shows the distribution of the investments in the industry with cot-

9 Firms that conduct electroplating within large manufacturing operations

Figure 2 Industry Size Based on Capitalization



tage enterprises ranking first followed by the micro enterprises that are dominated by the machining sector based on the profiling conducted. Most of the firms under the cottage enterprises are from the welding sector, while micro and small enterprises has its largest number of firms coming from the machining sector. This indicates the large number of independent firms investing on the business, providing a short glimpse on the activity of the industries.

II. Industry Performance

Industry Markets

The M&E Industry is a derived demand industry for the manufacturing industry. As a support industry, the sales of the M&E industry products are heavily affected by the factors that are shaping the different manufacturing sectors. Based on the business cycle of the respective manufacturing sectors that each M&E sectors are catering, the sales could go up or down depending on economic conditions. The major market that the M&E industry caters to is the automotive industry with machining having at least more than five hundred shops providing their services. Other industries that require the most from the M&E industry are the jewelry for electroplating, and industrial machinery for heat treatment and machining.

Market Trends

The contribution to GDP is a way to measure the value of an industry to a country's economy. GDP is defined as the aggregate market value of all recognized final goods and services produced in a country within a certain period. In 2011, according to the World Bank published report, the estimated GDP of the Philippines was worth 224.8 billion US dollars.

Tool and Die Sector

The export and import performance of the tool and die industry were noted from the year 2000 to 2012. The starting year of 2000 has registered the highest exports level amounting to USD 8.99 million, while 2010 has shown the most remarkable dip in export gross revenues with figures dropping by sixty-three percent ($1.25 million) of the previous year's value ($3.4 million). The dip in exports experienced in 2010 indicates a shift in market preference to other suppliers. Data reveal that Japan is the top export destination of the industry's products from 2007 to 2011. Other countries of destination are Indonesia, Malaysia, China, Thailand, USA, and Hong Kong.

Of interest in the importation performance is the increase in imports in 2010 and 2011. This could be due to political climate change which has favored the revitalization of the manufacturing sector. The mean import value is calculated to be US$ 36.1 million with a standard deviation of US$ 5.7 million (15%). The top seven countries of origin of imported tool and die goods are Japan, Korea, China, Singapore, Taiwan, USA, and Thailand. Japan supplies the highest amount of products to the local market.

Table 3 shows the local demand of tool and die in Asian countries indicating the Philippines as having the smallest number of companies and the lowest cost of local demand in tool and die. The cost of local production of the Philippines is estimated using the above of the total local demand in which the importation in 2007 was closed to US$ 35 million while exports stand at US$2.6 million.

The major commodities with iron castings exported by the country were: a) pumps for liquids; b) air/vacuum pumps, air/gas compressors; and c) parts of machinery for sorting, separating, washing, crushing, grinding, mixing or kneading earth, stone ores, or other mineral substances in solid minerals.

Table 3 Asian Tool and Die Shops and Total Local Demand

	No. of shops	Estimated Total Local Demand,[9a] US$ million
Philippines	*170*	*47 to 58*
Indonesia	280	333
Malaysia	410	273
Singapore	1,200	840
Thailand	1,110	760
China	30,000	12,740
India	NA	2,500
Japan	6,700	18,400
Korea	4,000	2,800
Taiwan	3,500	1,780

Sources: The Philippine Tool and Die Industry: A 2006 Study and FADMA Country Members Reports Year 2007.

Metalcasting Sector

The export of the selected commodities with iron castings has reached $112 million in 2007 and then steadily declined in the next two years before recovering to $138 million in 2010 and has dropped to about $115 million in 2011.

The import of commodities with iron castings far surpasses the value of exports. After decreasing between 2007 and 2009, the import of commodities with iron castings has

9a Cost of Local Production + Importation

increased from about US$560 million in 2009 to roughly US$906 million in 2011.

Export of commodities with steel castings declined between the years 2007 and 2009 before increasing in the succeeding years. In 2011, the exports for this commodity have reached about US$ 51million mainly from: a) flanges of stainless steel; b) semi-finished products of non-alloy steel; c) transmission shafts and cranks; and d) tube or pipe fittings of stainless steel. On the other hand, the value of the country's imports has steadily increased during the five-year period reaching US$ 282 million by 2011. The major imports include: a) machinery lifts, accelerators and conveyors; b) ships' derricks and cranes; c) fork-lift and other work trucks used for lifting/handling equipment; and d) tractors.

The Philippines mainly exports a) ships' propellers and blades; b) taps, cocks and valves; and c) statuettes and other ornaments. Import of commodities with bronze castings include: a) unwrought products of refined copper; b) taps, cocks, valves; and c) copper plates, sheets and strips. Exports show a decrease from 2007 to 2009. After which, an increase was observed from 2009 to 2011.

Commodities with components of aluminum casting commonly traded during the five-year period covered include: a) plates, sheets, and strips of aluminum alloys; b) tube/pipe fittings (e.g. couplings, elbows, sleeves); c) motorcycle engines with less than 250 cc; and d) table, kitchen, or other household articles. Exports dropped steeply from 2007 to 2009. Fortunately, the market seems to have recovered although very slowly from 2009 to 2011.

Electroplating Sector

The electroplating exports and imports from 2007-2011 exhibited opposite trends. Imports increased from 2007 to 2008 and took a dip in 2009 but were able to recover in 2010 up to 2011. This could be attributed to the economic activity of other sectors in which the electroplating sector is dependent like the automotive industry in particular. Exports, on the other hand, have significantly dropped from 2009 until 2011. As a derived demand, the data considered do not include indirect exports and imports.

Heat Treatment Sector

The export and import of metal products commonly requiring the heat treatment process include materials such as bolts, nuts, and screws; gears; shafts; hand tools and cutlery; leaf springs and roller chains. Data on tools, dies and molds sector which also undergo heat treatment are excluded from the analyses. The exports of the selected metal products are larger than the imports however, if trade statistics for tools, dies, and molds are included, imports would surpass the exports. As a derived demand for other segment, this signifies that there is still a potential market for heat treatment companies but the growth in heat treatment industry is dependent on the development of other segments.

Welding Sector

The total export of metal products utilizing the welding process during production or manufacture grew by an average of sixty-eight percent or US$ 476.877 million in 2007 to US$ 934.185 million in 2010. The increasing trend in export earnings is an indication of increasing demand for such product in the foreign market particularly in the welding sector.

On the other hand, the value of imports of metal products has doubled compared to the exports products. The total imports have increased by an average of twenty-four percent US$2924.082 million in 2007 and US$3970.944 million in 2010. This figure indicates that portion of the growing local market for welded products in the welding industry is not sufficient to supply the growing enterprises.

Industry Technology

Equipment Statistics

Based from the information gathered through the industry profiling, most of the equipment used by the various M&E sectors are not at par with the technologies that other companies abroad have. This could be attributed to the unavailability of resource to acquire technologies that are expensive such as CNCs, coating techniques (e.g. CVD and PVD), robotics and automation and rapid prototyping.

Surprisingly, there are no indicators to tell whether the M&E industry is one of the recipients of the influx of industrial robots. According to a study conducted by the Asian Development Bank (ADB), Asia is now the largest market for industrial robots, accounting for half of the shipments globally. The report says that the strong increase in shipment was driven by the strong demand from industries like automotive and metal. The equipment named by respondents however do not include industrial robots, and this could mean that even with the emergence of new technologies that is sweeping Asia, the level of technology used by the Philippine industry has yet to leap-frog to catch-up.

Despite lagging behind technologically, we are still resorting to import of technologies that local firms uses. Since the equipment are sourced outside, in case of machine breakdown, critical spare parts would have to be imported and this could hamper operations.

III. Industry Analysis

Industry Challenges

The industry has faced many challenges over the years. In the profiling conducted by the MIRDC, the respondents were asked to identify challenges and issues that affect their businesses. Out of 693 responses 35.2% relates that their top big challenge is the material procurement where prices are high, sourcing is difficult, and good quality is lacking. The next most common challenge focused on the market forces which are limited market, intense competition against local and foreign shops, etc. Other top challenges included: human resources (12.7%), equipment / facilities (10.5%), utilities (6.6%), unavailability of capital (6.3%) and quality control (3.2%)[10].

For human resources, the lack of skilled workforce and absenteeism/tardiness were identified as the main challenges encountered. Respondents

10 Formulating the R&D Program and HR Development Plan of MIRDC Technology Roadmaps of the Metals and engineering Sectors through Technology and Training Needs Assessment.

have also raised concerns such as the lack of support facilities (testing and design engineering), the high power cost, and the unavailability of capital and high interest rates.

a. Raw Materials

Material is the major challenge for the M&E industry, with almost all seven sectors putting this issue on top of their list. Reasons given why this is a concern include: low quality or substandard materials; continuing export of waste and scrap of metals; foundries have to import raw materials such as foundry and special sands; the smithery industry faces the lack of sources for medium and high carbon steel; and metalcasting battles the raw materials challenge to acquire the following: aluminum (scrap & ingots), various types of steel (cold rolled steel, mild steel plate, 1045, 4140, 4340, low carbon steel, low alloy steel), dolomite, chromite and activated carbon.

b. Market

For tool and die sector, the domestic market is small, catering mostly to the automotive and electronics. The machining sector profiling, on the other hand revealed that the shops are suffering from a weak market. This weak market is defined by the irrational price competition, limited market, foreign competition, product quality and distribution channels. To address this problem, owners have to focus their revenue on jobbing service and have to compete with the shrinking market just to survive.

c. Human resource

Despite the increase in employment, there is still a major shortage of technical personnel. The diaspora of Filipino workers could also be contributing to the eroding advantage of the country as more workers search for greener pastures, producing a smaller worker pool. In addition survey revealed business owners complaining on professionalism issues, a reflection of discontent.

d. Equipment

In a study, it was cited that "new technologies are changing the nature of manufacturing." The software and advance robotics is taking Asia slowly, as a support industry of the manufacturing sector. The M&E has to adjust as new manufacturing practices are adopted. Lagging behind technologically, the survey discloses the same challenges that seem to remain unresolved through the years: continuing high prices of equipment that impede the growth of the sector, repairs and maintenance problems, difficulty of sourcing the necessary equipment, import and export regulations.

e. Finance

In order for the Philippines to further strengthen and expand its industrial base investment, the ADB suggested that the country improve its investment climate and attract foreign direct investment. Working capital remains limited, with revenues not enough to run the business, even pay for rentals and overhead cost. The financial difficulties remain a challenge to firm owners but they are apprehensive to borrow from major lending institutions because of high interest rates.

Metals and Engineering Analysis

Roadmaps for some of the M&E sectors have been developed in 2012, providing blueprints for the development of the industry. Below is a summary of the analysis of the M&E Industry based on the road mapping activities conducted:

Strengths	Weaknesses
Presence of highly trainable workers; *Presence of organized and cohesive associations like the Philippine Metalcasting Association, Inc (PMAI);* *Presence of the Metals Industry Research and Development Center (MIRDC) that supports the growth and global competitiveness of the metals, engineering and allied industries;* *Presence of various universities offering foundry technology and engineering courses;* *Presence of the Technical Education and Skills Development Authority (TESDA) with various courses for M&E – related technical skills;* *Presence of various government agencies such as the DTI and DOST with various programs in support of the SME's;* *Presence of government policies and laws such as the Magna Carta for Small Enterprises in support of the SME's*	*Majority of the products are low value added competing with imports;* *Inadequate design tools and testing facilities;* *Lack of funding and human resources for technology transfer and research and development;* *Limited knowledge in M&E technologies because no institutions offer such courses;* *Continued use of outdated equipment and processes for design, analysis, production and quality control resulting to low productivity;* *Most firms do not have the necessary skilled and knowledgeable managers, engineers and workers to carry out their production effectively and efficiently;* *Untapped huge local market in automotive, mining and other applications where the castings requirements are imported;* *As a result of lack of financial sources and appropriate trainers, the trainings conducted by DOST and DTI have little emphasis on productivity improvement which are critical to international competitiveness (Aldaba, 2008);* *"The curricula of engineering and technical schools do not address the technological needs of* *the industry and hardly receive inputs from the industrial sector." (Aldaba, 2008);* *High rate of migration of skilled workers;* *Difficulty in meeting stringent environmental laws and regulations due to additional capital investments;* *Most raw materials are imported and expensive;* *Rising cost of raw materials, fuel and energy;* *Insufficient government assistance and support to the industry;* *Insufficient supply of raw materials such as scrap materials due to competition from exporters;* *Difficulty of obtaining good financial packages;* *Limited capability on repair of CNC machines* *Inability to upgrade capability in terms of software application.*

Opportunities	Threats
The upcoming AFTA 2015 will open the ASEAN countries such as Singapore, Malaysia, Myanmar for Philippine metalcasting products; Untapped huge markets in automotive, mining, construction and other applications; Huge local market in automotive, mining, industrial, utilities, machine and equipment manufacture, construction and other applications; Presence of major multi – national corporations (MNC's) with metal product requirements; Availability of markets and applications for high value added metal products; Emerging technologies; Foreign exchange rates Competitiveness of Philippine M&E seven sectors	The upcoming AFTA 2015 will open the Philippine market to more competition from Thailand, Indonesia and Vietnam; Competition from other countries with FTAs such as Japan, Korea and Australia and low – cost products from India and China; Cheap imported products from China, i.e. glass molds, rubber molds, stamping dies, jigs & fixtures Increasing production in Vietnam and Indonesia. Decisions for procurement in large companies are decided by their principal which is outside the country

Conclusion

As revealed by the data gathered from the industry profiling initiative of the MIRDC, there are weaknesses that hamper the take-off of the local metals and engineering industries. Undertakings that support the industries' growth and development are countered by threats and challenges that more or less cause a break-even standing between success and failure. Thus, the industry most often finds itself back to square one – where it is difficult to put together efforts once again in order to begin the uphill journey. The continued assistance provided by government agencies and the academe, plus the active involvement of industry associations, empower the local metals and engineering industries. Through the development blueprint established from the Roadmapping activity in 2010, several factors that require immediate attention come into focus. There is a pressing need to address the human resource requirements of the industry through the provision of appropriate trainings and exposure to rigid R&D. Training, as a matter of fact, must begin with the academe where the country's workforce are molded into efficient and effective skilled workers or professional industry players. Another crucial factor to achieving success is the availability of financial packages that will allow the SMEs to acquire much-needed technologies.

Recommendation

Continuous monitoring is most usually the key to the success of any aspect of development. In the case of the metals and engineering industries, the constant presence and assistance of involved organizations are crucial in preventing the occurrence of problems. At the same time, it is a way of giving immediate remediation or intervention when the need comes up. The establishment of the 2015 ASEAN economic community is one inevitable challenge that requires the M&E industries to give its best performance. It is recommended that partnerships among the government, the private sector, and the academe be made stronger through projects that will aim to answer the weaknesses and overcome the threats identified in the Roadmapping activity. Further studies are also highly recommended, since the trends and performance of the various sectors differ and fluctuate from time to time, depending on the prevailing situations of local and international markets.

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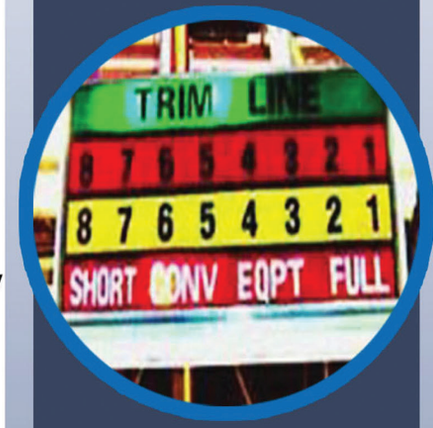

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Enhancing the Local Manufacturing Industry's Competitiveness Through the Establishment of a

Die and Mold Solution Center

Fred P. LIZA*[1]

The Establishment of Die and Mold Solution Center (DMSC) in Support of Components and Parts Manufacturing Industry is a project implemented by the Metals Industry Research and Development Center in partnership with the Philippine Die and Mold Association, Inc. that aims to enhance the competitiveness of the local tool and die sector in support of the automotive industry. The main strategies of the DMSC include the provision of facilities, technology, and manpower development. Since the die, mold, and tooling industry in the Philippines mainly serves the automotive and electronics industries, it has been identified for accelerated development because it has great potentials for enabling a faster growth of the manufacturing sector. The DMSC facility, complete with all its equipment and state-of-the-art technologies, is envisioned to empower the local manufacturing industry.

Introduction

Consistent with its goal of accelerating economic development and consequently reducing dependence on foreign technology, the Department of Science and Technology (DOST), through the MIRDC, partnered with the PDMA in an initiative to enhance the local tool, die and mold-making industry. The market of the die and mold industry in the Philippines remains limited and small despite its economic significance to the manufacturing sector. It is for this reason that Research and Development (R&D) Projects are undertaken in order to address the resurgent importance of attaining a more productive manufacturing industry.

Manufacturing serves all economic industries that span across: aerospace; automotive; biotechnology; electrical and electronics; metals, minerals and materials; marine; and nuclear, among others. Being a vital part of the manufacturing industry, the tool and die sector is a constant and indispensable ingredient to the industry's success. This intricate involvement of the tool and die sector to practically all other industries called the attention of both the government and the private sector, leading to the implementation of the project entitled, "Establishment of a Die and Mold Solution Center in Support of the Components and Parts Manufacturing Industry."

The DMSC project generally aims to enhance the competitiveness of the local tool and die sector in support of the automotive industry through the provision of facilities, technology and manpower development. It specifically aims to focus on the acquisition of the needed technology and facilities to support the competitiveness in the localization of currently imported dies and molds.

MakiBayan Program's Memorandum of Understanding Signing

From left to right: MR. VICTOR V. GRUET, Vice President of EIAPI; MR. VIRGILIO F. LANZUELA, President of MIAP-National; HON. MARIO G. MONTEJO, DOST Secretary; MR. ANTONIO LUIS T. FUSTER, President of PDMA; and DR. AURA C. MATIAS, Program Leader of the Engineering Research and Development for Technology (ERDT).

This intervention was initiated by DOST Secretary Mario G. Montejo and was formalized through the signing of a Memorandum of Understanding (MOU) between the DOST and the PDMA last 16 April 2012 in Quezon City.

*1 *Officer-in-Charge, Prototyping Division*
Metals Industry Research and Development Center
Bicutan, Taguig City, Philippines

The MOU specified in detail the different aspects of the project and designated the Metals Industry Research and Development Center (MIRDC) as the official R&D station. The MOU signing is a leap not only to give the 'Makinarya at Teknolohiya para sa Bayan' (MakiBayan) Program a strategic focus but will further strengthen the collaborative relationship of public and private sectors.

Consequent to the signing of the MOU is the launching of the DMSC project in 2013 by the MIRDC in partnership with the PDMA. The effective implementation and realization of the objectives of the project requires careful planning and keen execution. To bring about the enhancement of the sector's competitiveness, several activities are being undertaken relative to the implementation of the DMSC.

The DMSC featured at the PDMEx 2013 held at the World Trade Center in Pasay City.

From left to right: DR. AGUSTIN M. FUDOLIG, MIRDC's Deputy Executive Director for Technical Services; MR. ANTONIO LUIS T. FUSTER, PDMA President; PROF. FORTUNATO T. DELA PEÑA, DOST Undersecretary for Scientific and Technological Services; and ENGR. FRED P. LIZA, OIC of the Prototyping Division of the MIRDC and the DMSC Project Leader.

Expected Outputs of the DMSC Project

Technology, Facilities and Manpower Development are the three main aspects of this intervention. Under the project, the MIRDC will acquire identified technologies and facilities needed to localize imported dies, tools, and molds with improved quality, reduced cost and/or shorter delivery lead time.

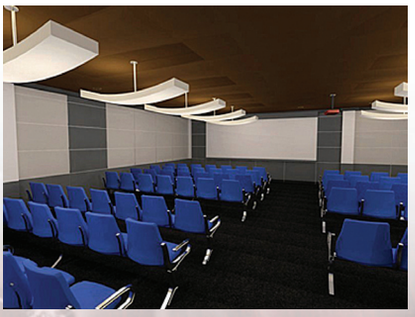
The technology aspect involves the acquisition of design and simulation software plastic mold injection, molds and stamping dies. Design optimization, through simulation, will be achieved by offering the translation of CAD into CAE and CAM.

On the other hand, the facility aspect refers to the acquisition of machines to complement and/or upgrade the present CNC Machines at the MIRDC. This will include CNC High Speed Machining Centers, 5-axis CNC Multitasking Machines, CNC EDM Sinker/Drill/Wirecut, LASER Welding Machine and Surface Grinders, among others. Renovation of the MIRDC' Metalworking Shop I (MWS I) Building is also a part of this initiative so as to accommodate the new equipment to be acquired. Access to advanced dedicated technology and facilities on die and mold designing and making will be provided and implemented to include the offering of common service facility for the local tool and die makers under a facility-sharing scheme at reasonable rates.

For the manpower development, new die and mold makers will be trained. Moreover, knowledge about best practices, techniques and technology of current professionals will be supplemented. This will be conducted in reference to basic die and mold-making as well as advanced technologies relevant to die and mold making, particularly in high speed machining.

The MIRDC is also gearing up to provide consultancy and training on specialized techniques and procedures relevant to tool, die and mold-making. To realize this planned output, DMSC personnel will undergo training which includes participating in benchmarking activities within and outside of the country. The MIRDC-PDMA Technical Working Group (TWG) will also review and update existing curriculum on die and mold designing and making to ensure the enhancement of innovative and creative capabilities of the trainees. Local and foreign consultants will also be engaged to provide technical advisory services to die and mold shops around the country.

The MWS I Building will soon have its new Business Center.



Perspective of the auditorium in the MWS I Building.

The MWS I Building will have this new look.

Conclusion

In summary, the collaboration of the MIRDC and the PDMA will result to the creation of various solutions that will bring about long-term benefits to the tool and die sector. At a glance, the following are what the sector can look forward to:

INTERVENTION	SPECIFIC ACTIVITIES
Manpower Solutions	Training of CNC Machinists and Programmers Training of Die and Mold Designers and Makers
Design and Engineering Solutions	Computer-Aided Designing (CAD) Computer- Aided Machining (CAM) Plastic Injection Molding Simulation Stamping Die Simulation
Facility-Sharing Solution	CNC 5-axis (Multi-tasking) Machining CNC High Speed Machining CNC EDM Sinking CNC EDM Wire Cutting CNC EDM Drilling CNC Milling/Turning CNC Vertical Machining Surface Grinding Centerless Grinding Laser Welding Micro Deposition Die and Mold Assembly and Trial Shot Die and Mold Repair Plastic Injection Molding Turret Punching Power Pressing Hydraulic Die Spotting Hydraulic Shearing Plasma and Laser Cutting CMM with Laser Scanning
Technical Solutions	Productivity and Quality Improvement Cost Reduction and Competitiveness Technology Upgrading Quality Management System

With the completion of the project, the tool and die sector will surely deliver its most remarkable performance to bring about the long-awaited significant changes in the industry. The concerned agencies, especially the PDMA as the strategic industry partner and the MIRDC being the Die and Mold Solution Center, are continuously working towards the realization of the objectives and will continue with the work–in–progress until a more competitive and productive local tool and die sector is achieved.

Recommendation

In view of the forthcoming launching of the newly-established DMSC, the visit of companies and other organizations involved in the local tool and die sector is highly suggested. The services that the DMSC facility can offer are designed to aid in the processes and operations of the sector. Valuable inputs from the industry and all stakeholders are necessary in order to improve the facilities. Continuous improvement, through strategic collaboration, can possibly be obtained faster and more effectively – for the benefit of the Philippine metals and engineering industries.

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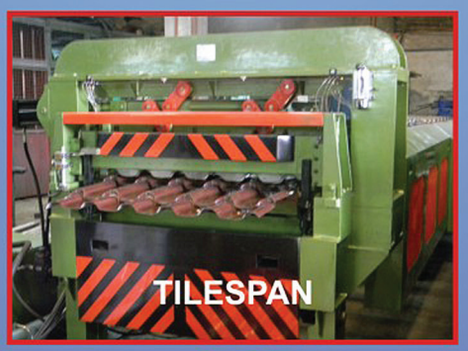
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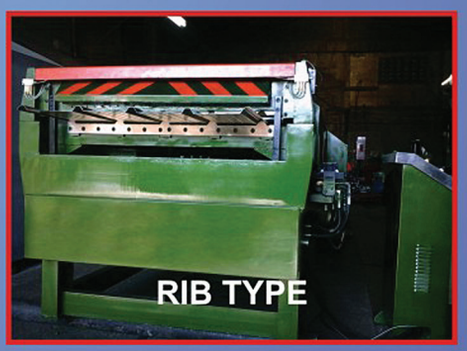
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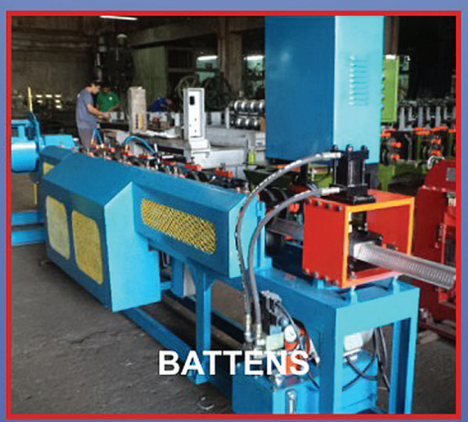
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Philippine Aerospace Industry: Overview and Prospects

Mercedita G. ABUTAL,*1 and Restituto Felipe R. GABUYA*2

ABSTRACT

This paper provides an overview of the Philippine Aerospace Industry and presents statistics from secondary sources to describe the status of the industry. Issues that impact the further development of the industry are also discussed. Current players stress the importance of supply chain integration in order that the Philippines can take advantage of more opportunities in the market.

1. Introduction

The United Nations Statistics Division classifies economic activities using the International Standard for Industrial Classification (ISIC)[1]. Under the ISIC, establishments are classified based on the activity from which they derive their major income or revenue. ISIC Code 3030 refers to the manufacturing of air and spacecraft and related machinery. The industry's activities include the manufacture of airplanes, helicopters, gliders, hang-gliders, dirigibles and hot air balloons, ground flying trainers, spacecraft and launch vehicles, and intercontinental ballistic missiles. The overhaul and conversion of aircraft or aircraft engines, and aircraft seats are also part of the industry.

In the book "The Structure and Performance of the Aerospace Industry," Herman O. Stekleroffered to explained the scope and coverage of the aerospace industry using two definitions – as an industry engaged *"in the research, development, and production of manned and unmanned vehicles and supporting equipment for movement above the earth's surface" or as an industry that "encompasses all companies or activities from business flying to air transport to military aircraft to space craft*[2]." The aerospace industry covers a broad scope of activities and produces a wide range of products – such as commercial aircraft, military fighter jets, missiles, satellites and other spacecrafts.

This paper focuses on three aspects within the industry where the Philippines has shown potential for growth: aerospace manufacturing; maintenance, repair and overhaul (MRO) of aircrafts; and aviation.

Aerospace manufacturing involves the procurement of raw materials, the physical transformation required to produce aerospace parts, and the building of subsystems and assembly of final products[3]. The aerospace manufacturing supply chain is made up of original equipment manufacturers (OEMs) and tiered suppliers. The OEMs control the design, manufacturing and assembly of aircrafts. Tier 1 companies directly supply the requirements of OEMs, those classified as Tier 2 typically cater to Tier 1 companies, while Tier 3 vendors support the Tier 2 companies. Special processing shops, suppliers of raw materials, jigs and toolings are usually classified as lower-tiered companies.

MRO is focused on the provision of aftermarket support activities for aircrafts. MRO activities can range from a wide spectrum of service including providing a detailed inspection of the airframe and a comprehensive structural inspection of the aircraft; engine overhaul; maintenance of aircraft components such as navigation and control, communications, control surface movement, electrical power, and braking; and regular maintenance checks to ensure the aircraft is fit for flight[4].

Aviation, meanwhile, refers to activities involving aircraft operations (whether civil or military), airports and air navigation services.

2. Trends and Developments

2.1 Developments in the Global Arena

The global aerospace industry is projected to have very strong long-term growth prospects. In the market segment for civilian aircraft alone, there is a need to replace aging fleets and the demand for air travel continues to grow. One aircraft manufacturer forecasted a demand for newly-built passenger and freighter aircraft, with at least 100 seats, to reach 28,200, between 2012 and 2031[5]. This translates to a demand of more than 1,400 airplanes a year. It is expected that by 2020, mid- and old-generation aircrafts would represent only about 5% of the fleet in service[6].

This trend has driven manufacturers in the upper supply chain to outsource and shift production in order to reduce cost, focus on their core business, and increase efficiency.

2.2 Developments in the Philippine Scenario

As the boom period in the global aerospace industry continues. The Philippines aims to attract more

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AIAP logo.

Ms. Mercedita G. Abutal, Planning and Management Division Chief of the MIRDC joins the AIAP during its Planning Session in Baguio City in January, 2013.

investments from foreign aerospace companies. The country is once again on the radar of foreign investors as thePhilippines' manufacturing sector shows signs of resurgence.

The government is likewise positioning the country to become a market player considering the Philippines' competitiveness location for MRO operations and growing expertise in the manufacture of helicopters, high quality aircraft parts, and commercial aircraft galleys[7].

It is in this context that the Aerospace Industries Association of the Philippines (AIAP) was organized by industry manufacturers, contractors, suppliers, traders, dealers and importers. The association is committed to establishing a globally competitive and viable aerospace and aviation industry in the country. The AIAP seeks to promote the Philippines as an aircraft parts and components production hub by: increasing the sector's value added in manufacturing and services; raising the competency and capability of its members; and expanding its members' local and export markets.

The association aims to achieve this by developing the country's supply chain through the infusion of technology with partner technology providers, enhancement of manpower knowledge and skills through partnerships with government and educational/training institutions, and the application of quality management systems or implementation of productivity methodologies by member companies. In order to achieve this, the AIAP has spearheaded the formulation of a roadmap for the growth and development of the industry.

3. State of the Industry

3.1 Presence of Major Foreign Players

International companies have already established operations in the Philippines. Table 1 provides a partial list of companies with parent companies from abroad. Moog Controls Corporation, B/E Aerospace BV and Jamco Philippines are Tier 1 (direct) suppliers of Boeing and Airbus.

Attracting more foreign companies to invest in the Philippines would definitely help spur development of the industry. The presence of foreign players has likewise helped the Philippines in its pursuit of establishing a globally competitive identity. The aerospace sector is one of the most highly-regulated industries in the world. Aerospace suppliers must provide assurance that their products meet customer and applicable regulatory requirements consistently. Attaining a certification to the AS9100, an international management system for the aircraft, space and defense industry, is one way that suppliers demonstrate this capability.

Currently, only seven (7) suppliers in the Philippines have attained AS9100 certification. These companies are listed below in Table 2[8].

These companies have parent companies from abroad. The Philippines needs to develop a significant base of AS9100-certified suppliers in order to attract additional investors to the industry. Compared to neighboring countries in Asia, the Philippines

Table 1. International Companies operating in the Philippines

Machining	Aircraft Interior Fit-out	Maintenance, Repair and Overhaul (MRO)
• Moog Controls Corporation • D-J Aerospace, Inc.	• B/E Aerospace BV • Jamco Philippines Inc.	• Lufthansa TechnikPhils. Inc. (*joint venture with Macroasia Corporation*) • SIA Engineering (Phils.) Corporation • Aviation Partnership (Phils.) Corporation • Honeywell Systems (Phils.) Inc. • Asian Aerospace Corporation • Aerotechnik Services, Inc.

Table 2. AS9100 Certified Suppliers in the Philippines

Company	Scope of Certification
Assistance Aeronautique & Aerospatiale (AAA Dornier Technology Inc)	*AS9100C / JIS Q 9100:2009 / EN 9100:2009* -All technical services (production, quality, production engineering) for aircrafts and helicopters or elements of aircrafts and helicopters, carried out as subcontracted services on customers' sites or in its unit of Tarbes in accordance with the customers' cotracts, in France and abroad, by dedicated teams, formed and directed by AAA group.
B/E Aerospace BV	*ISO 9001:2008 and EN/JISQ/AS9100:2009* -Manufacture of Transport Category Aircraft Interior Components (Galley, Lavatory, Galley Inserts)
D-J Aerospace Inc.	*ISO 9001:2008 + AS9100C* -Machining, Forming and Heat-treating of Aircraft Components
Honeywell System (Phils.) Inc.	*ISO 9001:2008 and EN/JISQ/AS9100:2009; AS9104A* -Repair / overhaul of turbine power systems, aircraft propulsion, associated components, avionics/navigation, data/software systems and related airframe accessories for aerospace applications for military, space and commercial programs.
Microsemi Semiconductors-Manila (Phils.), Inc.	*ISO9001:2008 with AS9100:2009 Rev C* -Development, manufacture, production and test of discrete semiconductor devices
Moog Controls Corporation	*BS EN ISO 9001:2008; EN9100:2009; AS9100 Rev C* -Manufacture of Hydraulic and Mechanical Control Systems, Servovalves, Servoactuators and Components for the Aerospace and Industrial Applications, Repair and Overhaul of Moog Aircraft Servovalves and Servoactuators
Surface Technology Int'l Philippines, Inc.	*ISO 9001:2008 and AS9100:2009* -Manufacture and Supply of Printed Circuit Board and Box Build Assemblies for Aviation, Space and Defense Applications

Source: International Aerospace Quality Group (IAQG) Database Certified Suppliers Directory.

Table 3. No. of As9100 Certified Suppliers in Selected Asian Countries

Country	No. of Certified Suppliers
Japan	596
South Korea	228
Singapore	142
Taiwan	105
Malaysia	43
Thailand	24
Indonesia	11
Philippines	7
Vietnam	6

Source: International Aerospace Quality Group (IAQG) Database Certified Suppliers Directory.

Table 4. Air and Spacecraft Manufacturing in the Philippines

	2008	2010
Number of establishments surveyed	13	15
Value of Output (P1,000)	11,488,724	10,659,097
Value Added (P1,000)	3,812,305	2,713,949
Value Added / Value of Output	33.18%	25.46%
Total Cost (P1,000)	8,351,488	7,940,299
Intermediate Cost (P1,000)	6,568,751	6,608,739
Total Number of Employees	2,971	3,145
Compensation / Paid Employee (P1,000)	755	642.4

Source: 2008 and 2010 Annual Survey of Philippine Business and Industry (ASPBI), National Statistics Office.

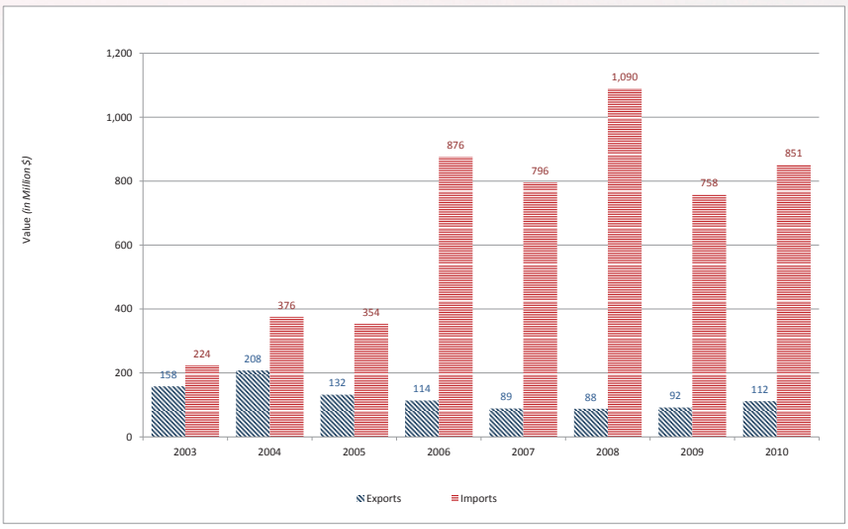
has one of the lowest number of certified suppliers. Table 3 shows that the Philippines lags behind Malaysia, Thailand and Indonesia.

3.2 Industry Performance

The National Statistics Office (NSO) conducts the Annual Survey of Philippine Business and Industry (ASPBI) to collect and generate information on the levels, structures and trends of economic activities for a specific year. The NSO adopts a classification system aligned to the ISIC for ASPBI.

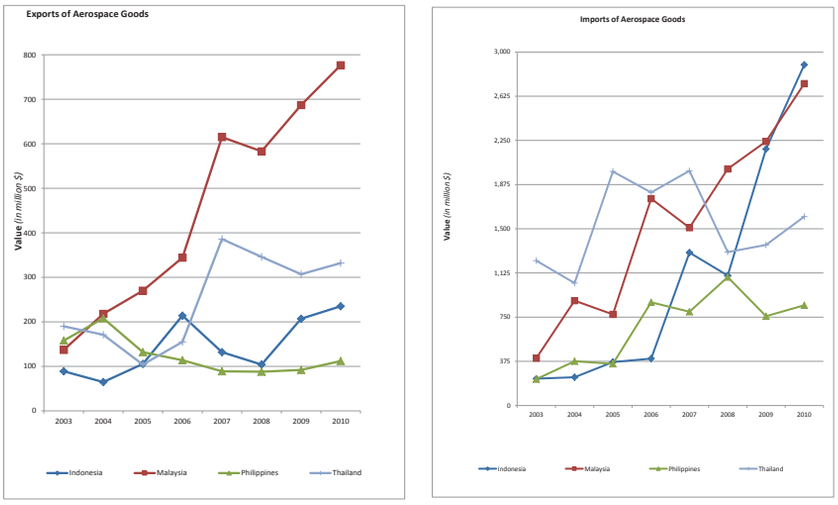
Table 4 provides summary statistics taken from the results of the

Figure 1. Philippine Exports and Imports of Aerospace Goods



Source: National Science Board. 2012. Science and Engineering Indicators 2012

Figure 2. Exports and Imports of Aerospace Goods of Selected Asian Countries

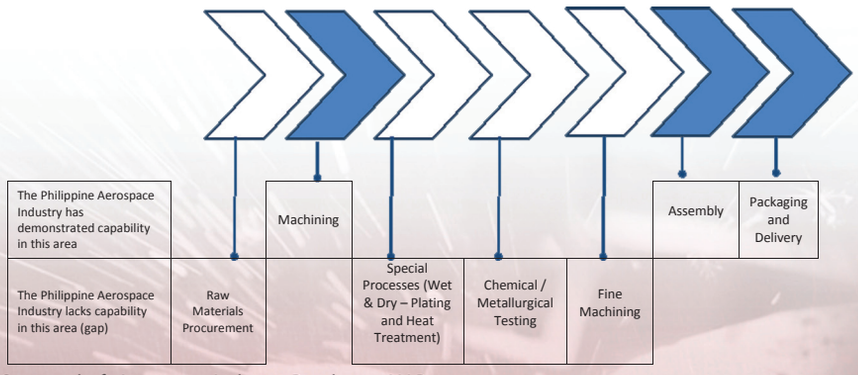


Source: National Science Board. 2012. Science and Engineering Indicators 2012

2008 and 2010 surveys for the manufacture of air and spacecraft and related machinery. The survey excluded other players in the aerospace industry that have been classified under other categories.

The results for both survey periods reveal that value added as a ratio of the value of output within the industry is low (less than 35%). This is symptomatic of gaps within the supply chain which should be addressed if the development of the industry is to be pushed.

Figure 3.Sample Supply Chain Analysis



Source: draft Aerospace Industry Roadmap, AIAP

3.3 Trade Performance

To produce a single aircraft, more than a thousand unique parts are required to be manufactured using different processes. Consolidation of statistics in order to record the trade of commodities in the aerospace industry is a very daunting task. Even the Agreement on Trade of Civil Aircraft of the World Trade Organization (WTO), signed by thirty-one countries to eliminate customs duties and other charges in connection with the importation of certain products used in civil aircrafts, listed over 200 product subheadings using international harmonized commodity descriptions. And yet, the list is not exhaustive of the products covered in the industry[9].

Figure 1 provides estimated values of aerospace goods imported/exported by the Philippines between 2003 to 2010[10].

There is a big disparity between the country's value of imports and exports. In 2003, for every dollar of exports, the Philippines imported $1.42 worth of aerospace goods. In 2008, the disparity increased further to $12.39 worth of imports for every dollar of export. This gap represents a potential market for local companies looking to enter the aerospace industry.

The country's trade performance can also be considered dismal when compared to neighboring countries. As shown in Figure 2, the Philippines lags behind Malaysia, Thailand and Indonesia. Malaysia exhibited the fastest rise in exports during the period. Indonesia, meanwhile, started with a low value of imports but eventually surpassed Malaysia by 2010.

3.4 Industry Gaps

The disparity between imports and exports and the low value added is partly due to the gaps in the industry's supply chain. Figure 3 illustrates a typical supply chain in aerospace manufacturing – starting from the procurement of raw materials to the packaging and delivery of the products[11].

Philippine companies commonly source raw material requirements abroad. There are a number of companies in the country that are capable of machining the parts requirements

of the Tier 1 suppliers operating in the Philippines.

However, as a result of the supply gaps, the next stages in the value chain have to be undertaken abroad. The Philippines lacks the capability in these areas although there are processes, such as anodizing, that could already be provided by current industry players.

The Philippine aerospace companies then import the parts for assembly, packaging and delivery.

3.5 Benefits to Other Industries

A developing aerospace industry will also impact tertiary industries such as tourism and air transport/civil aviation. Growth in air transport facilitates international trade, unlocks a location's tourism potential and promotes investment.

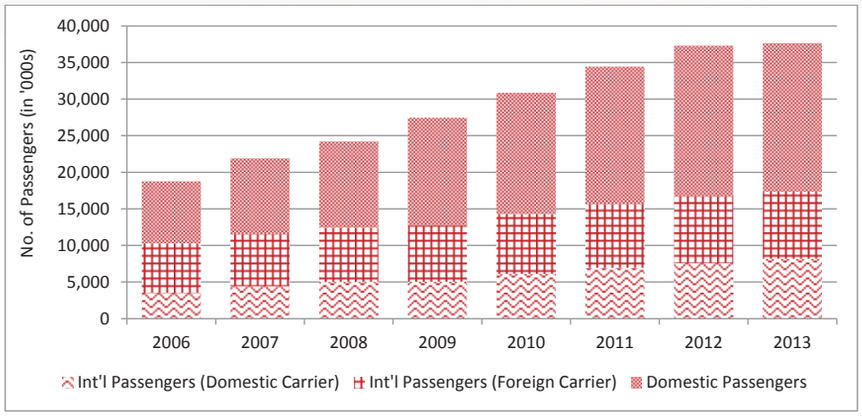
Air transport covers all transportation services, provided by air, and performed by residents of one economy for those of another involving the carriage of passengers, including international passenger transportation; the movement of goods (freight); rentals (charters) of carriers with crew; and related supporting and auxiliary services.

Air transport services are broken down to passenger carriage, freight/cargo, and support/auxiliary services. Other air transport services provided by the Philippines refer to the value of other supporting and auxiliary transport services which cannot be allocated to either the carriage of passengers or freight of goods. These services may include airport operation services (excluding cargo handling) and air traffic control services[12].

As mentioned earlier, the rise in the demand for new aircrafts is partly due to the growth in civil aviation. In the past four decades, world air traffic has doubled every 15 years[1]. Increased air traffic in return translates as a boost to the country's tourism.

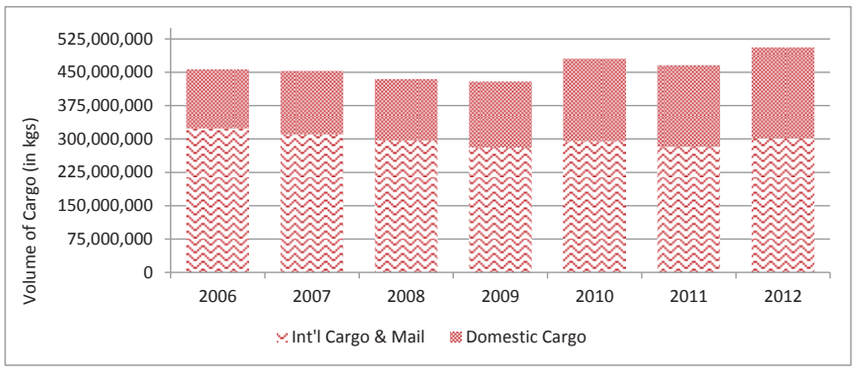
There are more than 80 airports operating in the Philippines. Figure 4 provides the number of air passengers in the Philippines from 2006 to 2013[13]. The number of domestic passengers

Figure 4. Philippine Air Passengers Traffic



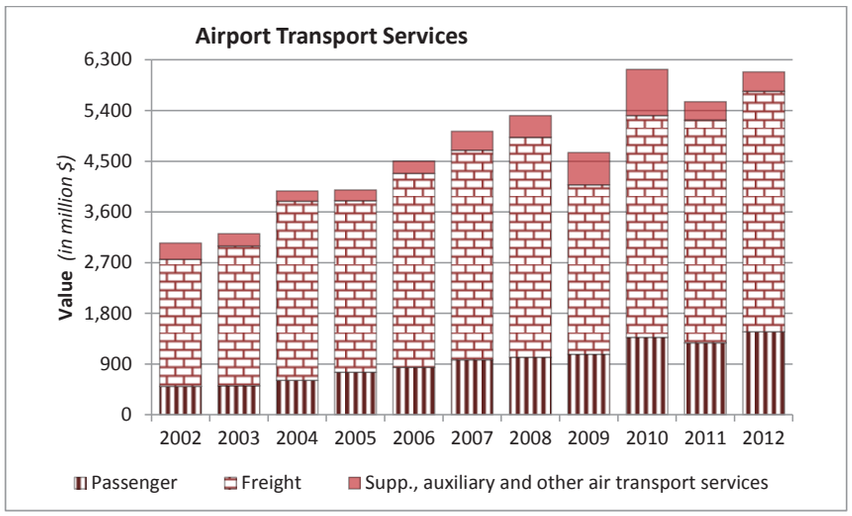
Source: Philippine Civil Aeronautics Board

Figure 5. Philippine Cargo Statistics



Source: Philippine Civil Aeronautics Board

Figure 5. Value of Philippine Air Transport Services (Imports)



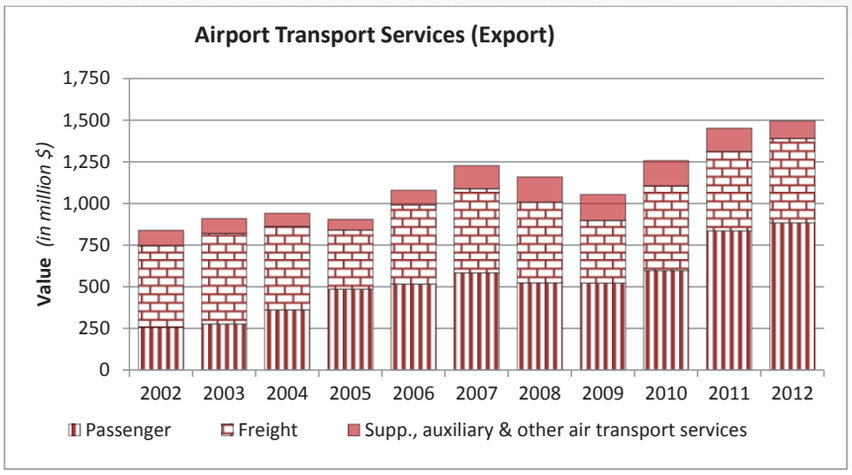
Source: UN Service Trade Database

increased from 8.47-million in 2006 to 11.78-million in 2008. By 2009, the number of domestic passengers has surpassed the number of international passengers as low cost carriers (LCCs) have made local travel more and more affordable. In 2013, domestic passengers reached 20.33-million while international passengers totaled 17.32-million. Foreign visitor arrivals have increased from 3.52-million in 2010 to 4.27-million in 2012. ,

In terms of freight, Figure 5 provides information on Philippine cargo statistics from 2006 to 2012[14]. The volume of domestic cargo increased from 132.64-million kilograms in 2006 to 204.64-million kilograms by 2012.

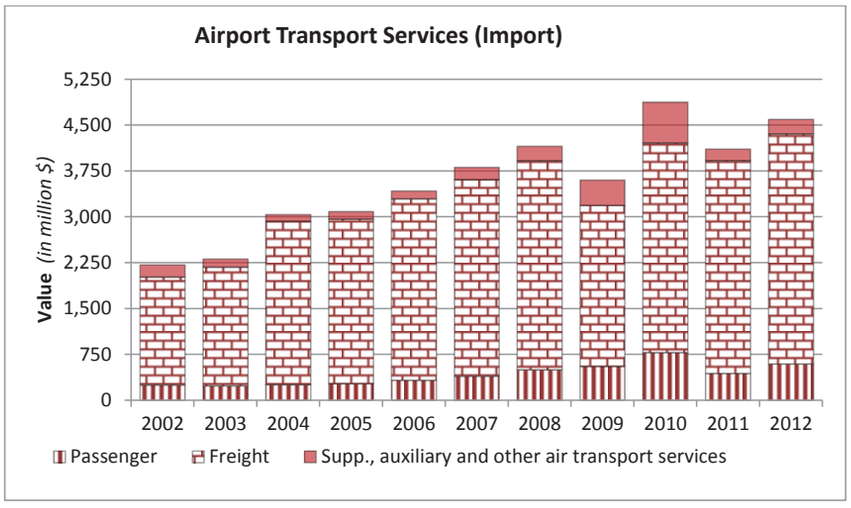
1 Navigating the Future, Airbus Global Market Forecast 2012 - 2031

Figure 6. Value of Philippine Air Transport Services (Exports)



Source: Bangko Sentral ng Pilipinas

Figure 7. Value of Philippine Air Transport Services



Source: Bangko Sentral ng Pilipinas

International cargo experienced a declining trend from 2006 to 2009, a period marked by high oil prices worldwide. The volume of international cargo and mail rebounded in 2010 to reach 295-million kilograms, declined slightly in 2011, and increased roughly to 301-million kilograms by the end of 2012.

From 2002 to 2012, roughly eighty percent (80%) of the value of air transport services came from cargo freight, largely on account of payments made to foreign carriers for the country's imported goods. In 2002, $1.76-billion worth of freight from other countries entered the Philippines (import of air transport services). This increased to $3.42-billion by 2008 and further to $3.76-billion in 2012[2,3].

In contrast, export data for air transport services show that the carriage of passengers contributes a higher value than cargo freight moved by domestic carriers outside of the Philippines.

An increase in the total value of trade for transport services, as shown in Figure 8, bodes well for the Philippine aerospace and aviation industries even if imports continued to outpace exports as this reflects an increase in air traffic. A deficit in freight services (imports is greater than exports) means that more goods are being moved into the country. A deficit in the air transport of passengers means that airline companies outside the Philippines are bringing in more passengers into the country as compared to the number of passengers transported outside by airline companies in the Philippines.

4. Potential Areas for Government Support

The AIAP formulated a roadmap to help chart the development of the Philippine aerospace industry. In their report, the AIAP emphasized the following areas where government can provide support: production and process capability/supply chain integration; training and education; promotions; and incentives.

Government support is needed in attracting investments that help bridge the supply gaps. The establishment of facilities for the following critical processes should be encouraged by government: nondestructive testing; surface finishing; gear manufacturing; composites manufacturing; and other special processes. As an alternative, AIAP also suggests that the government should consider establishing advanced manufacturing facilities that are vital to the industry but where the private sector does not want to venture in.

Government programs which help raise the competency of the workforce and enhance the technical capability of the firms in the industry are also needed to promote the Philippine aerospace industry to be globally competitive.

5. Summary

1. The aerospace sector is considered as a 'promising' industry for the Philippines. The country has potential to grow as a hub for aerospace manufacturing or MRO services. The development of aerospace parts manufacturing shall complement growth in MRO and, in turn, both shall further contribute to the development of other tertiary industries (e.g. civil aviation, tourism).
2. Value added in aerospace parts manufacturing is currently low. As a percentage of the value of output, value added comprises less than thirty percent (30%). Exports of aerospace-related goods are also low compared

2 http://www.nscb.gov.ph/secstat/d_tour.asp

3 http://www.nscb.gov.ph/beyondthenumbers/2013/05102013_jrga_tourism.asp#tab5

to imports. The main reason for these disparities is the lack of supply chain integration. This signifies a huge market potential for localization that the industry could tap into.

3. The gaps in the supply chain are evident in terms of special processes, chemical and metallurgical testing, heat treatment, and nondestructive testing facilities.

4. The industry has identified areas where government support is required: production and process capability / supply chain integration; training and education; promotions and incentives.

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Technical Study for the Value Adding of Philippine Iron Ore Resources

Agustin M. FUDOLIG,[*1] Carla Joyce C. NOCHESEDA,[*2] and Antonio V. ARIZABAL[*3]

Abstract

This paper examines the value adding of local iron ores in order to obtain maximum benefit from Philippine mineral resources. Ironmaking operations in the Philippines during the Spanish and American colonization era were reported and attempts of putting up modern operations particularly from1960s to the present were appraised. The Philippines has considerable deposits of iron ores, coal and natural gas and are of adequate supply to support an ironmaking facility in the country. Local lump magnetite is the most applicable iron source for an ironmaking facility. Natural-gas based DRI production will provide the most value adding since it can process local iron resources as well as natural gas deposits which has been recently extracted commercially in the country. Rotary kiln technology can also make use of local iron and coal resources but offers limited capacity and high environmental impact.

1. Introduction

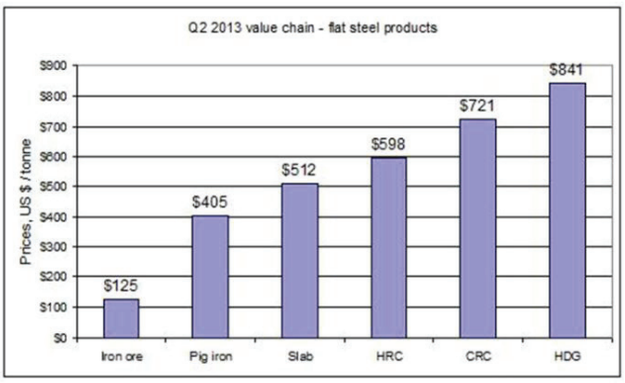
The Philippines is rich in mineral resources. It ranks among the top world producers of important precious and base metals and is considered as the fifth mineralized country in the world, third in gold reserves and fourth in copper.[1] The Philippines also ranks third in deposits of nickeliferrous laterite resources after New Caledonia and Indonesia. The more common minerals mined in the country include ores that contained copper, gold, chromium, nickel and iron.

The state of mineral resources extractions in the Philippines involves either shipping them directly as mined with little or no value adding, or they may undergo processing into intermediate products. According to a paper from Deloitte & Touche,[2] quite a large portion of the value adding process takes place outside of the resource-rich country. In most cases the resource-rich country operates the actual extraction of the ore and its subsequent concentration and further beneficiation into a saleable product defined by industry standards.

Figure 1 shows the prices of iron ore, pig iron and semi-finished flat steel products during the second quarter of 2013.[3] The transformation of iron ore to pig iron involves a value adding of around US$280/ton. A higher value adding can be realized in the Philippines considering the facilities available at Global Steel (formerly National Steel Corporation) in Iligan City which has the capacity to convert Slabs into CRCs.

In the Philippines, adding value to mineral resources may involve increasing the grade of the required metal compound or transforming the mineral into the desired metal or adopting the metal into usable items. Value adding of mineral resources thus involves mineral processing, extractive and/or adaptive metallurgical processes including manufacturing operations. The benefits of imposing value addition

Fig. 1. Value Chain of Flat Steel Products.



of mineral resources are not limited to getting more dollars from the increased value of the mined ore but it also creates additional jobs, which is essential for a developing economy.

In the case of iron resources, the Mines and Geosciences Bureau (MGB) reported that 1,255,356 DMT of iron ore concentrates was shipped abroad in 2012 by Leyte Ironsand Corp., Ore Asia Mining and Development Corp. and small scale iron sand mining companies from Region 2.[4]

There were previous and present bills in the Philippine Congress to impose prohibition on direct shipping ore and promoting value adding. The Philippine Development Plan 2011-2016 as issued by National Economic Development Authority (NEDA)[5] also recognizes the mining industry's potential as a driver of economic growth promoting the development of downstream industries to maximize the benefits or value-added from mining.

More recently, President Benigno S. Aquino III signed Executive Order No. 79, "Institutionalizing and Implementing Reforms in the Philippine Mining Sector, Providing Pol-

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icies and Guidelines to Ensure Environmental Protection and Responsible Mining in the Utilization of Mineral Resources," which provides for the development of a national program and roadmap for the development of value-adding activities and downstream industries for strategic metallic ores.[6]

This study looks into the possibility of value adding Philippine iron ores. Generally, this will provide technological solutions to obtain maximum benefit from value adding of iron resources in the Philippines particularly its function in the integration of the iron and steel industry, including the iron castings industry.

2.0 Iron and Ironmaking Reductant and fuel reserves of the Philippines

In order to evaluate the value adding of Philippine iron resources, the extent of iron deposits in the country must be known. Likewise, it is also necessary to examine the local coal and natural gas resources since these serve as potential reductant and fuel in many ironmaking processes. Charcoal making is also included herein since these were used as reductant and fuel in most of the indigenous small scale smelting activities.

2.1 Iron Ore

Previous studies made on Philippine mineral resources provide important information on iron ore reserves. Diaz-Trechuello's[7] study on the Philippine economy during the 18th century stated that among the first iron mines to be developed in the country were those of Mambulao (now Municipality of Jose Panganiban) in Camarines Norte where operations can date as far back as 1653. The Sta. Ines iron mines in the Province of Tondo (now part of Rizal) was also discovered around 1758. Kreiger,[8] in his study of Philippine primitive weapons, mentioned that the mining of iron ore in the country has been carried for centuries in the Angat Mountain region in Bulacan Province.

McCaskey[9] also confirms the iron ore sources in Angat, Bulacan, as reported to the US Secretary of Interior a few years after the US occupied the Philippine Islands. The report also included other important deposits of magnetite and hematite which were found in Abra Province, in San Miguel, Bulacan, in Bosoboso, Rizal, and in Camarines Norte. Foreman[10] made mention of the Sta. Ines mine which is near Bosoboso, previously of Morong district, now Rizal province.

According to the MGB, the important iron districts of the Philippines are those in Ilocos Norte, Ilocos Sur, Camarines Norte, Cotabato, Nueva Viscaya, Surigao, Cagayan Valley, Marinduque, Zamboanga del Sur, Samar, Rizal and Davao (see Table 1).[11] The important iron deposit classification are skarn (contact metasomatic) followed by magnetite sand.

The most applicable Philippine iron ore deposits for ironmaking would be the magnetite deposits, which require concentration by magnetic separation before becoming suitable for smelting reduction or direct reduction process.

Table1. Some Iron ore reserves in the Philippines[11]

Location	Ore reserves
Calamaniuga, Appari, Cagayan	1 million MT >50% Fe hematite and magnetite ores
Jose Panganiban, Camarines Norte	21 million MT of 26.1% Fe magnetite ore
Sta. Ines, Rizal	33.5 million MT 32-33% Fe magnetite ore
Carasi, Ilocos Norte	796,000 MT of 58% Fe magnetite ore
Sta. Cruz, Ilocos, Agoo, La Union	4.2 million MT magnetite sand
Surigao Peninsula	1.0 billion MT 47%Fe laterite
Nonoc Island, Dinagat	150 million MT of 47% Fe laterite

2.2 Coal

The recoverable coal reserves in the Philippines can amount to 316 million ton composed of around 41 million tons of anthracite and bituminous and 275 tons of sub-bituminous and lignite.[12]

Coal deposits, both lignite and anthracite, have been mined in Cebu during mid-1800s, although they are reportedly not quite profitable. Coal were also mined in Albay and Sorsogon province, particularly in the island of Batan. By 1925, the three (3) districts were considered principal coal fields; Cebu; Batan Island in Albay; and Malangas in Mindanao (Zamboanga Sibugay).

Coal deposits in the towns of Malangas and Kabasalan in Zamboanga Sibugay were considered the most exploited source of high grade coal ranging from semi-anthracite to subbituminous.[13] It was considered as a good source of coking coal back in 1966 owing to its grade and large quantity, estimated at round 10 million tons.

The Semirara Mining Corporation is the largest coal producer in the Philippines engaged in surface open cut mining of on Semirara Island, Antique. Coal Asia Holdings, which plans to operate the second largest coal facility in the country, has a potential coal resource of 120 million metric tons.[14]

2.3 Natural Gas

The estimated natural gas reserves of the Philippines ranges from 5.8 to 20.7 TCF (trillion cubic feet) as shown in Table 2[15]

Table 2. Estimated Philippine natural gas reserves[15]

Gas Fields	Minimum (BCF)	Prospective (BCF)	Maximum (BCF)
Proven			
Camaga/Malampaya	2,528	3,340	4,277
San Martin	243	359	454
San Antonio		4	
Total	**2,771**	**3,703**	**4,731**
Potential			
Mindoro-Cuyo	2,720	7,060	11,120
Cotabato	60	1,158	1,760
Cagayan	176	322	518
Central Luzon	78	637	2,594
Total	**3,034**	**9,177**	**15,992**
Grand Total	**5,805**	**12,880**	**20,723**

The Malampaya natural gas field comprises 90% of the proven gas reserves. It is located in the West Philippine Sea which is one of the major production offshore facilities in the Philippines that opened in 2001. The natural gas is pumped to Batangas where it is used by a natural gas processing plant and three power generation plants.

Another natural gas field located in the same area is the Sampaguita gas field in the Recto Bank (also known as Reed Bank) which is 80 nautical miles northwest of Palawan, well within the Philippine's maritime Exclusive Economic Zone (EEZ). This gas field has been an area of exploration since 1970. It has an estimated high of 16.6 TCF and 416 million barrels of oil.

2.4 Charcoal

In the Philippines, charcoal production is basically done through the indiscriminate cutting of trees from the forest thus mitigating the recent issuances of charcoal making bans in several provinces. Tree plantations in the country are growing trees for purposes of lumber and little or none is aimed at charcoal production.

Charcoal and its other forms play a major role in meeting the energy requirements of the population more so in the rural areas.[16] Charcoal making in the Philippines as an industrial material has been limited to the carbonization of coconut shell into activated carbon for the gold processing industry and as an absorption agent. In Brazil, charcoal has been used in the production of metallic iron from ore,[17] wherein the resulting pig iron has low sulfur content than those iron produced using coal or coke.

3.0 State of Ironmaking in the Philippines

The smelting of iron ore into pig iron in the Philippines always went hand in hand with its mining during Spanish rule, These smelters also served as foundries where the melt is cast directly into usable items; ship-nails, plowshares, plow points, anchor, etc.[7] instead of producing pig iron. Iron ore was not treated then as a commodity that can be traded, and thus necessitating its value adding for local consumption.

During the American occupation, the value adding of iron ore continued the practice and use of the smelting furnaces during the Spanish time. These furnaces were said to be similar to iron smelters used in China.[18]

3.1 Angat, Bulacan smelting furnaces

Blast furnaces operated in the country during the entry of American occupation as reported by McCaskey,[9,19] are around 1.8 m high with internal diameter of 0.7 m at the bottom and widening to 0.82 m at the top and having an output of around 2-3 t/month. In a report by Dalburg and Pratt in 1925,[20] bigger furnaces were also operated at heights of 2.25 m and diameters of 1.0 m at the top and with an output of around 7 t/month. The operating at fuel rates of 1,700 kg of charcoal per ton of ore which are inefficient based on today's standards. These smelting furnaces were operational even up to the 1970s.

3.2 NASSCO Project

In view of Republic Act No. 1396, the National Shipyards and Steel Corporation (NASSCO) was tasked to put up a Pig Iron smelting facility. Based on initial designs of the metallurgical plant, it has a projected rated capacity of 40 tons pig iron per day or 12,000 MT per annum at an estimated 300 operational days in a year.[21] The NASSCO pig iron smelting plant was designed to make use of local iron ores, coal and limestone. It reportedly had a working height of 6 m and a working volume of 30 m^3. It completed a total of eight (8) campaigns from January 1966 to March 1969 where it produced a total of 4,745 tons of pig iron.[22] Its longest campaign lasted for 88 days producing 1,761 tons equivalent to around 20 tons/day or half its rated capacity. The highest average daily output was during its 7th campaign which yielded 27 tons/day. The coke rate was at 1,140kg for every ton of pig iron.

During its trial operations, it used imported coke instead of local coal leading to its closure since it was deemed uneconomical at that time due to the high cost of coke which comprised 62% of the operating cost.

3.3 Sta. Ines Steel Corporation

In March 1961, the ironmaking plants of Sta. Ines Steel Corporation were almost nearing completion at Laguna de Bay. This project involved Germany's Krupp Industries and the Inter-Consulting Ltd., of Zurich, Switzerland. This project was started during the term of President Carlos P. Garcia but appeared to have been discontinued during the term of President Diosdado P. Macapagal which started in December 30, 1961, since the latter supported the creation of the Iligan Integrated Steel Mill Inc. (IISMI).

3.4 Nippon Steel Corporation Study

In this study, Nippon Steel recommended the erection of two (2) blast furnaces with a combined capacity of 2 million tons per year of crude steel after 8 years (1981).[23] However, start-up will consider a single blast furnace at a capacity of 970,000 tons per year which can be established in a 5-year period (1979). Construction of the second blast furnace at 1,030,000 tons per year capacity will however commence even if the first furnace is not yet completed.

The proposed facility is complete with coking ovens, sintering plant, steelmaking, hot strip mill, blooming/slabbing and billeting mill. The source of iron ore however was partly imported, considering the depletion of reserves since the Philippine Iron Mines at Larap, Jose Panganiban, Camarines Norte was already near its mine life at that time.

3.5 ECAFE Study

Complementary to the study being made by Nippon Steel Corporation, the Economic Commission for Asia and the Far East (ECAFE) under the United Nations Industrial Development Organization (UNIDO) made a five-week study to address the "widening gap between rising steel demand in the Philippines and stagnant indigenous capacity."[24]

The study made mentioned of value adding plans of three (3) Philippine companies which were contemplating sponge iron production. The Engineering Equipment Inc. (EEI) embarked on a pilot scale operation involving reduction of an ore-coke briquette in an inclined shaft. FILMAG planned to add value to the iron sand concentrates mined at the coasts of La Union and Ilocos Sur involving solid-solid reduction by charging the iron sand together with coal in a rotating kiln. Marcelo Steel was in negotiations with HyL and Midrex where bench scale tests were already conducted by these companies.

The UNIDO/ECAFE considers both the blast furnace and direct reduction processes. However, the study recommends putting up one large blast furnace (about 1 – 1.2 million tons per year) instead of two small ones which would require less capital. For the direct reduction route, it recommends either HyL or Midrex since they are already commercially applied elsewhere.

3.6 JICA Study

Between 1977 and 1979, President Marcos approved a recommendation by Japan's Ministry of Trade and Industry (MTI) of an Integrated Steel project under Japan's offer for concessionary financing for one major. A pre-feasibility study was undertaken by the Japan International Cooperation Agency (JICA) wherein the project was seen to be viable at a capacity of 1.5 million tons per year of crude steel.

The project however, was deprioritized by the Philippine Government in 1979 in favor of allocating the Japan Government financing for Project of Considerable Economic Importance.

3.7 NSC's Five-Year Expansion Program (FYEP) I and II

The National Steel Corporation (NSC) initiated a ten-year expansion program (Five-Year Expansion Program I and II or FYEP I and FYEP II) back in 1981 which included plans to establish a 1.5 million tpy Ironmaking-Steelmaking facility based on a Direct Reduction-Electric Arc Furnace (DR-EAF) route.[25]

The NSC considered several commercially available DR technologies which included the SL/RN, Krupp-Codir, DRC, Midrex and HyL Process. However, due to the absence of natural gas resources during that time, Midrex and HyL were dropped in the evaluation.

NSC was already in the final phase of negotiations with Thyssen-Krupp for the installation of a Krupp-Codir direct reduction process in Iligan City when Sen. Benigno Aquino was assassinated in August 1983 which brought an end to these plans.

3.8 US Steel Study

In 1990, the US Steel Corp. (USC) performed a study on the integration of the National Steel Corporation (NSC), particularly on its Flat Product steel plant in Iligan City. The USC recommended that a 2 million tons per year integrated Blast Furnace and a Basic Oxygen steel plant with continuous casting to produce slabs is a viable integrated iron and steel mill. However, the Philippine Government found the US$ 1,000/ton/year capacity a bit too high back in 1992 and decided to put the project on hold until it could find a financing source.

3.9 Proposed Ironmaking plants under the PISC

The Presidential Iron and Steel Committee (PISC) was created under Executive Order No. 7316) in order "to advise and recommend policies to the President of the Philippines on the over-all directions of the iron and steel industry in the country." Several proposals for the putting up of primary ironmaking facilities were received by the committee for endorsement to the President.

F. Jacinto Group, Inc. (FJGI)

In 1993 to 1994, the FJGI has submitted three (3) proposals for the local ironmaking projects and their integration to steelmaking:[26,27]

1. Transplanting of the mothballed Krupp Hoesch Rheinhausen Works of Germany to the Philippines which involved two (2) blast furnaces at a capacity of 2 million tons each.

2. Relocation of the 2.8 million ton capacity Ravenscraig integrated iron and steel facility of British Steel of Scotland.

3. Establishing the Philippine Integrated Steel complex by using the Corex process. Three (3) alternatives were proposed: a 1-furnace at 1.4 million tpy hot metal; 2-furnaces at 700,000 tpy hot metal and the last option is for a furnace operating at 300,000 tpy hot metal.

All of these proposals allowed FJGI to claim pioneer status for incentives from the government, but none was realized.

Philippine National Oil Company (PNOC)

In 1999, The PNOC proposed a project on "Combined Gas-Fired Power Plant and Iron and Steelmaking Facility," to the PISC. The iron making facility makes use of the Corex technology with a projected 1.66 million tons of steel production per year. The proposed facility also produces electric power, slag for cement production, and possibly methanol and urea for fertilizers.

Though this project was already endorsed by the PISC to the Office of the President for approval, it was caught in the transition of leadership from Estrada to Arroyo and never took off.

3.10 Treasure Steelworks Corporation (TSC)

The TSC is a subsidiary company of TKC Steel which manufactures and distributes steel products. In 2009, TSC put up 2 mini-Blast Furnaces (BFs) at 128 cubic meters each designed to produce about 700 MT of liquid iron per day. When operational, the 2 mini BFs will consume about 1200 MT of iron ore, 420 MT of coke and 180 MT of limestone per day. TSC holds the pioneer status from the BOI for this undertaking. However, recently, TSC announced that it is

going to produce nickel pig iron using local laterite sources for burden.

3.11 Ferromet Resources, Inc.

Ferromet Resources, Inc., a Filipino-owned single proprietorship company, started trial runs in value adding of local iron ores in San Ildefonso, Bulacan in 2009. Ferromet initially employed the direct reduction process for sponge iron production, where metallization was only at 75%,[28] though target is at 90%.

In 2012, Ferromet shifted their trial iron smelting procedure from direct reduction process to low-shaft blast furnace using local ore and locally sourced charcoal producing pig iron. The charcoal blast furnace of Ferromet is 5 m high and internal diameter of 0.8 m producing low sulfur pig iron.

4.0 Considerations in the Choice of Ironmaking Process for Philippine Resources

The compatibility of commercially available ironmaking processes with the Philippine mineral resources can be evaluated base on the scale of production. The ironmaking process that would prove most viable in the value adding of Philippine mineral resources considers not only the type of ores to be treated, but also the kind of reductants and fuel that will be utilized.

4.1 Scale of Production

The Philippine Iron and Steel Institute (PISI) and the Philippine Steelmakers Association (PSA) reported that the Apparent Steel Consumption (ASC) of the country stands at 6 million tons in 2012 which is quite a big jump from consumption of 4.1 million tons in 2010.[29,30] It was further estimated that for such ASC, 50% can be attributed to local production and the rest due to imports of semis and customer products.

By focusing only on the local steel demand, there is a big potential for the localization of crude steel amounting to around 3.0 million tpy thereby creating a potential for the value adding of domestic iron ores. Furthermore, putting up an ironmaking facility with higher capacities, e.g. over a million tons per year, will have an impact on the localization of the domestic steel demand.

4.2 Type of Ironmaking Product

The type of ironmaking product is of utmost consideration when factoring in the value chain of downstream industries. The production of DRI will be of importance to the domestic steel industry since it can be further processed for the production of steel with an electric arc furnace. However, it has little significance to the local foundry industry since they require their ferrous raw material to already contain carbon particularly for producing cast iron products. Foundries prefer pig iron as raw material in gray and ductile iron production since they already contain the required carbon content of the aforementioned castings. These foundries also prefer to use steel scrap instead of DRI in producing cast steel for reasons of cost and ease in melting.

Thus, considering only the demand of the steel industry, DRI and hot metal (pig iron) production are the types of iron products which are both applicable for steelmaking purposes.

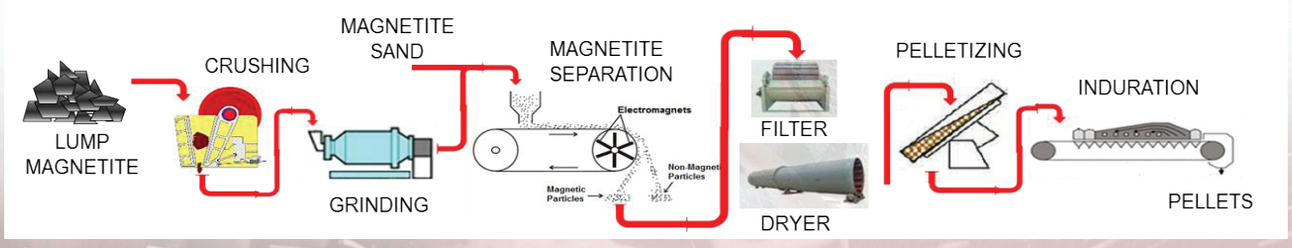
4.3 Type of Iron Ore

The Philippines lack hematite ore as discussed earlier, but lump magnetite ore abounds where around 55 million tons of deposit is known. However, the iron content of these lump magnetite deposits contains an average of 30%Fe, necessitating their beneficiation to increase iron grade to above 65%Fe making them suitable for ironmaking processes. Beneficiation to increase this grade will yield around 25 million tons of fine magnetite concentrate. Iron sand sources can also be used but Philippine mining and environmental laws restrict their extraction.

Since the raw material of iron ore to be used for ironmaking will be in the form of fine magnetite concentrate, agglomeration is required to produce pellets which will make it viable for the different ironmaking processes involved, including those making use of fluidized bed techniques. Figure 1 illustrates the operations involved in beneficiation and agglomeration of lump magnetite ore.

The run-of-mine lump magnetite ore will undergo crushing and wet grinding to liberate magnetite minerals which is then separated from the nonmagnetic materials (gangue) using a magnetic separation machine. This will raise the %Fe in the magnetic concentrate. The recovered magnetic minerals are filtered and dried prior to pelletizing in a pelletizing drum yielding 10-20 mm diameter pellets of iron ore. These pellets are indurated to harden the pellet and also transform Fe_3O_4 to Fe_2O_3. The transformation of

Fig. 1. Pre-treatment of iron ore by Beneficiation and Agglomeration



magnetite to hematite is needed since it dramatically boosts the reducibility of iron oxides.

4.4 Type of Reductant and Fuel

The reductants and fuels locally available for ironmaking purposes are coal and natural gas. Coal deposits, however, are mostly not of the coking coal variety which makes them unfit for blast furnace operations. Ash and volatile matters content of these coals are also quite high.

On the other hand, the Philippines have just recently make discoveries of natural gas deposits which were not being considered in previous studies for ironmaking. In view of the potentially high amount of natural gas deposits in the country, their use as reductant for high capacity DRI production is highly recommended.

With respect to charcoal as reductant and fuel, there are several concerns particularly that the forest cover of the Philippines is now quite small compared to decades ago.

In the 1970s, the Philippines embarked on wood-fired power plant projects to reduce its dependence on costly imported oil, which was referred to as the Dendrothermal program. This program was a failure and discontinued for reasons which include among others, the inability to properly grow the feedstock trees of Ipil-ipil (Leucaena leucocephala). Managed tree plantations for Ipil-ipil can yield 22-30 ton/hectare/year.[7] Typical commercial charcoal operations yield 1 ton charcoal for every 5 tons of wood. Thus, an hectare of land can yield around 4.4 to 6 tons of charcoal a year.

5.0 Value adding of Philippine mineral resources using a blast furnace

Most of the hot metal production in the world can be attributed to blast furnaces. The blast furnace has been one of the major ironmaking process contemplated for the integration of the iron and steel industry in the Philippines.

Among the commercial ironmaking processes the blast furnace is the only existing technology available in the Philippines at present being represented by the two (2) mini blast furnaces already installed by Treasure Steelworks Corp. in Iligan City. Thus, it is very important to determine compatibility of this facility to the value adding of Philippine iron ores as well as potential reductants and fuels that are also locally available. Fluxes of limestone and dolomite for use in the blast furnace can already be sourced locally.

The iron ore currently used in blast furnaces are usually hematite ore, which may be in the form of lump ores, as sinters (iron ore together with limestone and coke), or as pellets (iron ore mixed with binder and indurated). However, Philippine iron ores are mostly lump magnetite which needs to be pelletized or sintered first.

Our iron reserves will be more than sufficient to support iron ore burden requirements for the mini blast furnaces at TSC which will consume about 430,000 tons of iron ore per year. It must be noted that the annual production of hot metal from these two mini blast furnaces is only around 250,000 tons per year and comprises a meager 4% of the apparent steel consumption.

With respect to the fuel and reductant requirements for operating a blast furnace, there are very few coking coal deposits in the Philippines, and thus, the coke required will involve either the direct importation of coke or importing coking coal and processing them into coke by operating a coking oven locally. Both options will not contribute to value adding of Philippine coal resources.

In the case of operating a low shaft blast furnace, it has a disadvantage of high fuel rate, consuming more coke than a regular blast furnace. The NASSCO low shaft furnace had a coke rate of 1,140kg for every ton hot metal as compared to 450 kg/ton hot metal for large blast furnaces. Also, the shorter shaft height reduces the throughput time for an ore feed at the top by around 1/5 that of a regular blast furnace thus, shortening the reduction zone for the transformation of iron oxide to iron. The use of magnetite which has relatively poor reducibility may not be applicable for this kind of smelting reduction furnace. Thus, value adding of our magnetite resources using the low shaft furnace may not be efficient, but possible.

Operating a charcoal blast furnace is not feasible due to unreliable sources of charcoal. In order to operate a charcoal blast furnace producing 10,000 tons of pig iron per year, it will require around 7,000 tons/year charcoal. For a plantation harvest cycle of three years, this is equivalent to around 3,500 to 4,770 hectares planted with Ipil-ipil dedicated entirely to charcoal blast furnace operation. Low yields of the Ipil-ipil plantation can mean shortages in charcoal, and thus stoppage of the charcoal blast furnace operations. The failed project on the dendrothermal power operation in the Philippines may be repeated and would also spell disaster for the sustainability of a charcoal blast furnace.

6.0 Value adding using the Corex Process

In the COREX process, the metallurgical processes are done in two separate reactors: the Reduction Shaft and the Melter-Gasifier. Iron ore is fed into the Reduction Shaft where it is reduced to Direct Reduced Iron (DRI) by the reducing gas produced at the Melter-Gasifier in a counter current fashion.

The application of the COREX process to local iron ores and reductants cannot be fully realized. Experience indicate that non-coking coal of very high VM or very low FC cannot be used in this process,[31] which would make most of our coal unusable. In fact, coke is also used in COREX operations to blend with non-coking coals to lower VM and increase FC.

It is important to note that the recent ironmaking plans of the Philippines during the time of the Presidential Iron and Steel Committee in the 90s considers the COREX method as the most promising technology for the integration of our iron and steel industry. But that was during the time when natural gas in the Philippines was only starting commercial use.

7.0 Value adding thru Direct Reduced Iron (DRI) Production

During the plans for the integration of the iron and steel industry in the 1950s, the blast furnace was always the major consideration against other ironmaking processes. Caution in the adaption of DRI production technology has always been raised. However, quite a number of DRI processes has been proven commercially.

The recent commercial application of natural gas in the Philippines presents a large potential for a locally sourced raw material in ironmaking.

7.1 Midrex and HyL Processes

The Midrex process is the most adapted DRI process with 74 operating plants worldwide with scales of production varying from 350,000 to 1.76 million tons per year (tpy) of DRI.[32] This process involves the reduction of iron ore by natural gas which passes through a gas reformer. The Midrex process can make use of our magnetite concentrates and natural gas deposits. The process needs 16.2 BCF natural gas to produce 1.76 million t DRI/year equivalent to 2.3 Gcal/t DRI, which the Philippine natural gas reserves can fully provide. Most of the existing Midrex plants are near the natural gas source which could be a challenge when this ironmaking plant is going to be established here.

The Midrex process was among the technology thought of during the 70s by Marcelo Steel and NSC in the 80s but the reductant being considered then was reformed gas from coal sources. The recent commercialization of natural gas in the country would boost the potential of this process.

Similar to Midrex, the HyL (Hoganas y Lamina) process also makes use of natural gas as reductant. This is the second most adapted natural gas-based technology in DRI production. Around 29 HyL facilities are operating worldwide with capacities ranging from 200,000 to 1.60 million tpy of DRI.

The process comprises a moving bed in a shaft furnace reactor wherein reducing gases are introduced to remove the oxygen from iron ore pellets. It operates at slightly higher reduction temperatures and intermediate reduction pressures than the Midrex process.

The iron ore material input for HyL Process is flexible even with those containing high Sulfur since the process includes a sulfur removal step prior to the conventional steam reformer. It must be noted that Sta. Ines iron ores, and those mined in Larap contained considerable Sulfur as pyrite, FeS. This particular process stands a high applicability for the processing of our indigenous iron ores.

7.2 Rotary Kiln Technology

The most widely used coal-based ironmaking process using non-coking coal as reductant and fuel is the rotary kiln method. The process can make use of lump ore, pellets or beach sand and solid carbon to produce DRI.

The application of rotary kiln technology is also included as a potential ironmaking process since our local coal deposits are of the non-coking variety. This technology has been widely used in India and South Africa since it can make use of use low-quality coal. Thus, our local deposits of bituminous (low, medium, high VM) coal deposits can be used in this process. The use of a rotary kiln is less energy efficient than the blast furnace due to very high residual gases, wherein some plants resort to using these residual gases for power generation.

India leads in the commercial application of rotary kiln for ironmaking where 38 rotary kilns are operating at capacities of 30,000 to 150,000 tpy of DRI. The rotary kiln process will be applicable for processing local iron ores and will make use of our local coal deposits as well. However, the scale of production for each plant is limited to 150,000 tpy, and thus a battery of them is needed to address the apparent steel consumption.

7.3 Rotary Hearth Technology

In the Rotary Hearth Furnace technology, the process can make use of our magnetite concentrates, non-coking coal and natural gas deposits. Steel Dynamics Inc. in the USA is one commercial application of this technology which produces 500,000 tpy of iron nuggets containing 96 to 98% iron and the remainder being carbon. This plant makes use of the ITmk3 (Ironmaking technology mark 3), an ironmaking process owned by Kobe Steel of Japan.

The application of this technology in the Philippines will benefit both the steel industry as well as the foundry industry since the product is similar to pig iron. It can make use of the local magnetite ores, non-coking coal as well as our natural gas. The plant operation is also very flexible since retention time is very quick compared to the other ironmaking technologies.

8.0 Concluding Remarks

The Philippines has considerable deposits of iron ores, coal and natural gas. These raw materials can be utilized and are of adequate supply to support an ironmaking facility in the country. The recent commercial extraction of natural gas deposits in the country and its continued exploration would mean a cheap and readily available reductant and fuel for iron ore processing.

The following are assessments of several commercial ironmaking processes for their applicability to the value adding indigenous iron and reductant resources:

1. A conventional Blast furnace (BF) operations can make use of our local iron ores but will not add value to local coal deposits since most are non-coking varieties. The same is true for adapting a mini BF since input material are the same, and thus importation of coke is inevitable. Using charcoal as fuel and reductant may not be sustainable considering the extent of plantation required for charcoal making.

2. Adaption of a Corex process will make use of our iron resources but will only partially use our coal deposits since most local coals have more than 25% Volatile Matters (VM); a limitation for reductants used for

Corex. Coke is inevitably part of this process which will be imported.

3. Both the natural gas-based Midrex process and HyL process can make use of our magnetite concentrates and natural gas deposits. The HyL process further stands out due to its applicability for high sulfur iron content ores which characterizes some of our lump magnetite deposits.

4. The use of rotary kilns can make use of local iron ores and domestic coal deposits but plant capacities are low. To address the apparent steel consumption of the country, several units has to be constructed which will also impact on the environment.

5. Production of iron nuggets through the ITmk3 Rotary Hearth furnace technology can make use of our magnetite concentrates, non-coking coal and natural gas deposits. The product of this process which is similar to pig iron is applicable to both the steel industry and the foundry industry.

9.0 Recommendations

In view of the evaluation of the applicability of commercial ironmaking technologies to the value adding of our indigenous resources, it is recommended to further conduct a techno-economic feasibility of the following ironmaking processes for the value adding of local mineral resources, including environmental impact and the potential locations:

1. Midrex process
2. HyL process
3. Rotary kiln processes
4. Rotary Hearth Furnace (RHF) Process.

To conduct the techno-economic feasibility, a pilot plant may be needed to provide reliable data for putting up an ironmaking facility in the country. A pilot plant may need to be constructed first to reduce the risk associated with the construction of an actual facility. In identifying which ironmaking pilot plant will be proposed for construction, it is recommended to visit established ironmaking plants of the above processes, as well as visit their existing pilot plants and laboratories operating bench scale tests.

Lastly, due to the big potential in making use of our natural gas for ironmaking purposes, it is recommended that changes in the current policies regarding the use of coal and natural gas for industrial use on top of its being presently used in power generation should be advocated.

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Development of a Micro Cupola
for Foundry Research, Instructions and Small Novelty Items Casting Production

Lemuel N. Apusaga,[*1] Mervin B. Gorospe,[*2] Florentino J. Lafuente,[*3] Cornelio S. Baldon,[*4] and Romeo C. Bermudez[*5]

Traditional Japanese teapots and wind chimes are just some of the sample products of the Micro Cupola.

ABSTRACT

Typical cupola furnaces in the Philippines have a minimum size of 18 inches in diameter with a production capacity of at least 700 kg per hour. For regular commercial foundry operation, these furnaces are ideal due to the availability of molds. For teaching foundry technical and vocational courses however, these furnaces place undue demand both on the required volume of starting materials and the amount of molds needed where the resulting molten metal will be poured. In addition, budget constraints caused by the high cost needed to purchase the required volume of foundry coke and scrap metals force most schools offering foundry courses to shut down or limit the use of their equipment for teaching. This paper reports on the development of a small cupola furnace with a production capacity of 150 kg per hour and tap weight of 30 kg. A melt temperature of 13700C was achieved on the very first tap. High alumina castables were used as refractory linings resulting to a low-maintenance furnace. The developed small-capacity furnace consequently requires a small volume of starting materials, making it an ideal tool for teaching foundry-related technical, vocational, and even engineering courses. The furnace can also be used by entrepreneurs in the production of limited-run iron souvenir items and small agro-industrial iron implements.

INDEX ITEMS micro cupola furnace, iron souvenir items, iron agro-industrial implements, foundry technology, foundry technical vocational courses, pyrometer, thermal imager, phosphate-bonded rammable alumina castable, hydraulic-chemical-bonded free-flow alumina castable, foundry coke, blast air volume and pressure measurement.

I. INTRODUCTION

The cupola furnace, invented by John Milkinson in 1794, is one of the oldest and most cost effective methods of melting cast iron. The furnace is basically a cylindrical vertical shaft

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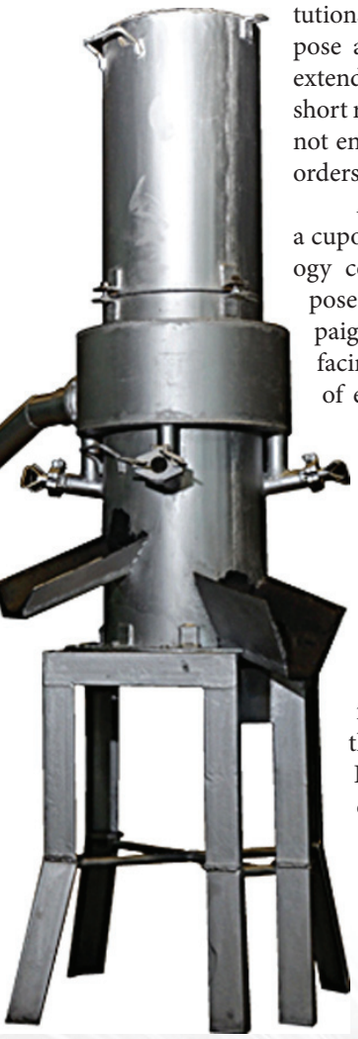
where molten metal is produced by the heat of the reaction between oxygen and carbon supplied by the blast air and foundry coke. The basic operational principles of the cupola furnace have not changed since its invention. Cupola furnaces can be made in virtually any size to fit the molten metal requirement of a foundry. The size of the cupola, through its internal diameter, generally dictates its melting rate.

In the Philippines, the available cupola furnace typically has a minimum of 18 inches in diameter and a melting rate of at least 700 kg per hour. These are the types of furnaces used by foundries and even educational institutions. Starting these cupola furnaces use a considerable amount of fuel and raw materials such as foundry coke and charge iron. Hence, to be profitable, these furnaces have to be operated for several hours per campaign to recover the starting expenses. A campaign of several hours requires preparation of molds and accumulation of orders on several tons of castings.

For commercial foundries with regular cast iron production, these requirements may not be a concern. For small jobbing foundries and educational institutions teaching foundry technology, these may pose a problem. Delivery lead times may be extended or they may be forced to unprofitable short runs just to meet delivery commitments if not enough molds are prepared or not enough orders are accumulated.



An educational institution might operate a cupola furnace for teaching foundry technology courses. High operational expenses can pose a problem in maintaining regular campaigns for teaching. In addition, schools are facing problems on the decreasing number of enrolees in foundry technology courses. Some of these schools no longer offer foundry technology programs.

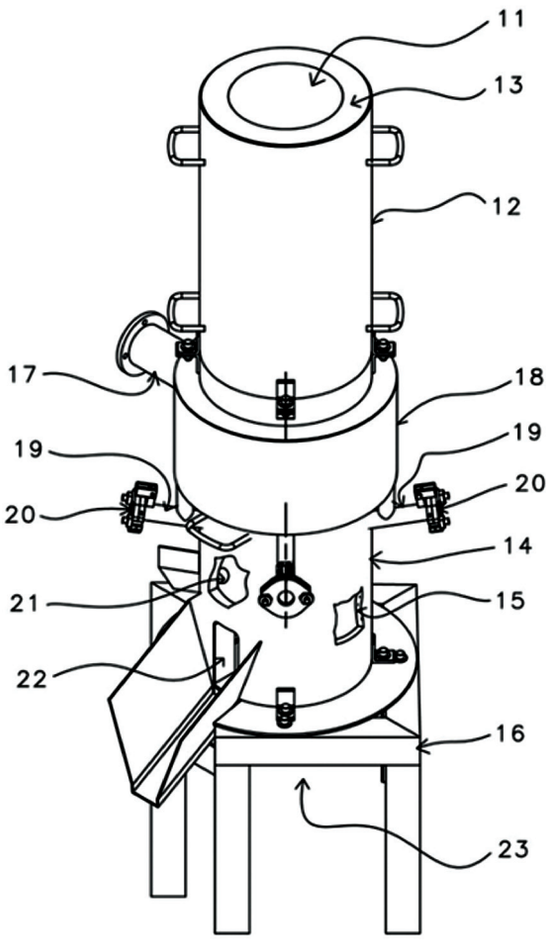
The project aims to develop a 10-in diameter small cupola furnace for cast iron melting. Being small, the starting requirements would also be low. This furnace will be ideal for small foundries with small cast iron melt requirements such as those producing novelty items for souvenirs. In fact, the inspiration for this project came from the recent trip to Iwate, Japan where small foundries produce various cast iron novelty items for souvenir.

The small or Micro Cupola Furnace may also be able to help with schools offering foundry education. It will require considerably lower starting resources resulting to lower operational expenses. More frequent campaigns can be made for a more effective teaching program.

The project was co-implemented with the Bataan Peninsula State University (BPSU), Balanga Campus, through its College of Engineering. The partnership provided a good opportunity for immediate deployment of the furnace in an educational setting. Since the BPSU is already operating a cupola furnace in their foundry, immediate comparison and evaluation for its suitability in this application were conducted.

II. DESIGN, CONSTRUCTION AND OPERATION

A cupola furnace of any size can be built depending on the melt requirement of a foundry. For commercial applications, common sizes have melting capacities ranging from 1 to 36 tons per hour. Micro-foundries and hobbyists are known to use cupolas with melting capacities of around 150 kg per hour or smaller.



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In the US, there are several books written about building and operating small cupola furnaces notably by Stephen Chastain and Stewart Marshall. The design parameters and principles of building a micro cupola, as discussed by Chastain, is the same as that of standard-sized cupolas.

The micro cupola was designed and constructed based on established requirements, dimensions and specifications of a standard iron melting furnace. The main reference used in the furnace design and operation was the book written by Stephen Chastain entitled, "Iron Melting Cupola Furnaces." Significant inputs with regard to design, choice of refractories, and practical operational practices were provided by the technical consultants tapped for the project. The BPSU team provided important contribution in actual foundry situation operation of the micro cupola furnace.

Design Modifications

Several design modifications were implemented to suit the requirements of the project:

- The structure was made modular and collapsible for easier fabrication, maintenance, and transportation;
- Wind belt was strategically located in consideration of possible refractory failure and shell melting;
- Castables, instead of bricks, were used as shell refractory lining for easier installation and improved performance;
- The structure made can be fitted with tuyere diameter reduction assembly to modify the blast air velocity;
- There is a provision for oxygen enrichment;
- The micro cupola is equipped with an oversized blower to enable testing up to the capacity of the shell.

Fabrication

Majority of the fabrication works were done at the MIRDC, while complicated sections were outsourced to commercial fabricators.

Lining and Sintering

For this project, the micro cupola shell was lined with better performing refractories, and not firebricks. The objective was to develop a cupola furnace with a lower maintenance cost by using a refractory capable of longer campaign period before needing replacement or repair. Maintenance cost refers to the total costs incurred by the materials as well as the man-hours used in the work.

In addition, a high tonnage refractory is needed by the project team to be able to focus on the cupola operation and improvement and not on the maintenance. The team used a casta-

Fig. 2: Various stages of micro cupola fabrication: (a) shaft fabrication, (b) stand and other accessories, (c) tuyere and wind belt fabrication, (d) tuyere and wind belt assembly, (e) blower and accessories assembly, (f) painting and completion of assembly.

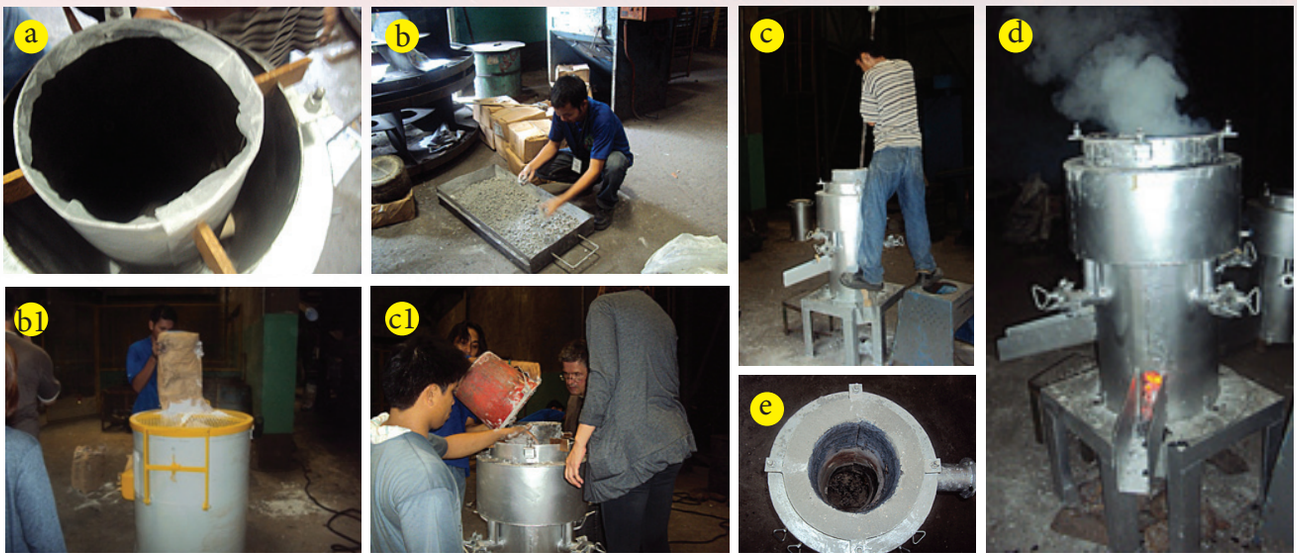


Fig. 3: (a) Preparation of the furnace shell for lining; (b) Preparation of the phosphate-bonded rammable alumina castable; (b1) Preparation of the hydraulic-chemical free-flow alumina castable; (c) Installation of the rammable lining; (c1) Installation of the free-flow lining; (d) Initial sintering of the lining; (e) Cupola furnace with refractory lining installed ready for full sintering.

ble type refractory for the lining of the furnaces. Since two (2) units of the furnace will be built, two types of castables were evaluated. One is a phosphate-bonded rammable silica-based castable and the other is a free-flow hydraulic-chemical bonded silica-based castable. These were selected after evaluation of their performance in ladle applications. The installation and sintering of these refractories were supervised by their respective manufacturers.

Micro Cupola Operation

The micro cupola operation is the same as operating an industrial-sized cupola furnace with the same basic procedures. Operating a cupola furnace exposes the operator to some hazards such as open flames, hot objects, intense heat, radiant light and high velocity dust. Proper protection equipment must be worn at all times.

III. METHOD

Performance Indicators

The micro cupola furnace was evaluated on several traditional performance criteria such as:

- Tap weight;
- Melting rate;
- First tap melt temperature; and
- Cost of melt

Controlled Factors

The above performance indicators were evaluated against the following factors:

- Blast air pressure and volume; and
- Type of foundry coke

Preliminary Tests and Trial Runs

Prior to the formal evaluation of the furnace, the following preliminary tests were conducted in an attempt to establish several baseline data:

- Charge density test to establish the height taken by a given weight of charge inside the cylindrical shell. The information is needed in the coke burn rate test;
- Coke burn rate test to establish if the blower was indeed oversized; and
- Shell temperature profile test in an attempt to detect the level of hot coke by thermal imaging the furnace shell.

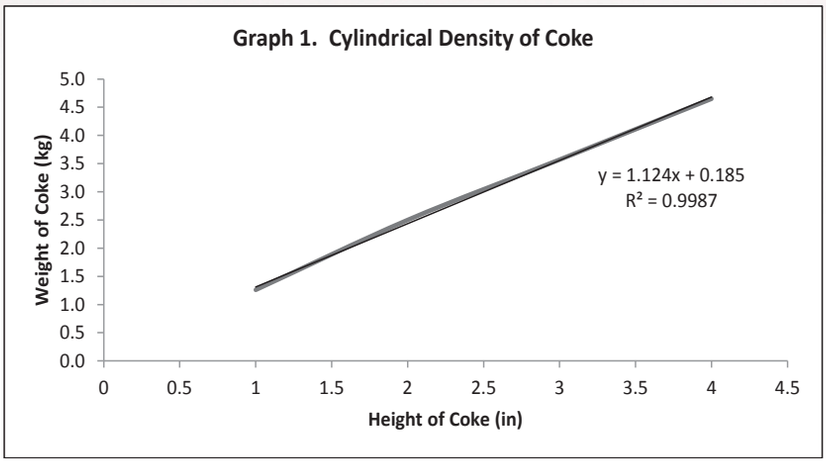
Several trial runs were also conducted for the project team to become acquainted with the operation of the furnace. Below are the structural modifications implemented to improve the handling, control and safety aspects of the furnace:

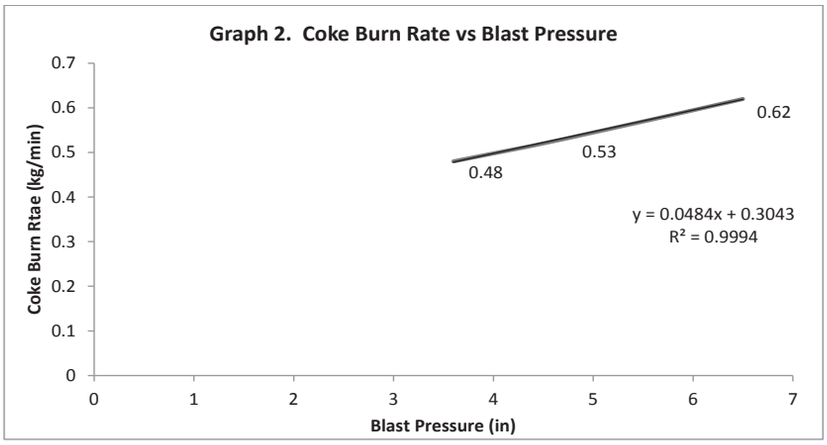
- Increase in the stand height to improve access to the bottom door during furnace shutdown;
- Improvement of the tap and slag runners;
- Installation of charge slide for safe charging; and
- Improvement of mating points between the top and main shells.

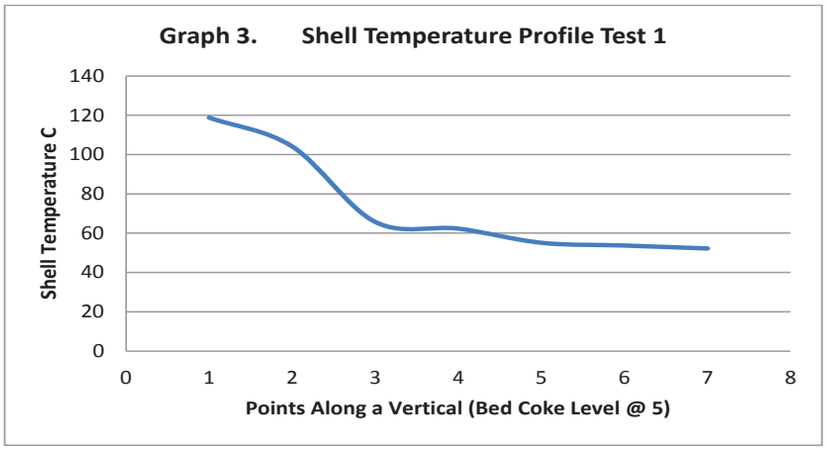
Others

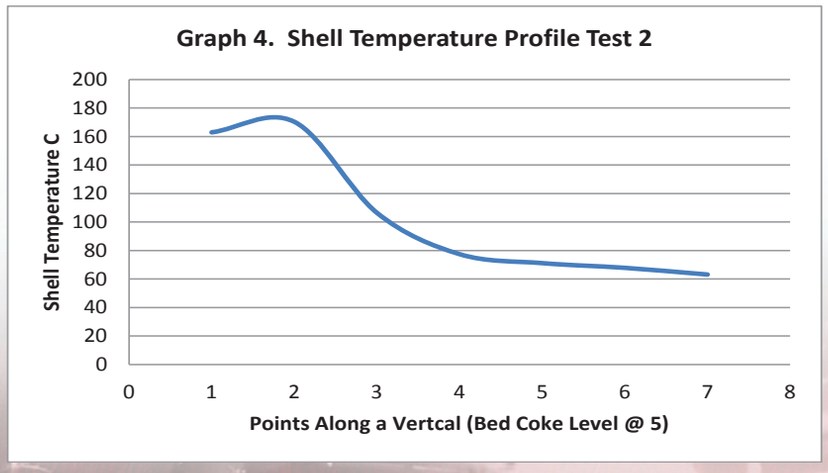
To reduce uncertainties in the measurements and the possible problems that might be encountered during the testing and evaluation, several precautions and preparations were taken:

- Use of highly durable, high-alumina content refractory linings to minimize the maintenance work in between heats. The alumina linings were so durable that the only maintenance done was cleaning in between heats. In traditional standard alumina content refractories, repairs and patching may have been needed in between heats;
- Use of uniform-sized metal charges. To prevent possible bridging caused by unevenly-sized metal charges, the project team prepared metal charges with identical dimensions of 2”x 2”x 0.5.”









IV. RESULTS AND DISCUSSION

Preliminary Tests

Charge Information Test

The Charge Information Test was conducted to determine the vertical space occupied by a given weight of foundry coke in the cupola stack. The information will be used in the subsequent Coke Burn Rate Test.

Coke Burn Rate Test

The Coke Burn Rate Test was conducted to determine if the blower is overrated. An overrated blower will enable evaluation of the furnace to its maximum capability.

As indicated in graph 2, the old blower was not overrated with the curve still increasing. The result was verified when the new more powerful blower was evaluated. The new blower produced much higher blast air pressure and volume and results to higher melting rate and higher melts temperature.

Shell Temperature Profile Test

The Shell Temperature Profile Test was conducted to determine if there is a correlation between the level of the burning bed coke and the outside shell temperature. The determination of the bed coke level is important to enable proper charge ratio adjustment. The bed coke dictates the melting rate and the temperature of the melt.

The test results show that there seems to be no correlation between the level of the burning bed coke and the outside shell temperature. It was, however, possible that the test methodology and data analysis may not be sufficient to determine the correlation. For the time being, the project team reports the results as is. (See Graph 3, 4, and 5)

Formal Cupola Performance Test Results

Melting Rate Performance

One of the primary objectives of the project is to develop a micro cupola furnace capable of producing 150 kg

of molten metal per hour of operation. The latest data achieved was 180 kg per hour. (See Graph 6)

The micro cupola developed successfully performed in this criterion.

1st Tap Melt Temperature Performance

Depending on considerations such as casting wall thickness, distance to mold, number of molds to be poured, a tapping temperature of at least 13000C may be considered sufficiently high. The micro cupola melt temperature on the first tap is shown on Graph 7.

The micro cupola can produce hot enough molten metal on the very first tap.

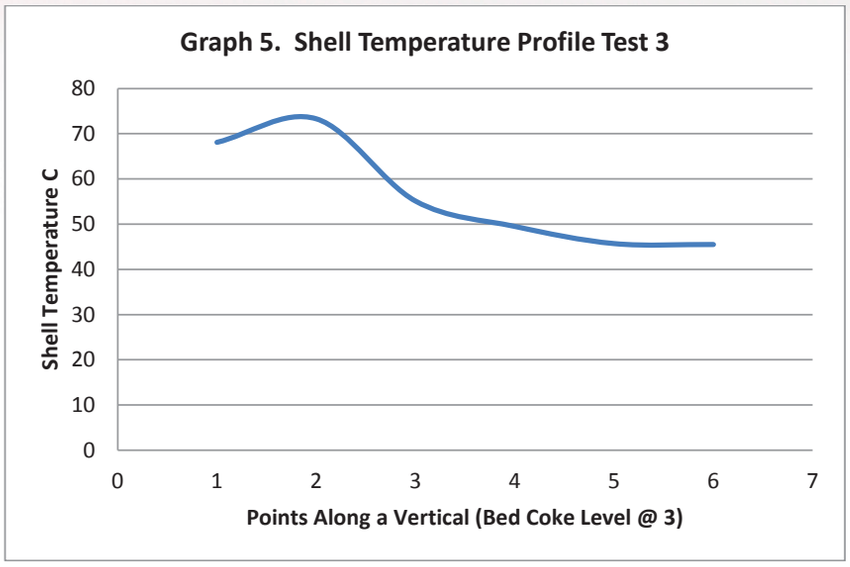
Cost of Melt Performance

The cost of cast iron castings in commercial foundries in the Philippines ranges from P65 to P100/kg. The cost per melting per kg of cast iron using the micro cupola furnace is shown on Graph 8.

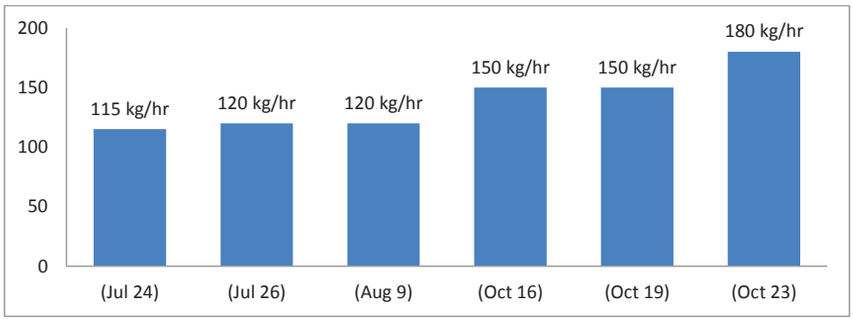
The data were computed based on 2–3 taps of operation. The costs will still decrease on extended melting campaigns because the starting costs are distributed over larger amount of melt.

The costs are incurred just for the melting. Other casting processing costs such as for molding, fettling, heat treatment, machining, labor, equipment depreciation, etc. need to be accounted for the final casting cost. Typically, melting accounts for at least 30% of the casting cost depending on the type of casting. In this regard, the micro cupola must be used to produce castings not sold per weight as they cannot compete with foundries operating bigger cupola furnaces.

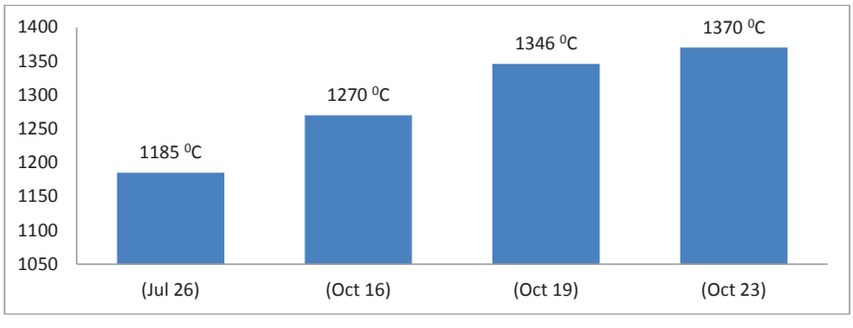
The higher melting cost in small cupola furnace is because they normally have lower efficiencies than bigger furnaces. A cupola with a 10-inch diameter typically has a coke ratio of 1:4 to 1:6 (coke:scrap iron) while bigger furnaces typically operates at 1:10 to 1:13.



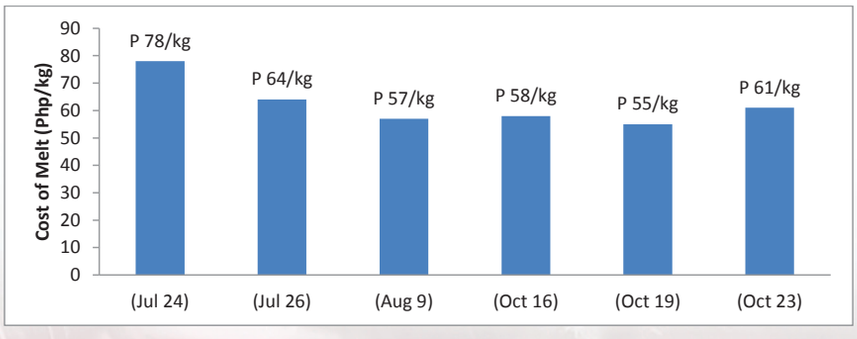
Graph 6. Melting Rate Performance

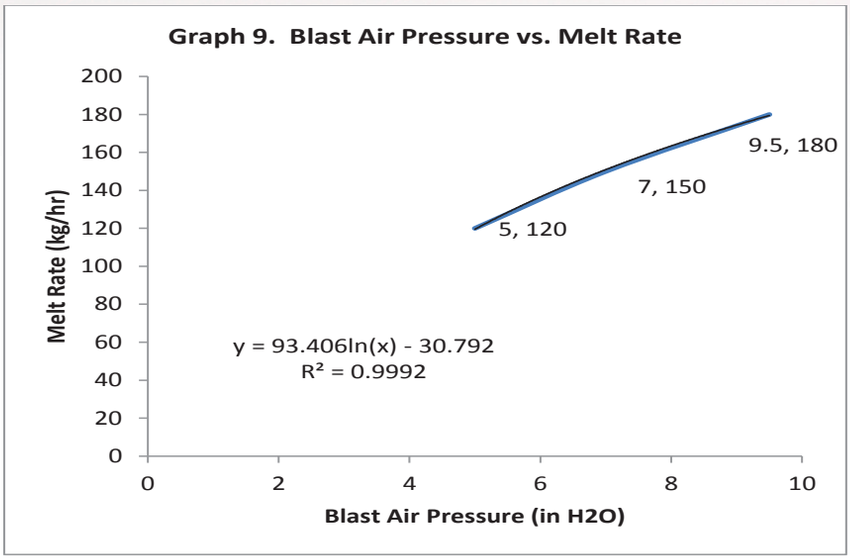


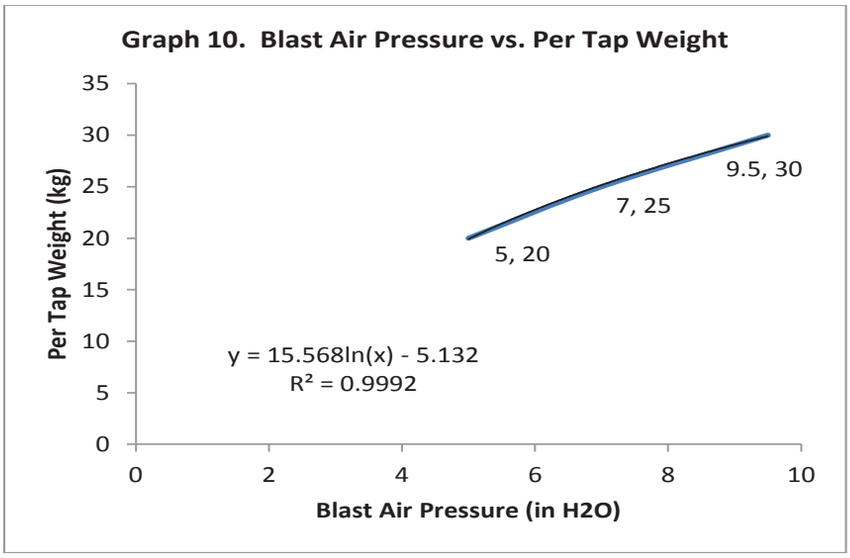
Graph 7. 1st Tap Melt Temperature Performance

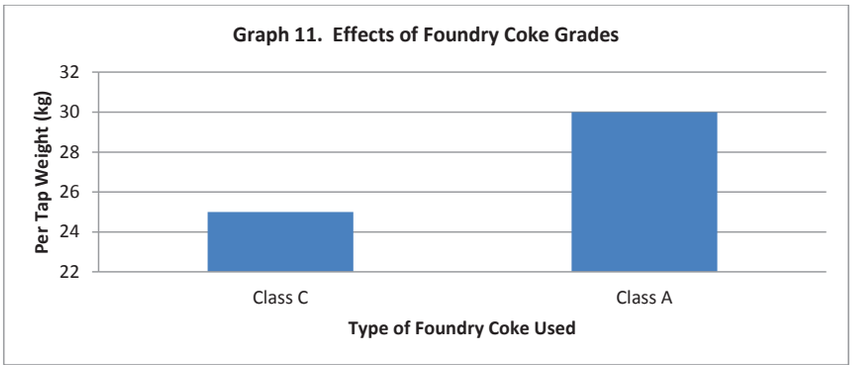


Graph 8. Cost of Melt Performance









Effect of Blast Air Pressure

A higher blast air pressure results to higher melting rate. This is because more air is available for the reaction between carbon and oxygen resulting to more heat generated.

The amount of air that can be blown in the 10-inch micro cupola is only up to 165 cfm. Beyond this amount, the air blown already exhibits cooling – the molten metal already solidifies before coming down the tap hole runner. (See Graph 9 and 10)

Effects of Different Grades of Foundry Coke

The grade of foundry coke used has significant effect on the melting rate of the micro cupola furnace. In the Philippines, there are two grades commercially available – Class A and Class C foundry coke. Both coke grades are imported from China. (See Graph 11)

Shell Refractory Comparison

The two units of micro cupola produced for this project were installed with castable refractory linings. Typical cupola furnaces in the Philippines use firebricks as lining. The observations on the performance of the lining in the micro cupola furnaces are shown on Graph 12.

So far both types of castable linings installed in the micro cupolas performed well. However, a complete comparison with bricks cannot be made because the project team did not have a furnace lined with firebricks. In addition, computations of full assessment can be done only until the linings used are sufficiently eroded and need to be replaced or repaired.

The castables contributed significantly to the project by not failing and exhibiting excessive erosion. The need to repair or replace them could have significantly delayed the project and limited the cupola's achievements.

BPSU Unit Melting Performance

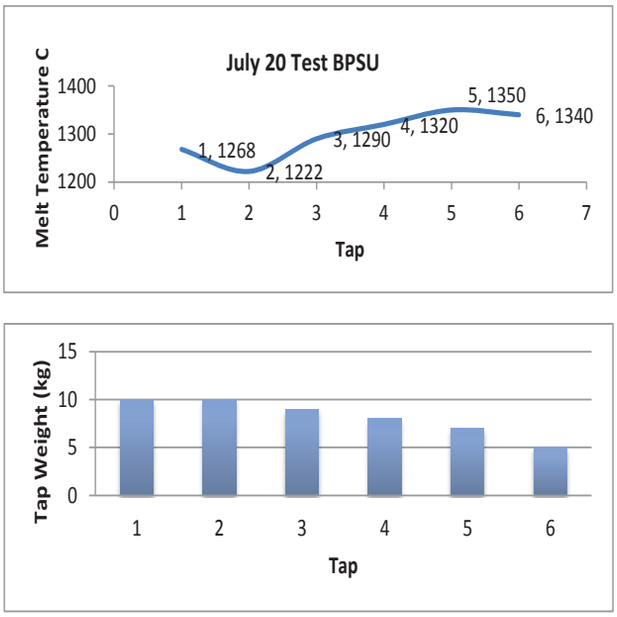
The project was co-implemented with the BPSU primarily because they operate a foundry with an 18-inch cupola furnace. They are in a very good position to evaluate the performance of the micro cupola furnace in an actual foundry environment. The MIRDC project team visited on two occasions and recorded the performance of the micro cupola furnace assigned to them.

The BPSU team is composed of regular foundrymen with years of experience in cupola furnace operations. The micro cupola was delivered to them on July 20 and was operated. There is a marked difference on the performance of the furnace when it was tested again on Oct. 24 due to the more powerful blower that was installed in the BPSU unit. (See Graph 13 and 14)

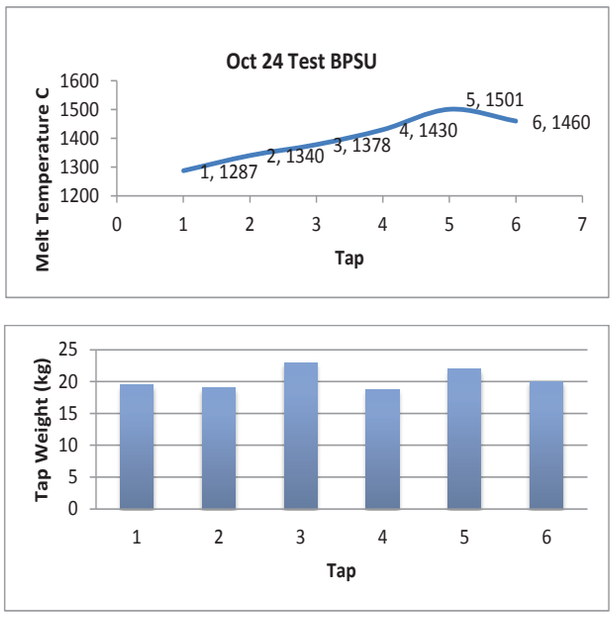
Graph 12. Shell Refractory Comparison

Particulars	MIRDC Unit	BPSU Unit	Remarks
Type of shell refractory	Hydraulic-chemical bonded free flow 80% alumina castable	Phosphate-bonded rammable 85% alumina castable	No definitive conclusion can be yet derived
Number of trials	20 hours	21 hours	
Observations and repairs conducted	No noticeable lining erosion after 40 hours	No noticeable lining erosion after 21 hours	

Graph 13.



Graph 14.



V. LIMITATIONS AND FUTURE WORK

Mature Technologies for Dissemination

The micro cupola furnace technology locally developed in this project can already be considered mature and ready for dissemination, adoption and commercialization. The project team believes that the capabilities of the present micro cupola design and configuration can already be promoted for adoption, either for commercial application or for use as training equipment in foundry technology courses. Given that several other parameters were not yet fully investigated, the performance of the micro cupola can still be significantly improved.

Inherent with small cupola, however, is their lower operational efficiencies compared with bigger furnaces. In this regard, the adoopter must carefully consider the type of products to be produced to be profitable. While the micro cupola cannot compete with bigger furnaces on mass produced castings sold per weight, the micro cupola has the following inherent advantages:

- faster lead times because of lower number of molds needed to commence operation
- capability to produce batches in smaller quantities
- if used as teaching aid, requires lower resources to be operated and maintained

These characteristics of the micro cupola furnace can be advantageous for the production of souvenir items where smaller amount of melt is needed. Delivery times can be fast on small quantities. Being works of art, these products rapidly change in designs and styles to be always on the mainstream.

Hobbyist metalcasters can also benefit from the low melting rate of the micro cupola as they typically only need small amounts of molten metal for very limited runs castings.

Research and Development Breakthrough

The micro cupola furnace is no longer a "new" equipment. It has been developed a long time ago in Japan, thus, this R&D project cannot claim any breakthroughs. It is continuously being operated until now to produce souvenir items and other cast iron castings in the US, China and possibly in other countries. The project

only discovered the technology to be disseminated and promoted for adoption by the local entrepreneurs and for possible use by schools in teaching foundry technology courses.

Technologies that Need Further Verification

The project team focused on establishing the operational parameters and furnace design configuration that will result in higher melting rate and higher melt temperatures. The performance of the cupola can be further increased with investigation of other parameters such as:

- Effect of tuyere diameter
- Effects of oxygen enrichment
- Effects of coke sizing

Another aspect of cupola operation that the team was not able to evaluate is the proper charging ratio that will enable continuous campaign. One major limitation of the project team in the determination of this parameter is the insufficient amount of iron scrap charge available at a time. Since the project team uses a controlled size scrap iron charge, its production cannot keep up with the evaluation requirement. The scrap iron charge is casted and its production is in time with the foundry's cast iron melting schedule.

VI. CONCLUSION

At the end of the project duration, the team was successfully able to achieve the following objectives:

- A micro cupola with a melting rate of approximately 180 kg per hour and a tap weight of 30 kg produced every 10 minutes was developed.
- Sound trial castings were successfully produced establishing the capability of the cupola furnace to produce sufficiently hot molten metal for pouring into castings.
- Several cupola performance indicators such as melting rate, per tap weight, melt temperature, campaign length on different commercially available refractories and cost per kg melt were successfully evaluated.

The project team however was not able to explore the effects of oxygen enrichment. The team was able to design, outsource fabrication and complete delivery of the oxygen enrichment accessory, unfortunately, there was not enough time to conduct experiments. It should be noted that oxygen enrichment is an advanced and potentially dangerous technique in cupola melting and should NOT be lightly attempted by beginners. Sufficient experience in cupola melting, planning and preparations, verifications of all components and training on oxygen equipment handling may be required before attempting to melt with enriched oxygen. The project team estimates an additional 5 to 6 months of work is needed to evaluate this aspect of cupola melting.

There is an ongoing application for funding for another cupola development project for 2014. The effects of oxygen enrichment can be fully evaluated in this project.

- The cupola was promoted to the academe and the industry by staging a project launching activity attended by members of the academe and the industry. In addition, the team was able to produce a promotional brochure for the micro cupola.

- The BPSU was able to successfully integrate the micro cupola in their foundry operations, serving as additional equipment in their foundry technology program.

Considering the various limitations of the project team such as being absolute beginners in cupola design and operation, majority of the project objectives were still accomplished within the allotted official project duration.

VII. ACKNOWLEDGMENT

The project team wishes to acknowledge the invaluable assistance provided by the following individuals in the completion of the project:

Delfin O. Magpantay, President, BPSU
Rodrigo C. Muñoz, Jr., Dean, College Of Engineering and Architecture
Rolando Olaya

Mr. Wolfgang Stanek, EKW Refractories
Mr. Napoleon Tanganco, Acetech Metal Industries
Mr. Joseph Navarro, RAS Golden Machinery

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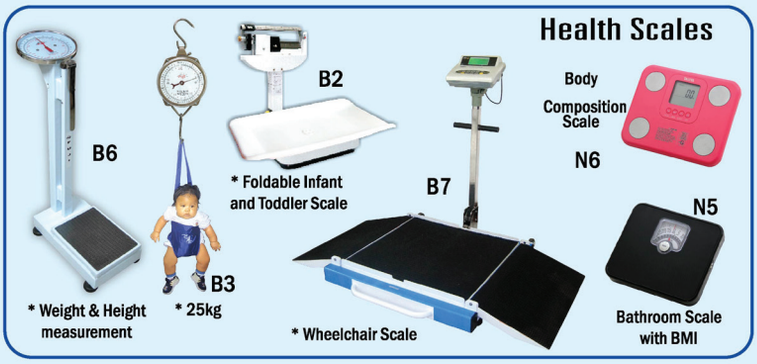


B6 — * Weight & Height measurement

B3 — * 25kg

B2 — * Foldable Infant and Toddler Scale

B7 — * Wheelchair Scale

Body Composition Scale — N6

N5 — Bathroom Scale with BMI

Price Computing and Counting Scales

D3

D2

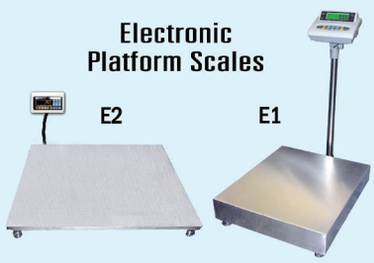
Waterproof Scale

D5

GS Crane Scale

D7

Electronic Platform Scales



E2

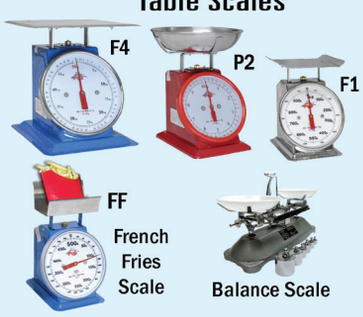
E1

* Available in different capacities

Label Printing Scale

D8

Table Scales



F4

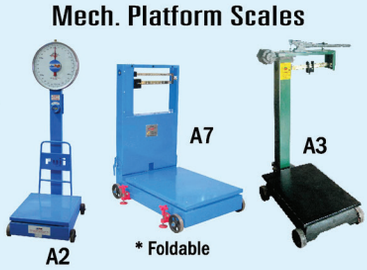
P2

F1

FF — French Fries Scale

Balance Scale

Mech. Platform Scales



A2

A7 — * Foldable

A3

Mechanical Hog and Cow Scales

A5

A6

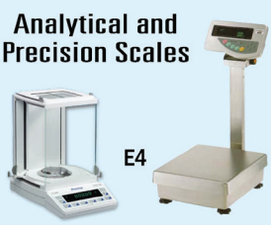
Hanging Scales

H1

HS

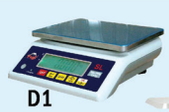
H2

Analytical and Precision Scales



E4

Office & General Purpose Scales



D1

N2

N2

Luggage Scale

N7

W2

W4

L5

L4

L7

L1

L8

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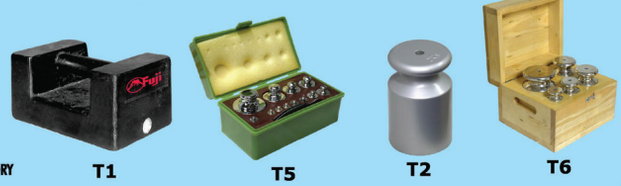

T1

T5

T2

T6

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Dr. Antonio V. Arizabal, Jr.

MIRDC's Man of Steel

Zalda R. GAYAHAN*1

As the first Executive Director of the Metals Industry Research and Development Center (MIRDC), originally established as the Metals Industry Development Center (MIDC), Dr. Antonio V. Arizabal strongly held faith to proper information dissemination and acknowledged that it is one very crucial means of achieving the goals of the Center. Thus, under his leadership, the Philippine Metals publication was born. This, and many more achievements of Dr. Arizabal, led the MIRDC management to the decision to pay tribute to the valuable contributions that he has made for the M&E industries. In this comeback issue of the Philippine Metals, the MIRDC proudly features Dr. Arizabal's passion for work, commitment to the industry, and life lessons to share to the next generations. He is the first among the personalities that will be hailed and recognized as "Men in the M&E Industries" in the succeeding issues of the Philippine Metals publication.

Dr. Antonio V. Arizabal, Jr. is acknowledged as the founder of the Metals Industry Research and Development Center (MIRDC), which was originally established as the Metals Industry Development Center (MIDC). He is the Center's first Executive Director.

Dr. Arizabal, Tony to relatives and close friends, is a BS Chemistry graduate of the University of the Philippines Diliman. His career took off immediately when he worked at the Elizalde and Co., Manila as Analytical and Research Chemist, and later at the Iligan Steel Mills, NASSCO as the Chief Laboratory Supervisor. At this early point in his career, he was already considered as the Philippine expert on iron and steel. He was one of the principal government loan negotiators for steel mill projects that cost millions of dollars. He negotiated with countries like the United States and Germany for the realization of such projects.

He then pursued Metallurgical Engineering and earned his Masters and Doctorate degrees from the Carnegie Institute of Technology as a Fulbright Scholar. He practiced his profession at the US Bureau of Mines in Pittsburg, Pennsylvania from 1956-57 and at the Research Laboratory of the Carnegie Institute of Technology where he worked part-time as a Project Metallurgical Engineer. He later transferred to the Jones and Laughlin Steel Corp. in Pennsylvania where he worked as the Senior Research Metallurgical Engineer from 1960-63.

Dr. Arizabal went back to the Philippines and worked under the Office of the President as the Director of the Metallurgical Advisory Group of the Program Implementation Agency. Concurrent to this, he was also head of the Iron and Steel Committee of the Bureau of Mines-sponsored National Symposium on Mining and Metallurgy. Dr. Arizabal was the Technical Advisor on iron and steel at the ECAFE Conference on Regional Industrial Development held in Manila in 1965.

His expertise was also extended to the academe as he became a Professorial Lecturer in the Graduate School of Engineering at UP, the Mapua Institute of Technology, and at the Graduate School of Business of the Centro Escolar University.

In 1966, Dr. Arizabal became the Director of the Industrial Programs Office of the Presidential Economic Staff under the Office of the President. He was responsible for drafting and spearheading the passage in the Philippine Congress the bill that created the MIDC (R.A. 4724) in the same year. The bill became a law and later was used as basis of the charter of the MIDC, the forerunner of the present

*1 *Science Research Specialist II,* Metals Industry Research and Development Center Bicutan, Taguig City, Philippines

MIRDC. The following year, 1967, was the year when he became Project Director of the MIDC, a position which he held concurrent to his position as Director of the Metals, Mining and Engineering Industries of the Board of Investments (BOI).

The MIDC published in 1971 the Philippine Metals, a brainchild of Dr. Arizabal. The magazine was born with the objective to disseminate information: the usages of metals; the existing facilities for the manufacture and application of metals; and ultimately the development and modernization of the metals industries of the country. During this time, the Philippine metals industries was already established, and in fact was performing at par with those of neighboring countries. The Center was trying to further expand the growth of the industry through information dissemination. The PhilMetals also featured updates and developments of the metals industries in other countries.

According to Dr. Arizabal, "technology by itself has limited use and it has to be disseminated through information." This is where the Philippine Metals comes in very useful.

The Center's efforts paid off – the industry felt the desired impact of the Philippine Metals. The metals industries, including mining, became very interested. They came to the Center for technical information. In fact, because they support the activities and they believe in the thrusts of the MIRDC, they even contributed money without bothering to collect services in return.

In total decision-making, the government has to consider political, technical, and economic factors. Top government officials, including former President Ferdinand E. Marcos, came to him for consultation regarding technology. He always gave them the truth. He was just a man who wanted to remain technical – politics was never appealing to him.

He continued serving the M&E industries through the MIRDC. The Philippine Metals publication was stopped sometime in the history of the Center, but information dissemination did not totally end. Brochures and an official newsletter served this purpose for the MIRDC.

His commitment to serve the country through science and technology runs deep as he continued with public service. He was the first Executive Director of the Philippine Council for Industry and Energy Research and Development (PCIERD) from 1981-1986. It was then under the National Science and Technology Authority (NSTA), the forerunner of the Department of Science and Technology (DOST). He was then named Secretary of the DOST from 1986-1989.

In all of this time, he was a man who held a strong belief that S&T should be used for the socio-economic progress of the country. For him, the creation of S&T is for the rich countries. Our job, then, is to make use of S&T, not create it.

He somehow feels disappointed that not enough of the country's S&T is used for economic development. The revival of the Philippine Metals publication is a suggestion that came from him because he had always been an advocate of information. He says that he continues to dream of a competitive industry that adopts the best technologies that it can adopt. By doing this, we can rival our neighbors and we will be a wealthier nation.

The country still holds so much potential, as seen through the eyes of Dr. Arizabal. The Philippines is highly-mineralized. If we know how to make industrial products out of these minerals, we can become a rich country. He also shares that we should not just manufacture – it is very important that we put in value. Through carefully planned and executed information dissemination, we can transform our society from price market to value market. But this is not something that we can accomplish overnight. He believes that information is one way of proving that technology is important in developing the country.

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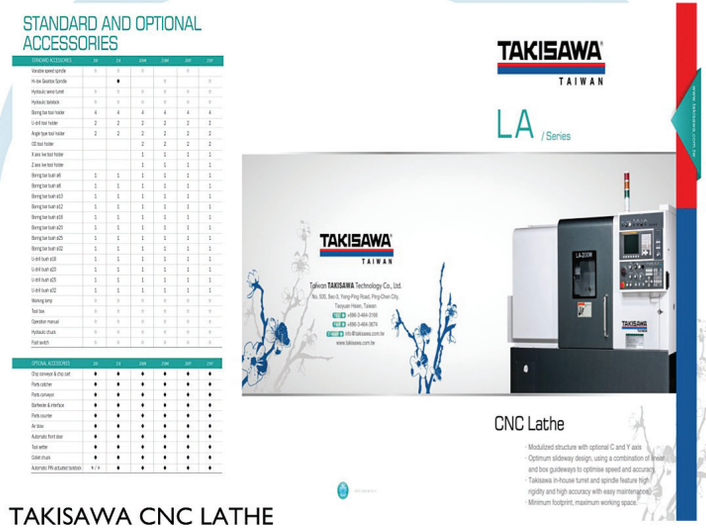

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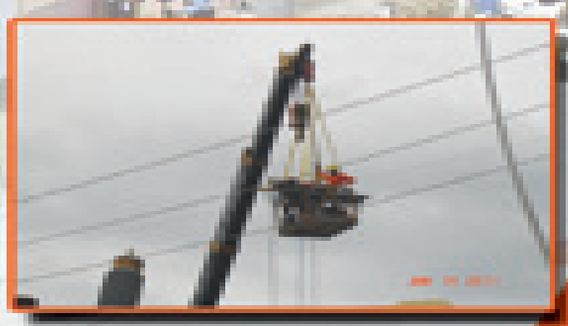

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Governing Council

Secretary Mario Montejo finished his Bachelor of Science in Mechanical Engineering degree at the University of the Philippines Diliman in 1975 and ranked 6th in the Mechanical Engineering Board Examination in the same year.

He designed a lot of "firsts" in the Philippines including, among others, the first GSM-based sensor that measures rainfall to detect depth of floods; the design of the very first Filipino-made equipment for making gabion, which is used to protect slopes and widely utilized by the National Irrigation Administration; the locally-fabricated equipment for making water well screens; and the design of the first robotic carpark in Frontera Verde, Tiendesitas in Pasig City.

His contributions as a Mechanical Engineer earned for him several awards, such as the Gold Medal Award for Creative Research – Filipino Inventors Society (1989); the Outstanding Alumnus – UP College of Engineering (2000); and the Outstanding Alumni for Professional Achievement – Tau Alpha Fraternity, UP College of Engineering in 2002, to name a few.

The multi-awarded mechanical engineer and technopreneur gave years of service to the private sector. He was President of Northwest Steel, a company engaged in the manufacture of steel poles, ship-to-shore gantry cranes, and mega tent structures. He also became President of Tree Top Adventure Philippines, Inc., a firm that develops eco-tourism theme parks.

Engr. Montejo's extensive background in engineering design and innovation is seen as an asset in carrying out the mandate of the Department of Science and Technology. As such, he was tapped to be a member of the Cabinet and was sworn into office as Secretary of the DOST by His Excellency President Benigno S. Aquino III on 30 June 2010.

As DOST Secretary, he started the "Local technology works!" campaign. His belief that the use of science and technology as a sound business model for the improvement of the individual and society is reflected in the programs and projects that the DOST undertakes.

His most recent awards include being named as one of the "100 Outstanding Alumni Engineers of the Century" during the Centennial Celebration of the University of the Philippines in 2010. He was selected as the 2011 UP Alumni Association (UPAA) Distinguished Alumni in Science and Technology.

The DOST took a different direction under the stewardship of Secretary Montejo. In its pursuit to address pressing national problems, the DOST is undertaking programs that focus on the development of appropriate technologies to create growth in the countryside, improvement of industry competitiveness, enhancement of delivery of government and social services, and building and enhancing capacity in emerging technologies.

He has so much faith in the Filipinos. He envisions a smarter Philippines – where the delivery of improved processes, products and services are best realized through the smart use of science, technology and innovation.

Mario G. Montejo
Secretary, DOST

Governing Council

Assistant Secretary Robert "Bob" O. Dizon was appointed the Metals Industry Research and Development Center's Officer-in-Charge by Secretary Mario G. Montejo of the Department of Science and Technology in the early part of 2013, making Asec Bob the newest member of the Governing Council.

His career as an engineer started at the Advanced Science and Technology Institute where he held the position of Senior Science Research Specialist and eventually, OIC of the Microelectronics Division. Several months later, he moved to the private sector and worked at the MK Screens, Inc./Northwest Rolling Mill, Inc. as a Design Engineer. During his ten years of stay in this company, Engr. Bob showed dedication to work and made significant career advances. Professional growth was clearly on his mind as he held the position of Electronics and Control Supervisor, EE R&D Manager, Electrical Engineering Manager and Assistant to the President. He was involved in major projects such as the design and development of electronic control devices, retrofit controllers for various reconditioned equipment and machineries, and controllers for various in-house developed equipment and machineries.

His career path then led him to Manly Plastics, Inc. where he worked as a Technical Development Officer. He held a key role in very critical projects such as: the development/installation/application of various energy saving devices, systems, and practices; repair of equipment and machineries; design and implementation of Electrical Plans/Systems of new plants and warehouses; and design and installation of controllers for various plant processes. Engr. Bob worked with the company for six years and was behind many of its successful projects and milestones. In March of 2010, Engr. Bob joined NWSteel Technologies as Consultant for Electrical Engineering. He was involved in the design and commissioning of the electrical and control systems of the various adventure park rides and prototype Robotic Carpark of the company. Through his expertise and strong motivation, he was able to effectively contribute to the company's commitment to promote and develop Filipino engineering designs.

Public service was probably a persistent call that he was not able to ignore. He returned to work for the government as Assistant Secretary for the DOST in September 2010. The experiences that he has encountered all these years have given him not only solid professional background, but meaningful direction and preparation for even bigger responsibilities. His work includes coordination with R&D Institutions, academe, and other government agencies in the conduct of S&T-related activities. As Assistant Secretary, he supervises the Information Technology Division (ITD), the Project Management and Engineering Design Services Office (PMEDSO), and the Office for Strategic Plans and Programs.

The MIRDC is in good hands under Asec Bob's leadership. The M&E industries' ever-changing needs are the focus of the programs and projects undertaken by the Center. With Asec Bob, the Center will always be engaged in activities that truly matter – those that will create impact and enhance the industries' competitive advantage.

Robert O. Dizon
Officer-in-Charge
METALS INDUSTRY RESEARCH
AND DEVELOPMENT CENTER

Governing Council

Rolly is presently into butterfly breeding and gardening at the family-owned Km. 89 Garden Resort and Butterfly House in San Vicente, San Pablo City. Now that he is retired, he is in part-time consultancy and also devotes time to writing – something that he loved to do since his high school days.

Rolly earned a degree in Chemical Engineering at the FEATI University. He also had post-graduate studies in business at the De La Salle, in economics at the University of Asia and the Pacific (formerly the Center for Research and Communication), and in management at the Asian Institute of Management. He had a 6-month glass technology training in Japan and attended a summer course on steel making at Michigan University, USA.This very impressive educational background led Rolly to find his professional niche in operation and project management in the steel industry. He worked for the Carlos Palanca Jr. Group of Companies, then for the Marsteel Corporation. Rolly later moved to the Armco-managed Armco-Marsteel Alloy Corporation where he became Vice President for Operationand Member of the Board of Directors during his 20-year stay. Then he worked for 10 years at the Philsteel Group of Companies as Senior Vice President and helped put up the Steel Corporation of the Philippines.

He became a respected figure in the steel industry. In fact, he was a member of the Presidential Iron and Steel Industry Advisory Committee during the time of President Fidel Ramos. He was the President of the Philippine Iron and Steel Institute for five years, during which he was head of the committee who studied and wrote the Philippine Iron and Steel Industry Development Plan of 1992. He was Chairman of the Board of the Southeast Asia Iron and Steel Institute (based in Malaysia) for two years, where he was the country's steel industry representative for many years. At the same time, he was a Vice President representing the Philippines of the ASEAN Iron and Steel Industry Federation. Rolly was a participant to the metals industry study mission in Germany, and led a steel industry mission to China. He has been to 30 countries around the world through his work and involvement in the steel industry. He was a recipient of TESDA's "Kabalikat sa Laang Bisig Award" in 1995, at the time when he was Chairman of the Metals and Engineering Industry Board. A past President of the Philippine Steelmakers Association and of the Philippine Foundry Society (now Phil. Metalcasting Industry Association), he was a founding officer of the Forging Industry Association of the Philippines. Presently, he is a member of the MIRDC's Governing Council representing the private sector.

It was not only the steel industry that got so much of Rolly's time and expertise. He also gave time to several civic and religious organizations. He is a charter member of the Knights of Columbus St. Paul of the Cross Council 6681, a Past Grand Knight and District Deputy, and a Past Faithful Navigator of the Marikina Valley Fourth Degree Assembly. He is a former President of the Rotary Club of Marikina North, a former Chapter Commander and Life Member of the Knights of Rizal.

Rolly A. Jaurigue is clearly a man who is passionate about what he does. He is able to establish for himself a good name and his services have gone a long way in uplifting the M&E industries.

Rolando A. Jaurigue
Representative
Engineering Industry Sector

Governing Council

He grew up helping out with the family-owned hardware store. He did odd jobs like sell nails and fluorescent lamps, fix broken flat irons, and serve as cashier or collector during weekends. His parents would take him with them on business trips to other countries like Japan and Taiwan, and these exposed him to the world of manufacturing at a very early age. With his background and experience, he aspired to be a manager in an industrial establishment.

During his school years, Jimmy says he was not an honor student, but he is the kind of student who gets the grade that he wants. He does not read a lot, but is very lucky to have the gift of remembering what he sees. So he breezed through school, and finished a degree in Business Management.

He later worked in a bank where he had the opportunity for a good solid training on handling loans and finances. Later, he went back to help out in their business. Jimmy helped restructure their hardware's credit and collections division, then the sales group, and also the purchasing group. He thinks there is still more that he can do, and so he decided to venture into manufacturing.

While helping out in the family business, Jimmy and his friends would regularly go out and meet for dinner. Their usual topic was about the potential business ventures they can engage in. He and his friends shared some things in common: they were young; they had all the time in the world; they had money, which they borrowed from their parents; and they had guts. They were all very eager to go into business because they had one goal in mind – to become rich at the age of 30. Jimmy was around 22 years old then.

They put up a company and finally decided to venture into manufacturing aluminum tubes for toothpaste. At first, his and his friends' parents were doubtful that this venture will succeed, but in a few years' time the company became very successful and even got Unilever as one if its biggest clients. He stayed with the company from 1977-1981. He gained a lot of experience, went into a number of business trainings, and met a lot of customers in the manufacturing field. As a former banker, he was able to find some who were worthy of receiving financial assistance for development. Jimmy again applied what he learned from his experiences in the bank, and loaned money to "potential" clients. In fact, the tricycle industry in the Malabon-Navotas area flourished through the loans he offered them.

His stint with the toothpaste tube manufacturing led him to his first encounter with the MIRDC because he had to have some tools tested. His relationship with the Center began with "informal experiences which came about because of the needs."

He sold his shares in the toothpaste tube company to put up his own. His career bloomed alongside his very successful married life. He also built his own family and has four children, all of whom have finished college and are into their chosen fields already.

Jimmy Chan reached his goal. He may even have gone farther than what he dreamed of. Hard work and clear directions have been his life's guiding principles. He is a man who learned so much from all his experiences, and put his learnings into good use. He truly deserves all the success.

Jimmy T. Chan
Representative
Metals Industry Sector

Governing Council

He was born and raised in Masbate. A typical boy who enjoyed a simple life in the province, went to mass every Sunday, and stayed in the farm during weekends. He is the seventh of ten siblings. His mother was a teacher while his father was a high school principal. Mark spent his elementary and high school years in a public school. Although his parents were both teachers, he did not exert much effort in his studies. Childhood, for Mark, was such a very happy experience that he did not want to miss play time and bonding time with his friends and siblings just so he can devote time to study his lessons. Getting high grades was never his goal. Play time is something that he holds very important. Even so, Mark usually topped his exams and graduated valedictorian of his grade school and high school class.

At the time that he was about to enter college, he had no particular course of choice. All he knew then was he just wanted to take the easiest course and finish college. But competition was stiff among the Villanueva siblings because his older brothers and sisters earned good degrees from reputable institutions like the PMA and UP. The challenge was to keep up with the competition. Luckily, Mark already qualified to enroll at UP because he is the class valedictorian. His older brother initially took up Mining Engineering at UP and convinced him to take up Metallurgical Engineering. After a year, the same brother shifted to Met Eng and both of them graduated as Metallurgical Engineers.

Mark worked for a mining company after college and transferred to the Metals Industry Research and Development Center (MIRDC) a year later where he headed the Mechanical and NDT laboratories. He was among the personnel who set-up the Testing Laboratories, and was sent to Germany for training even before they started operating. When he came back, he was appointed OIC of the Materials Testing and Research Department. During this time, (around 1975), Mark got himself involved in the planning and construction of the Laboratories Building of the MIRDC. This structure is Mark's tangible legacy to the Center. As Department Head, Mark is very passionate in spreading the word that the Center is here to serve the industry. He was behind the expansion and prompt delivery of the MIRDC's testing services.

In 1981, he resigned from the MIRDC when he decided to go full time with AG&P Company as QA/QC Manager and likewise, to accept professional challenges in a private firm. Mark was part of the Management Team which transformed AG&P into the leading offshore oil and gas structures fabricator in Southeast Asia. All his learnings and experiences came in handy when he put up his own companies.

Witco Inspection and Testing Corporation was put up to provide special services in the field of Welding, Nondestructive Testing, Quality Control and Inspection. He established this company based on what he learned from the MIRDC. His other company is a construction firm, whose establishment was inspired by his experiences with AG&P. This company specializes in steel fabrication and erection of storage tanks, piping and structural steel. He admits that his companies became immediate successes because he had the know-how and the connections. Mark has proven that experiences in life are really the best teachers. He learned from his experiences and made the best out of all the challenges and obstacles that he encountered.

This successful businessman shares with us his life principle: "If you are assigned to do something, you have to assess if you can do it. Be honest to admit if you cannot do it. If you say you can, see to it that you can deliver. Be honest with people, whoever they are, whatever they are. You have to be fair."

Marcelo B. Villanueva
Representative
Allied Industry Sector

Governing Council

One of the very important life lessons he learned is about not taking one's studies for granted. Dumaguete, his birth place, witnessed his elementary years from grades one to three. Rudy at his very young age moved to his Lolo in Negros Occidental where he spent grades four to six. He returned to rejoin his family in Dumaguete where he completed his high school.

He is sixth of nine siblings. His other brothers and sisters were able to continue schooling after high school because they qualified as scholars. Rudy's grades couldn't quite make it to a scholarship slot, so he did not enjoy the same privilege. Due to financial constraints, Rudy had to stop for two years after graduating from high school.

Coming from a two-year break, Rudy finally enrolled for college and later graduated with a degree in Bachelor of Science in Agricultural Engineering from the Central Mindanao State University in Musuan, Bukidnon.

His first job took him to the Philippine Council for Agriculture and Resources, Research and Development (PCARRD) at Los Baños. This was in 1977. At that time, he was also self-reviewing for the Board Exam and sometimes joined UP students for group study sessions. He later joined the National Water Resources Council in 1979, then the Ministry of Human Settlements until 1987. He rose to hold the position of a Provincial Manager, but the ministry was dissolved after the fall of Marcos administration. He had to start from the bottom when he found an opportunity at the Board of Investments (BOI) in 1988. He worked as an Analyst, then became Senior Analyst, then promoted as Assistant Division Chief.

Rudy availed of the scholarship offered by the Civil Service Commission when he pursued his Master's Degree in Business Administration, which he earned from the Ateneo De Manila University in 1999. This became his passport to being promoted as Division Chief. In 2005, he became Director for Project Evaluation and Registration where he had the opportunity to familiarize himself with all sectors including agriculture, forest products, and even manufacturing.

From his work experiences, he learned the value of giving one's best, loving one's work, and respecting one's superiors. He has learned that at work, respect is different from obedience. One may express his own ideas and opinions, but eventually the decision of the boss is always obeyed. He is the kind of boss who admits that he has weaknesses. "Hindi naman ako ang pinakamagaling. Pero pag dating sa linya ko, mas alam ko yan, kaya pakinggan mo ako." He says he can assert himself on areas that he knows best. He also shares his belief that we can find happiness in work if we work harmoniously and avoid animosities. Upholding righteousness and integrity is also very important.

As a member of the MIRDC Governing Council, he says that the Center is a vital agency of the DOST that caters to a very vital sector as well. According to him, the MIRDC plays a big role in developing the manufacturing industries. He recognizes the big effort that the Center exerts in disseminating the researches that it has successfully conducted, "para makarating sa mas maraming tao, para palawakin pa ang abot ng ating mga programa."

Rudy Belnas Caña
Director
Board of Investments

Governing Council

Teddy hailed from a very remote barangay in Batac, Ilocos Norte where he spent his elementary days. First year high school was spent at the Mariano Marcos State University (MMSU). The untimely death of his mother forced his uncle to bring him to Mindanao where he spent his remaining high school years at the Southern Christian College. He took up Agricultural Engineering at the Mindanao Institute of Technology, now called the University of Southern Mindanao (USM), which is a Protestant School.

According to him, he was poor in drawing skills – a talent that is expected of engineers. He remembered to have once submitted a drawing and to his dismay, his professor joked that his work deserved a grade of 8.0, way below the failing grade of 5.0. As food for thought, his professor told him that "it is better to be a good agriculturist, than to be a lousy engineer." He vividly remembers two significant events during his college days: he shifted from Agricultural Engineering to Agriculture and majored in Entomology; and he started to have a personal relationship with God.

Everything has changed since then. He became more serious with his studies and more responsible with his life. While studying, he worked as a janitor of the university. He was taken in by the USM as Assistant Professor immediately after graduation. Teddy then went to the University of the Philippines at Los Baños (UPLB) and taught as a substitute instructor at the College of Agronomy. He stayed with two elders whom he took care of when they got sick. Through them, he got acquainted with the President of the MMSU who, upon learning that Teddy is an Entomologist, suggested that he teach at the MMSU. Grabbing the opportunity, Teddy decided to go back to Batac to teach, and later on pursue his Master's Degree in Entomology with Cognate in Statistics.

He and his wife worked for the Cotton Research and Development Institute. Pursuing a PhD degree in Texas was one of his plans in 1986. Unfortunately, immediately after the EDSA Revolution, President Cory Aquino cancelled all IMF loans, and Teddy had to give up his dream of studying abroad. Instead, he went back to UPLB for his PhD studies.

Not being able to leave the country during that time was, according to him, part of God's plan because many beautiful things happened when he stayed: they were able to build a happy family together with three beautiful daughters; and they established good relationships with one another. His career also took more exciting developments: his technical papers were published; he was detailed at the Bureau of Agricultural Research (BAR) as a technical expert from 2001-2005; and he was appointed BAR Assistant Director in February 2006.

Coming from a poor family posed big challenges to Teddy. Narrating his story makes him proud because he overcame the challenges through hard work. And ever since he had a closer relationship with God, he does all his work to please and love God, for His greater honor and glory.

As a member of the Governing Council of the MIRDC, he extends warm congratulations to the men and women who play key roles in molding the future of the M&E industries. He shares that in order to successfully hurdle more challenges, it is always important to work as a T.E.A.M. – Together Everyone will Achieve More.

Teodoro S. Solsoloy
Director
Department of Agriculture

Governing Council

He earned his Bachelor of Science degree in Electrical Engineering at the Central Luzon Polytechnic College in Cabanatuan City. After graduation, he worked at the Department of Trade and Industry (DTI) Aurora Provincial Office as a Municipal Trade and Industry Officer where he was tasked to help organize industry associations and provide them with technical assistance. Part of his work was to prepare feasibility studies and business plans for the associations.

In 1993, he pursued a Master's Degree in Management, Major in Public Management at the Nueva Ecija University of Science and Technology. In the same year, he worked as Trade and Industry Development Analyst at the same DTI Office. For a year, he was responsible not only for the regulation of the selling of mandatory products through market analysis and post-market surveillance, but also for organizing and regularly conducting trade seminars to the business and industry sectors.

Jerry transferred in 1995 at the Bureau of Product Standards (BPS) as a Trade and Industry Development Specialist under the Standards Conformity Division. While at BPS, he was able to help more than fifty manufacturing firms establish their quality management system and conform to quality standards; he was responsible for the management and overseeing of compliance to standards of sixty companies. He was also instrumental in speeding readiness for international development by means of conceptualizing, organizing and conducting seminars and trainings for companies.

He finished his Master's Degree in 1998, which was the same year that he rose up to the Senior Trade and Industry Development Specialist position at the BPS. During this year, he heads the Electrical Product Section where he acts as the Quality Manager for Product Certification Division; supervises four electrical engineers; performs technical tasks such as factory inspections, ISO 9000-related audits, and product evaluation for compliance to standards and product certification; serves as resource speaker for several seminars and workshops; and takes part in the policy/regulation-making process of the BPS, among others.

The year 2010 gave him another shot at professional development. This was the year that he became the Division Chief of the Bureau of Product Standards Testing Center (BPSTC) under the BPS-DTI. As head of the BPSTC, he is responsible for the technical management of the operation of the Center; the supervision of twelve test engineers and other utility personnel; the review and approval of test reports and certificates; the management, which includes maintenance, repair, and procurement of necessary equipment and materials of the testing facilities, among others. He makes it a point that as Division Chief, he is able to foster good relations with other testing laboratories so as to encourage technical cooperation. The Bureau regularly sends him to international fora such as APEC, ASEAN, etc., and he is a direct participant to technical development and enhancement programs of the BPS as well.

In May 2013 up to the present, he is designated as the Officer-In-Charge of the Bureau of Product Standards to oversee the over-all operations, management and supervision of the Bureau.

Engr. Gerardo P. Maglalang
Officer-in-Charge
Bureau of Product Standards

Governing Council

Atty. Angeles grew up in a family of nine siblings. Although their parents are determined to send all nine of them to private schools, she and one of her brothers chose to enroll in a public elementary school in Batangas City, because both of them found it adventurous walking to school every day and passing by a river. However, their stay in a public school did not last long because they had to move to Manila. High school was then spent with her sisters at the Philippine Women's University, where her talents for the performing arts were discovered and recognized. She was awarded two gold medals for declamation and a silver medal for acting.

Her father inquired what she wanted to take up in college. At that time, fresh from high school, she was considering taking up Education. After giving it some thought, she decided to take a pre-law course at the University of Sto. Tomas and later pursued law at the University of the Philippines. During her stay at UP, she also received awards for debating, both in the individual and group categories. After a successful bar examination, she officially earned the title Atty. Chita O. Angeles.

Of the nine Angeles siblings, three became lawyers. This is more than enough fulfillment of their father's dream to become a lawyer himself. After passing the Bar, she joined a group engaged in mission works in the Caroline Islands, South Pacific. She worked for the Solicitor General's Office for two years, then later for the Legal Office under the Office of the President in Malacañan.

Atty. Angeles joined the Metals Industry Development Center (MIDC) as one of its pioneer officials after her work in the President's Legal Office. She was part of the group that drafted a law to convert the MIDC into the MIRDC, a full-pledged government agency. She was instrumental in the growth process undergone by the Center. She was there from the very beginning, and served the Center to the best of her abilities. While at MIRDC, she was detailed to the Board of Investments (BOI) as Corporate Board Secretary in 1980. In 1984, she decided to leave the Center and worked full time with BOI. She was first Head of the Finance and Administrative Services Department. Her work with BOI gave her opportunities to travel. She went to Europe, particularly in Belgium, Paris, Russia, Sweden, Austria, Germany, Netherlands, and Turkey. In Asia, she went to Thailand, Malaysia, Tokyo, among others, to undertake negotiations regarding bilateral investment agreements. She was the Director of the Legal Department of the BOI when she retired in 2001.

She then put up her office as a solo practitioner. According to her, "practicing law is invigorating because you get a lot of experience." She mentioned that a career in "law is good because you deal with the facts of life." Looking back, she said that success is an outcome of three very important ingredients: perseverance, worthy examples and timely opportunities.

Atty. Angeles is fortunate to have kind and loving parents. She says she has been lucky to have met professionals in her private law practice as a solo practitioner who help her gain insights into analyzing the applicable law in a particular case. She always tries to give her best in whatever she does. Atty. Angeles firmly believes that people have an innate sense to do what is right. That faith is key to successful human relations, and she convinces others to have faith when the opportunity presents itself. Our conversation lingers on with a quotation from Tagore, an Indian poet that Atty. Angeles reiterates – "Faith is the bird that sings while the dawn is still dark."

Atty. Chita O. Angeles
Legal Council

Governing Council

Brenda was born and raised in Manila. She finished her Bachelor of Science in Chemical Engineering at the University of the Philippines Diliman (UPD). She also earned her Postgraduate Certificate in Development Economics and likewise her Master of Arts Degree in Economics also from the UPD.

She attended trainings on various courses on policy analysis and evaluation as well as plan and policy formulation. Brenda has undergone project appraisal trainings, aside from those which concern management of export processing zones in the Philippines.

She started working for the National Economic and Development Authority (NEDA) as the Chief Economic Development Specialist of the Trade, Industry and Utilities Staff. As a professional, she specializes in the following fields: Economics; Development Planning; and Project Appraisal. She later held the position of Director III for seven years, and then moved up to become Director IV from May 2002 to June 2013. She currently holds the position of Director IV of the Trade, Services and Industry Staff.

Brenda R. Mendoza
Director
National Economic and Development Authority

Director Leo L. Jasareno is a mining engineer by profession, having obtained his Bachelors of Science degree in Mining Engineering from Adamson University in Manila, Philippines in 1978.

Upon graduation, he was immediately employed in the then Bureau of Mines and Geosciences (BMG) of the Ministry of Natural Resources as a Casual Mining Engineer. He subsequently rose from the ranks, taking the position of Engineer III in 1988, Engineer IV in 1998, Director II or Regional Director in 2002 and Acting Director in 2010.

Among his key designations in the BMG or now the Mines and Geosciences Bureau of the Department of Environment and Natural Resources are as Officer-In-Charge of the then Planning and Management Staff from 1995 to 1997, then Officer-In-Charge of the Mining Tenements Management Division from 1997 to 2010, then Officer-In-Charge, Assistant Director and on September of 2010, he was appointed Acting Director of the Bureau.

As an Engineer of the Bureau, Director Jasareno has specialized in mine feasibility evaluation; mining policy study and development; and enforcement.

Director Jasareno also takes pride in serving the Bureau's employee association as President from 1986 to 1988 at a time filled with struggles and challenges. This association is now one of the oldest, biggest and most active employee associations in the Department of Environment and Natural Resources.

At the same time, Director Jasareno is a faculty member of the Department of Mining, Geology and Ceramics Engineering of Adamson University since 1992. He teaches Economics of Mining and Mining Laws, among others.

Leo L. Jasareno
Director
Mines and Geosciences Bureau

PHILIPPINE WELDING SOCIETY, INC.

DOST-MIRDC Cmpd., Gen. Santos Avenue, Upper Bicutan, Taguig City
Telephone Nos.: (02) 8185255 / (02) 8944609; Mobile No.: 0917-9090261
Email:philweldsoc@yahoo.com; URL: www.philippineweldingsociety.org

The Philippine Welding Society started as a vision of various industry professionals whose aim is to advance the science and professionalize the practice of welding in the country. On September 19, 1991, encouraged by the government, business sector, educators and practitioners, twelve founding members from construction, manufacturing and inspection companies bonded together and established the Philippine Welding Society, Inc. (PWS). On February 13, 1992, the Securities and Exchange Commission (SEC) registered the PWS as a non-stock, non-profit organization.

The objectives of the organization are: to promote the advancement of the science and practice of welding and to advise and support government entities whenever possible on matters of standardization, public safety and health; maintain among members high ideals of integrity, learning, professional competence, public service and conduct; provide proper forum for meeting, exchanging of ideas and opinions, and to be involved in the solution of multifarious problems affecting the country in general and the welding profession; conduct workshops and seminars for purpose of keeping its members abreast of progress in the welding field; and promote consciousness among members of their serious responsibilities in helping our country move forward in our national development.

SERVICES OF THE SOCIETY:

Qualification and Certification
- Welding Engineers
  - JIS Z3410 (ISO 14731) / WES 8103 Certification
  - (equivalent to ISO14731 -ISO Certification)
- Welding Inspectors
  - PWS CWI Standard
  - AWS CWI Standard

Skill Assessment for Welders
- TESDA Certification –NC Levels:
  - Shielded Metal Arc Welding
  - Gas Metal Arc Welding
  - Flux Cord Arc Welding
  - Gas Tungsten Arc Welding
- WPQT:
  - AWS D1.1 Standard
  - ASME IX Standard
  - PWS Standard

Certified Welding Inspectors Course (Seminar, Review and Exam)
Qualification and Certification of Welding Personnel
Conduct of Welding Inspection
Upgrading Courses for the Industry
Preparation of Welding Procedure for the Industry
Technical Consultancy
Accreditations of Training/Testing/Inspection Institutes

COURSES OFFERED:
- Welding Inspectors Course
- Welding Trainer's Training Course
- Welding Supervisors Course
- Maintenance Welding Course
- AWS Welding Inspectors Course Review

LOCAL LINKAGES:
- Metals Industry Research and Development Center (MIRDC)
- Technical Education and Skills Development Authority (TESDA)
- Department of Labor and Employment (DOLE)
- Bureau of Product Standards (BPS)
- Department of Science and Technology (DOST)
- Department of Science and Technology - National Capital Region (DOST-NCR)
- Department of Trade and Industry (DTI)
- Philippine Institute of Steel Construction, Inc. (PISC)

INTERNATIONAL LINKAGES:
- American Welding Society (AWS)
- Japan Welding Engineering Society (JWES)
- Singapore Welding Society (SWS)
- Welding Technology Institute of Australia (WTIA)
- Asian Welding Federation (AWF)
- Pacific Ocean Coalition of Welding Associations (POCWA)

MEMBERSHIP

PWS membership this 2012-2013 increased throughout the fiscal year. Every member of the Society is encouraged to support the organization's objectives.

New members of the Society are attracted to our free technical training courses, which are totally beneficial for them. They become updated of the latest technology and ac¬quire more skills and techniques for the development of their knowledge in the welding discipline. Other members' benefits include the participation/availment of the following: Annual Welding Competition and Convention; Seminars & Workshops; Forum for Exchange of Ideas on Welding; Research and Development/Special Reports; Technical

Engr. Reynaldo L. dela Cruz, PWS Corporate Secretary, conducts a presentation on Welding of Titanium Alloy at the Regional Training Center in TESDA-Batangas.

100 students were awarded Certificates on SMAW NC1 and WQT as a requirement for their local and foreign employment application. The seminar is sponsored by the PWS through its Partnership and Corporate Social Responsibilities Program in collaboration with the Save the Children Int'l.

Bulletins; Welding Products Exhibitions; and Welding Library.

PWS has served and developed technical trainings for its members and for the welding industry sectors. It also offers members the opportunity for local and inter¬national employment.

Through the help of the Board of Trustees and members, along with local and international linkages, the PWS ensures to give more competitive services and maintains high integrity of all Filipino welding practi¬tioners.

MOA BETWEEN THE PWS AND THE MIRDC

As the MIRDC and PWS recognize the need to strengthen the weld¬ing and fabrication industry by keeping abreast of developments in the science and technology of welding, skills training and certification of welders, advancement of welding experts and sustaining database and networks of fabricators and contractors, hence, both parties bind themselves in an agreement wherein both will work hand-in-hand in promoting and helping the metals and engineering industries, spe¬cifically the welding sector. The PWS embraces its new MIRDC family which gave the PWS its new office and Welding Laboratory address. The MOA was signed during the MIRDC Governing Council Meeting held in May 2012 at the DOST Executive Conference Room.

BRINGING TOGETHER ALL STAKEHOLDERS IN THE PHILIPPINE WELDING INDUSTRY THROUGH PARTNERSHIP WITH THE GOVERNMENT

The convention themed "PWS: Bringing Together All Stakeholders in the Philippine Welding Industry" was held on April 12, 2013 at the MIRDC Auditorium, Bicutan, Taguig City. It was attended by more than 760 individual and corporate members of the Society. The PWS is grateful to all stakeholders and its advocates for the warmest support in the high ideals and objectives of the Society. Likewise, the Society continues its efforts in the attainment of its mission and vision through partnership with the government in the conduct of the following activities for the year:

- ***Enriching the Competencies of MSMEs Welding Sector in the National Capital Region through Special Training and Certification***

The DOST-NCR is presently supporting the Micro, Small and Medium Enterprises (MSMEs) which comprise most of the business enterprises in the Philippines. Twenty five percent (25%) of these MSMEs are located in the NCR and fourteen percent (14%) of the manufacturing companies are into manufacture of fabricated metal products including machine and equipment. To enhance the skills of our workers, training and other means of support for the MSMEs are considered part and fundamental aspects of the DOST's Small Enterprise Technology Upgrading Program (SETUP) program for our technology transfer initiative.

It aims to promote and provide technical assistance and technical know-how to MSMEs in the M&E industries. The DOST-NCR has been tapping the support of different industry associations in Metro Manila including the PWS. The PWS has been around for almost 20 years and has undertaken cooperative activities with the MIRDC in developing and implementing standards for the welding sector. This joint project between government agencies (DOST-NCR and MIRDC) and the PWS focuses on the conduct of col-

MOA signing between the PWS and the MIRDC.

laborative activities to answer the need for additional competent welding personnel in the NCR.

The main objectives of this project are: to sustain the demands of skilled, competent and qualified work force of the MSMEs in the metals, allied and engineering sectors; upgrade technical skills of the MSMEs in the metals, allied and engineering sectors; improve product quality and increase productivity; create employment/income opportunities; and accelerate industrial/economic growth.

The PWS, the MIRDC and the DOST-NCR jointly held a Free Welding Training in various Welding Competencies conducted from April to November 2013 at the DOST-MIRDC. These seminars were provided to 100 Metro Manila residents who individual members of the Society. This training course aims to help welding professionals and practitioners to broaden their experience through specialized welding education. Each program consisted of a five-day lecture and actual demonstrations/hands–on. These training courses are intended for those new in welding and for welding practitioners who wish to broaden their knowledge and aim to be certified under the Industry Certification. After completing the training program, participants were able to take the corresponding assessment based on industry standard that was facilitated by the PWS.

This project trained and assessed a total of 110 welding personnel from various locations of Metro Manila. The success of this project is very essential to us as a developing country in becoming more competitive. MSMEs can now have products that can compete in both local and foreign markets.

M&E Week Conference: "MAKIBAYAN-Makinarya at Teknolo¬hiya Para sa Bayan"

The PWS joined the M&E Week Celebration and attended the M&E Conference held on June 19, 2012 at the Traders Hotel Manila, Pasay City. One of the most significant milestones of the Society is being one of the industry associations to ink a Memorandum of Understanding with the DOST. The MOU is relevant to the implementation of the Makina at Teknolohiya para sa Bayan (MAKIBAYAN) Program. Along with other industry associations, PWS plays

PWS representatives to the M&E Conference: (from L): Exec. Director Fernando M. Opeda; Corporate Secretary Reynaldo L. dela Cruz Jr.; Committee Chairman Isidro D. Millo; and Supervising Officer Tosh Eleazar.

PWS as one of the exhibitors during the 2012 NSTW.

an important key role in boosting the country's M&E industries particularly the welding sector. The event was initiated by the MIRDC in conjunction with its 46th Founding Anniversary.

2012 National Science and Technology Week (NSTW)

The PWS was invited to join the 2012 NSTW themed as "Sci¬ence, Technology and Innovation: Working Together for Growth and Development" on July 10-14, 2012. The DOST-Technology Application Promotion Institute (TAPI) allotted two booths for free for the PWS. The NSTW 2012 Exhibi¬tion showcased the DOST's lat¬est R&D results and developed technologies, innovations and winning inventions from the regions. It was participated in by academic institutions, business sectors and other government institutions which presented their developed technologies in the areas of food, agriculture and aquaculture, biotechnology, alternative energy, environment, health pharmaceuticals, manufacturing/engineering, nano¬technology and information communication, fabrication and welding technologies. This opportunity was shared by the PWS to its corporate members & supporters with the aim of promoting welding edu¬cation, newest technologies and job opportunities. The PWS booths were visited by more than 9,000 individuals represented by students, stake holders, fabricators, engineers and other individuals who have the keen interest in welding.

2012 DOST-NCR: "Science, Technology Road Show and Open Forum"

In view of the grow¬ing competition in the interna¬tional market due to the coming of the ASEAN Economic Community (AEC) 2015, the DOST-NCR held a fo¬rum to acquaint entrepreneurs, industry key play¬ers and other stakeholders on the realities of doing business at present. The forum likewise served to present initiatives being undertaken by various organizations in the public and private sectors, and the academe in preparation for global competition. The PWS participated in giving the cur¬rent situation of the welding sector and committed to exert continuous effort in striving for the realization of the Society's vision and mission. This was held on December 12, 2012 at the Heritage Hotel, Roxas Boulevard, Pasay City. *(Above right)*

Mr. Fernando M. Opeda, PWS Executive Director, commits the Society's contribution to the pursuit of global competitiveness.

PARTNERSHP AND SERVICES PROVIDED TO THE INDUSTRY

Technical Seminars -
Certified Welding Inspectors Course

This course aimed to help welding professionals and prac¬titioners to broaden their experience through specialized welding education. PWS-CWI Seminar is a five-day semi¬nar for those new to Welding Inspection or those needing a brush-up before taking the AWS & CWIP-Certified Welding In¬spectors' Licensure Review and Licensure Examination. It is prepared and designed following the AWS Course Module QCI-96. The PWS conducted several in-house training courses for the welding industry.

The PWS usually holds training courses at TESDA Women's Center, TESDA Compound, Taguig City and at the new office located at DOST-MIRDC Compound, General Santos Avenue, Bicutan, Taguig City. These training courses have monthly schedules for the year. For the year 2012, the PWS trained 194 individuals for 13 schedules ex¬cluding review classes and examinations.

PWS produced 12 Certified Welding Inspectors and 13 Associate Welding Inspectors for the year 2012. For the year 2013, PWS trained 254 individuals for 13 schedules ex¬cluding review classes and examinations. 24 Certified Welding Inspectors and 16 Associate Welding Inspectors were produced by the PWS for the year 2013.

PWS conducts in-house training on Welding Inspectors Course for oil and gas companies: Pilipinas Shell Petroleum Company.

…for shipbuilding: Subic Shipyard in Olongapo City.

…for heavy fabrication and construction: AG&P Company in Manila.

Regional Visit and Technical Presentation Program

The PWS conducted a Technical Seminar on "Welding De¬fects and Remedies" in Bakilid, Mandaue, Cebu last February 28, 2013. It was an invitation by ZOIE Skills and Assessment Center Inc., a corporate member of the Society. The technical seminar was conducted by MIRDC's Engr. Reynaldo L. Dela Cruz Jr. It was attended by professional groups from the welding sector in Cebu, DOST Region 7 representatives and graduates of the ZOIE.

PWS goes to Cebu to conduct Technical Seminar for its Cebuano members.

LINKAGES WITH INTERNATIONAL WELDING SOCIETIES

Ministry of Economy, Trade and Industry (METI) - Japan Welding Engineering Society [JWES]

In pursuit of the progress on globalization and economic integration of the entire East Asia region, the Ministry of Economy, Trade and Industry (METI) of Japan, through its Training Project for Improving the Business Environment related to Trade and Investment, has been assisting developing countries in improving industrial structure and the business environment by sharing Japanese economic/social system, technologies and know-how, all of which have been a foundation of the economic growth of Japan and its subsidiaries in different countries.

In the Philippines, the training program for Welding Engineers (WE) was conducted in cooperation with the Japan Welding Engineering Society (JWES) through the PWS. The certification of welding personnel started in 2006. To date, there are 180 engineers who have been certified to comply with the requirements of the JIS Z3410 (ISO 14731) / WES 8103 Certification System of welding coordination personnel; at the following levels: "Associate Welding Engineer (AWE)" - 51 engineers; "Welding Engineer (WE)" – 135; and "Senior Welding Engineer (SWE)" - 6. Further, the METI and the Association for Overseas and Technical Services (AOTS) have supported ten (10) consecutive training programs. Such WE training program benefited almost 200 local companies in the development of their business environment. *(opposite above)*

PWS as Member of the Asian Welding Federation

The PWS is a member of the ASIAN WELDING FEDERATION (AWF), a federation formed in 2004 by the Asian Welding Associations.

It is a non-profit-making organization devoted to the improvement and promotion of welding technology through the exchange of scientific information and knowledge for the betterment of the welding communities in Asia in terms of economics and technological progress and growth.

Currently, there are 13 members namely: China; Indonesia; Iran; India; Japan; Korea; Malaysia; Mongolia; Myanmar; Philippines; Singapore; Thailand; and Vietnam. The first meeting and general assembly of all members was held in October 2004 at the World Trade Center Metro Manila, Pasay City, Philippines and was hosted by the PWS.

On November 21-24, 2012, PWS official representatives, namely, Engr. Reynaldo L. Dela Cruz, Jr. – Corporate Secretary & Information Publication Chair (from MIRDC) and Engr. Gerald Gallardo – Corporate Treasurer (from CIFRA Industrial Corporation) attended the 18th Asian Welding Federation Governing Council Meeting and 11th Task Force Meeting for Common Welders Certification Scheme (CWCS). They attended along with the 13 representatives of the Asian countries. Highlights of the meeting were: approval of the Common Welders Certification Scheme and the establishment of a standard based on ISO 9606. The events were held in conjunction to METALEX

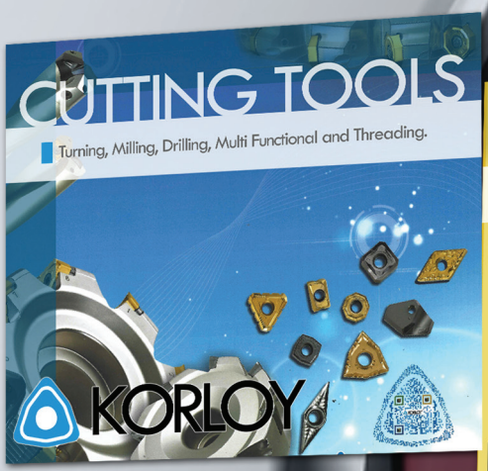
2012, the ASEAN largest International Machine Tools and Metalworking Technology Trade Exhibition and Conference, 26th Edition held in Bangkok International Trade & Exhibition Center (BITEC), Bangkok, Thailand.

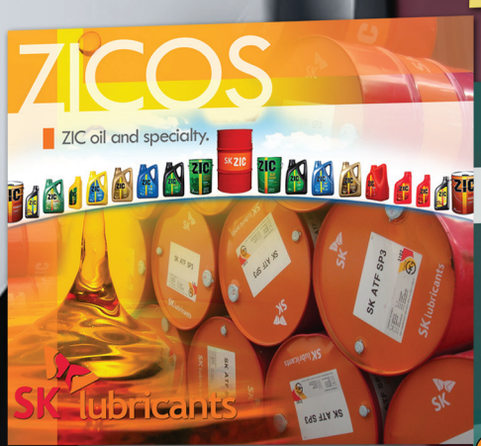
On July 11, 2013, the PWS was represented by Mr. Eric Montes (President), Mr. Sesinandi Abulencia (Committee Chairman), and Mr. Ernesto B. Policarpio to the 12th CWCS Task Force Meeting held in the Executive Seminar Room of the Singapore Management University.

(Front row, 4th & 5th from left): Mr. Shoichi Nomura and Mr. Hideaki Harasawa, general manager and senior technical adviser from Japan Welding Engineer Society, respectively, are the visiting technical experts in the Philippines who conducted the seminar on Welding Engineers (WE).

(L): Official representatives pose at the METALEX 2012 and (R) 18th Asian Welding Federation Governing Council Meeting and 11th Task Force Meeting for Common Welders Certification Scheme (CWCS).

Official representatives of the PWS: – Mr. Eric Montes (1st row, third from left); Mr. Sesinandi Abulencia (3rd row, fifth from left); and Mr. Ernesto Policarpio (3rd row, sixth from left).





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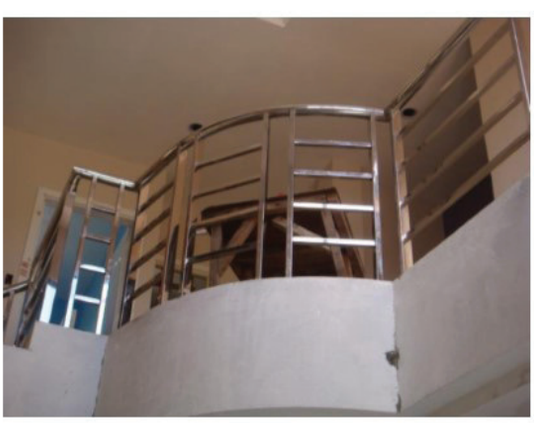

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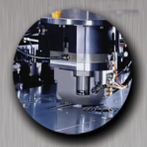
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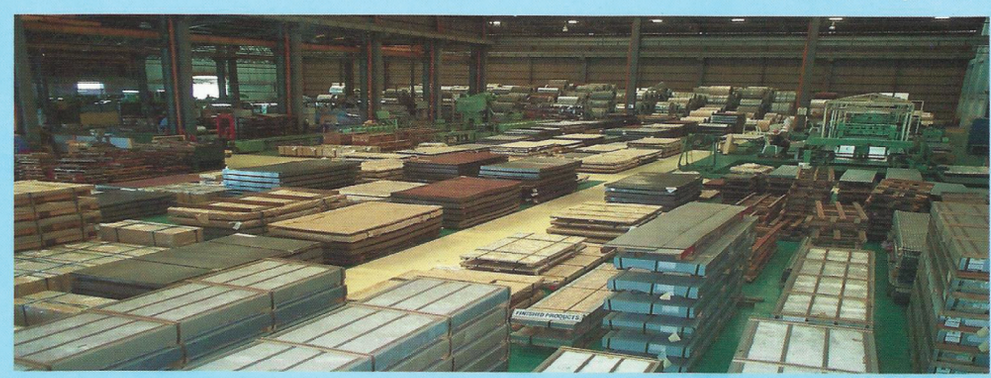

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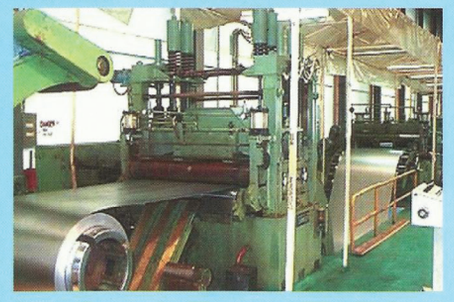

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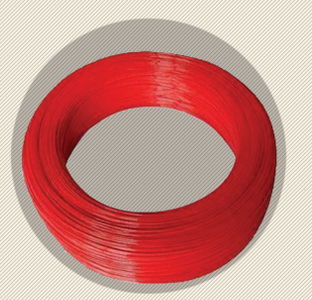

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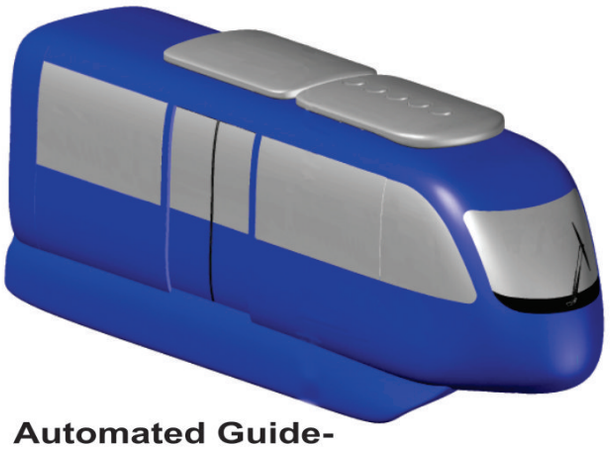

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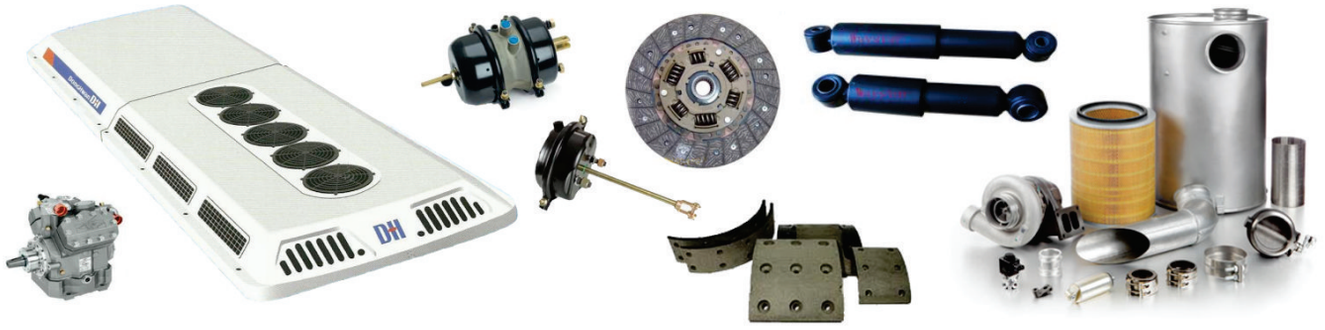

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