

THE PHILIPPINE HEAT TREATMENT INDUSTRY

A 2018 Study

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Department of Science and Technology
Metals Industry Research and Development Center

**The Philippine
Heat Treatment Industry
A 2018 Study**

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The Cover: Heat Treatment Furnace. Picture was taken at MIRDC Heat Treatment Facility.

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PREFACE

The Philippine Heat Treatment Industry Study is one of the industry studies prepared in 2018 by the Department of Science and Technology - Metals Industry Research and Development Center (DOST-MIRDC). With this study, the DOST-MIRDC aims to present data on the current status of the industry including its market and technical profile, as well as to identify technological trends, to determine the perennial problems of the sector, and eventually, to have an overview of the metalworking sector where the heat treatment industry belongs. This study also serves as a ready reference for policymakers in formulating solutions for the identified industry problems to advance its status towards a globally-competitive industry.

The study is the result of actual plant visits, personal interviews, e-mailed questionnaires, telephone interviews, and intensive research. The DOST-MIRDC hopes that this study will be of great help to the industry players, investors, researchers, businessmen, and the public.

The Center envisions to excel in science, technology, and innovation for a globally competitive metals and allied engineering industries for the year 2025. These industries have been the focus of the activities and programs of the Center. Regularly, the Center, through the Technology Information and Promotion Section (TIPS), updates its study of the eight industries (machining, die and mold, forging, stamping, electroplating, metalcasting, heat treatment, and welding) in a two-year timeline to provide the current status at the industry level of the metalworking sector.

The Center's study team gathered the data through the survey questionnaire approved by the Philippine Statistics Authority (PSA) per PSA Approval Number: MIRDC-1708. The industry study for the heat treatment industry started in 1990 and was updated in 1996, 2005, and 2013 (profiling study version).

It is the pleasure of the DOST - MIRDC to render quality service and prime assistance to the metals, engineering, and allied industries through the provision of relevant information.

ROBERT O. DIZON

Executive Director

ACKNOWLEDGMENT

DOST-MIRDC respectfully acknowledges with deep gratitude the generous assistance rendered in many ways by top caliber personnel and officials by both government and private organizations that made possible the 2018 Philippine Heat Treatment Industry Study.

Special thanks to the industry associations, such as the Philippine Die and Mold Association, Inc. (PDMA), the Metalworking Industries Association of the Philippines (MIAP), national officers and staff and the MIAP Provincial Chapter Officers, and the Philippine Welding Society (PWS). We are grateful for the assistance and unwavering support of government agencies, such as the Regional Offices of the DOST and the Philippine Statistics Authority (PSA) who helped make the conduct of this study possible and truly be an enjoyable experience. Also, we would like to thank Ms. Ma. Gracia M. Peralta, Engrs. Nelson L. Tumibay, Joey G. Pangilinan, and Edilbert M. Dela Peña, DOST-MIRDC's technical experts in the design of the survey instrument and technical consultancy.

The DOST-MIRDC Industry Study Team sincerely expresses its gratitude especially the respondents who are either managers, owners, or supervisors of the companies that constitute the heat treatment industry. The respondents squeezed their time schedule to enable them to discuss with the team, thus ensuring the success of this endeavor. These people are able to operate and manage their shops and companies and render service to their respective market and likewise, provide jobs to many.

And most especially to the Eternal God, our Creator, Who gives us every opportunity to be a part of His purpose.

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EXECUTIVE SUMMARY

“Metalworking industry is not only fundamental to the expansion of the engineering, construction and infrastructure sectors but also to the advancement of the business landscape in our country,” an excerpt from the message of President Duterte during the 30th MIAP National Convention. The HT industry is one of the most important drivers of the metalworking sector. Majority of the heat treatment companies are serving major industry clients, such as automotive/transport, metalworking and heavy equipment, construction, food processing and sugar industries.

The survey reveals that the top location for most of the respondents of the HT industry is Region IV-A Calabarzon, followed by the National Capital Region and Region VII with 20, 13, and 8 respondents, respectively. Majority were established from 1991 to 2010. There are four shops that have been in operation for about 50 years. The study also reveals that the top answers for the type of economic organization are establishment and main office, next is the single establishment and followed by main office. However, the form of business organization is topped also by corporation followed by single proprietorship and partnership with 40, 7, and 2 respondents, respectively. Majority of the large and medium corporation are located in Region IV-A Calabarzon followed by Region III and National Capital Region. More than half of the total number of shops fall under small-sized companies according to employment. The estimated number of employees is 2,229; 67.5 percent claimed that they have undertaken formal training and 32.5 percent are only trained in-house. Majority of the machine operators and technicians fall under the ranges “less than five years” and “five to ten years” length of working experience. These are the employees who are directly involved in production. As to the level of proficiency, 1,265 operators and technicians are categorized as very satisfactory, while 217 or 17 percent are rated as satisfactory.

The market profile shows that there is an increasing trend for total annual production from 2014 until 2016. The export is far below the local sales. 68 percent of the total annual production are performed and delivered by large companies. The three crucial sectors served by the respondents are: heavy equipment and industrial machinery;

automotive or transport; and metalworking. The trends for export of heat-treated products are initially increasing, but is in a critical position in 2017, according to the PSA data. Import, since 2013 to 2016, increased consistently, though it decreased in 2017. Commodities which are top imports for 2016 are: screws for metal, cam shafts and crankshafts, razors, and bolts and nuts.

The technologies required by the industry are new facilities that are high-end but can accommodate a minimum number of heat-treated products, thus with a low operating cost. Majority of the respondents' equipment are chamber furnace, vacuum HT, and metal treatment oven. Commonly used processes in HT are annealing, tempering, and direct hardening. Raw materials are usually machine products and majority are customer-supplied materials.

The problems encountered by the respondent-shops are equipment, materials and human resource. Although they face some critical problems, the respondents are still positive that they are improving (previous and current year). Expansion plans of the HT industry are mostly to add additional equipment.

Some of the recommended solutions are as follows: personnel training on theories and current good practices on HT, extensive monitoring of the grades of raw materials, and proper maintenance and calibration of equipment.

INTRODUCTION

In order to monitor the metalworking industries' status, the DOST-MIRDC regularly conducts surveys to assess the different trends in market and technical fields of its different sectors. The data gathered are used in crafting industry studies that provide analysis of the potential as well as challenges and opportunities of each industry. To pursue its mandate to assist the metals, engineering, and allied industries in terms of professional management training, research and development, and analysis, testing and inspection, the DOST-MIRDC shares this information to policy makers, industry partners, investors, researchers, and the public in order to create an environment conducive to increased innovation and production activities. After completing a profiling report of the metalworking industry, including the HT in 2013, the Center is setting the pace to produce a more substantive analysis of the industry based on the survey conducted in 2017 until 2018.

The HT industry is comprised of companies that are also of great importance in the metalworking industry. HT is intended to change the microstructure or properties of the metal, specifically for the purpose of increasing its resistance against wear and tear. Usually, companies maintaining shops of either machining, metalcasting, and surface finishing are also maintaining HT facilities.

This study delved on the industry, market, and technical profiles. Prior to 1990, there were 20 identified HT companies. Between 1990 to 1995, companies conducting heat treating services increased to 28. In the 2005 study, there was a total of 51 identified establishments. 75 percent of which responded to the previous study.

After a more comprehensive profiling of the metalworking sector in 2013, additional companies were added to the list. The previous study¹ shows that the top three sectors served by the HT industry are metalworking, followed by automotive/transport and heavy equipment, sugar, and tool and die. Other industries served are construction, electronics, food processing, industrial machinery, mining,

¹ Philippine Heat Treatment Industry, A 2005 Study

agriculture, cement, pressworking/stamping, appliance manufacturing, ship building, chemical processing and utilities. Formerly, top common equipment utilized by heat treaters are chamber furnace (56 percent), followed by salt bath furnace and vertical shaft furnace with 9 and 8 percent, respectively. Finally, top problems encountered by the respondents are the lack of skilled labor/workforce, difficult maintenance of equipment, and the substandard quality of raw materials available in the market.

In the current study, the Center identified a total of 63 potential respondents and 53 companies served the purpose of this study. Out of the 53 total respondents, 12 were respondents of the 2005 study. The remaining 41 are new respondents in the recent study. However, in 2005, there were 13 that did not participate to the previous study, thus, there are probably 21 to 32 of these 41 new respondents are only established recently. Likewise, the 26 HT companies identified in 2005 survey could have merged or changed management that eventually changed the companies' identity.

The HT process is one of the metalworking methods used to alter the physical, and sometimes, chemical properties of a material. HT involves the use of heating or cooling, normally to extreme temperatures, to attain a desired result such as hardening or softening of a material. HT techniques include annealing, case hardening, precipitation strengthening, tempering and quenching. It is worth noting that while the term *heat treatment* applies only to processes where the heating and cooling were done for the specific purpose of altering properties intentionally, heating and cooling often occur incidentally during other manufacturing processes such as hot forming or welding.

This study covers the results of the survey conducted between 2017-2018 in nine (9) regions of the country.

Objectives of the Study

1. To provide an assessment of the metalworking sector particularly the HT shops in terms of facilities, manpower, and investment requirements;
2. To identify the needs of the HT industry in terms of technology requirements and technical capability of manpower, issues and concerns, as well as the plans of the HT shops;
3. To come up with a statistical analysis of the 2013-2017 data on import and export of heat-treated commodities which could determine the growth or decline of the industry;
4. To determine if the HT industry is still facing the same issues and problems as identified in the previous study;
 - a. pool of skilled workers for the HT industry;
 - b. problems on the supply of raw materials, as there were shortages in the supply of metals in most of the industries of the metalworking sectors in the previous studies; and
 - c. capability of small- and medium-sized companies across the heat treatment industry in making investments to maintain their competitive position.
5. To identify the most appropriate programs to be implemented by concerned organizations, public and private alike, to significantly strengthen the local HT industry of the metalworking sector.

Methodology

The current study, that is descriptive in nature, used the following: primary data from the survey; and secondary data obtained from existing HT literature, and import and export data from the PSA.

The primary data were gathered through a survey of 63 respondent shops that was conducted by the DOST-MIRDC survey team in 2017 and 2018. Out of the 63 identified respondents, 53 companies served the purpose of this study. Data were obtained through personal interviews, electronically filled-out survey questionnaires, telephone interviews and actual plant visits. Questionnaires were designed and distributed to elicit responses that will reflect the present profile of the industry, its structure, nature of business activity, market served, level of production and

consumption, its technology and workers' training requirements, and issues and concerns where the government can intervene.

Data on import and export statistics of the heat-treated commodities were sourced from the PSA Handbook and its electronic data.

Scope and Limitations of the Study

Though this study basically tackles the aforementioned aspects, i.e. profile of the HT industry's technical and operational aspects, its market and problems as well as opportunities confronting it, the results of this study must be viewed in accordance with certain limitations.

First, a number of respondents did not provide adequate market data, thus this study resorted to utilization of secondary sources of statistical data. Second, a considerable number of HT shops failed to keep systematic and organized record of their production and equipment history, thus the difficulty to retrieve data from the respondents. Third, this study intentionally excludes data on the environmental-related data generated by the industry.

Because of these limitations, the study does not claim to be comprehensive enough to cover all aspects of the local HT industry. Notwithstanding these limitations, the study has endeavored to satisfactorily meet its research objectives.

INDUSTRY PROFILE

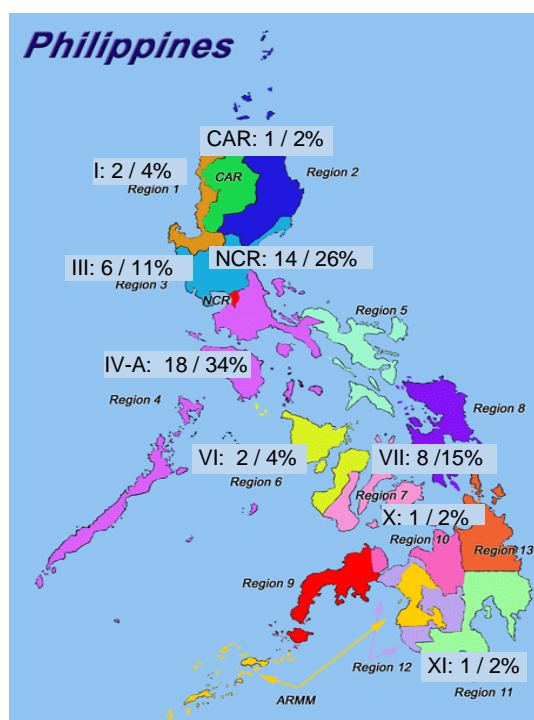


Figure 1. Geographical Distribution of HT Shops

Table 1. Distribution of HT Shops, by Region

Region	Number of HT Shops		
	Responded	Identified	% Share
NCR	14	14	26
CAR	1	2	2
I	2	2	4
III	6	5	11
IV-A	18	20	34
VI	2	7	4
VII	8	8	15
X	1	1	2
XI	1	4	2
Total	53	63	100

Figure 1 and Table 1 show the geographical distribution and the tabulation of respondent shops per region, respectively. As shown, there are only 53 shops that responded to the 2017-2018 survey. The HT shops identified in 2016 accounted to 63 shops. Unfortunately, nine (9) shops ceased operations and one potential respondent declined to be surveyed due to various reasons. There are 18 respondents (34 percent) from Region IV-A Calabarzon; followed by 14 respondents (26 percent) located in the National Capital Region; and 8 respondents (15 percent) in Region VII. The other shops are situated in Regions I, III, VI, X, XI, and CAR.

Figure 2 depicts the year of establishment of HT shops. Majority were established from 1991 to 2010. Only one shop was established between 2011 to 2016. Four HT shops have been in operation for about 50 years already. The oldest metalworking shop that owns a HT shop started operation in 1953 that is still existing today and located in Muntinlupa.

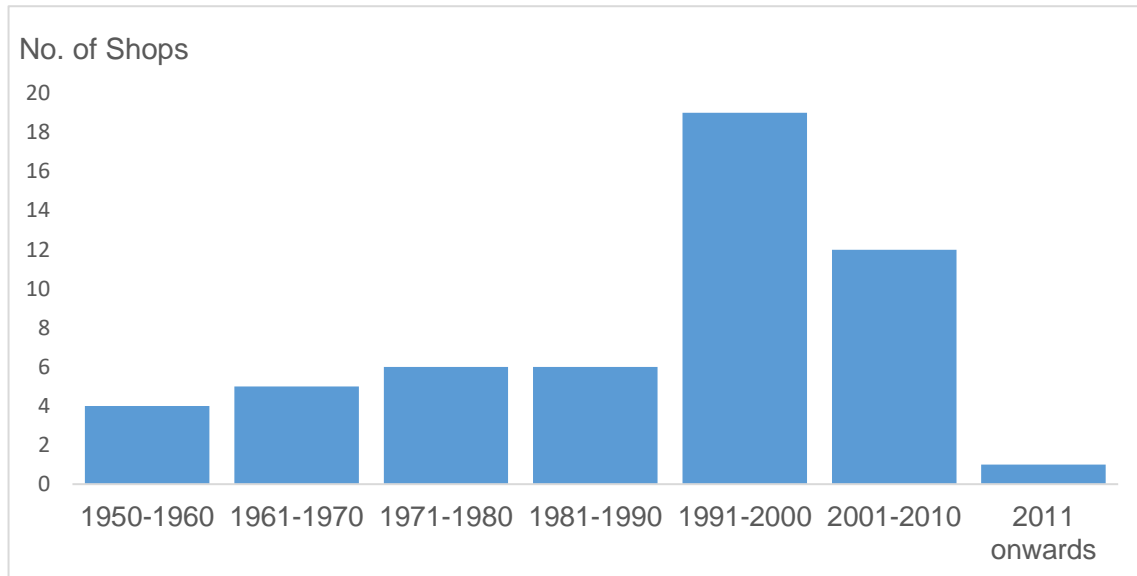


Figure 2. Year of Establishment

Figure 3 reflects the form of business organization. As reflected, 75 percent of the shops are organized as corporation and the remaining 25 percent are operating either as single proprietorship, government, academe, partnership, or cooperative.

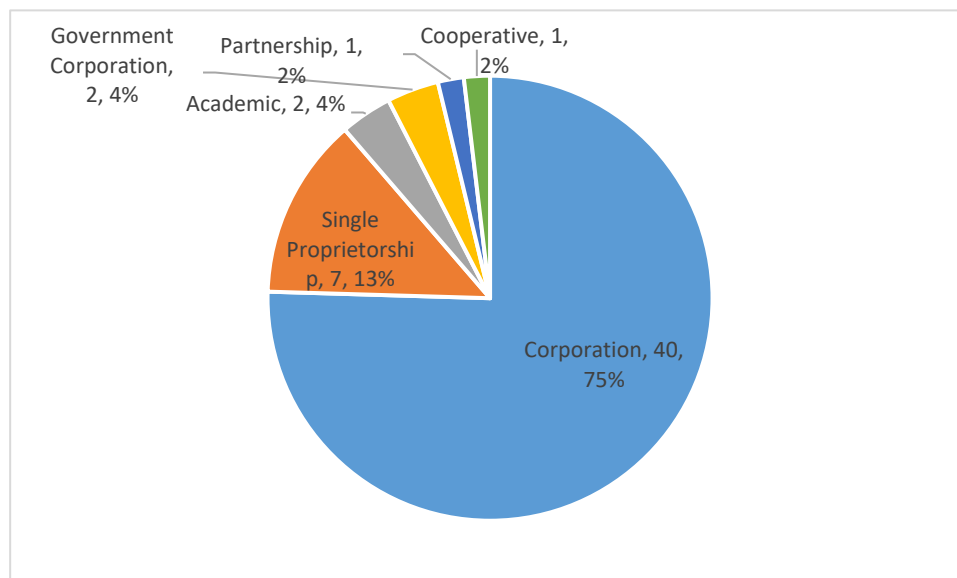


Figure 3. Form of Business Organization

Figure 4 shows the type of economic organization. Economic organization (from PSA) refers to the organizational structure or role of the establishment in the organization. Ancillary unit is the least of the types of economic organization.

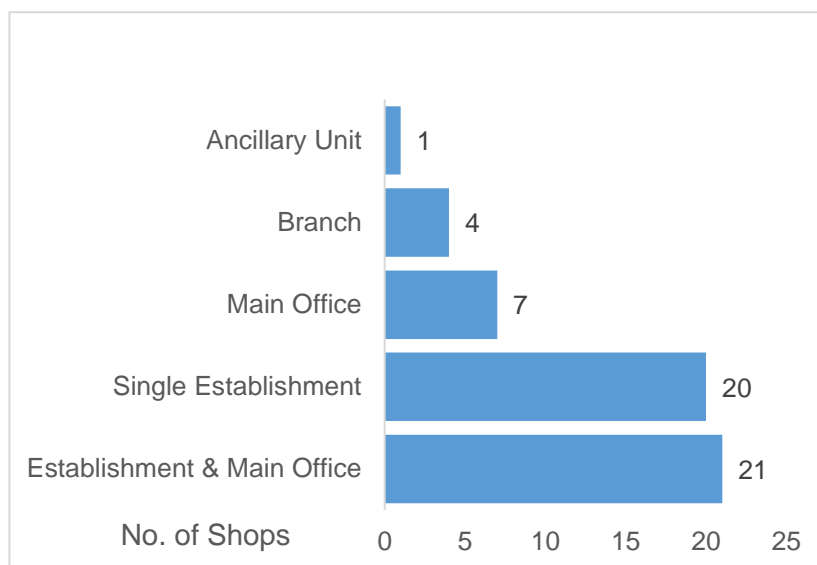


Figure 4. Type of Economic Organization

“Ancillary unit” is the unit that operates primarily or exclusively for a related establishment and provide goods and services that support but do not become a part of the output of those establishments.

Table 2 presents the number of HT shops by type of business activity. As tabulated, 43 out of 53 respondents declare that they are independent shops. These shops are providing products and services to HT customers. 10 shops are in-house (captive shops) or subsidiary of a larger company, rendering services and providing products exclusively to their respective companies.

Table 2. Distribution of HT Shops, by Type of Business Activity

Business Activity	No. of HT Shops	% Share
In-house (Captive)	10	19.0
Independent	43	81.0
Total	53	100

Table 3 shows the distribution of HT shops according to their total assets, using the Department of Trade and Industry’s (DTI) classification of company size. Of the 53 respondents, majority are classified as medium-scale (25 shops) and small-scale (13 shops) with total assets amounting to “more than 15M to less than 200M and “3M to 15 M” pesos,” respectively.

Table 3. Distribution of HT Shops, Based on Assets

Classification by Total Assets (In Peso)	No. of Shops	% Share
Micro (Less than 3M)	4	8
Small (From 3M to 15M)	13	25
Medium (More than 15M to less than 200M)	25	47
Large (Greater than 200M)	11	21
Total	53	100

The HT industry levelled up in terms of total assets for the period 1996 to 2018 probably due to expansion of some heat treatment companies since the boom of the construction and aerospace industries.

In 1996 study, the highest percentage (38 percent with 8 shops) of the HT shops have capitalization that fall within the range of “P1M to P10M” followed by “P10M to P40M” with seven (7) shops and the rest of the surveyed companies falls in the “higher than P40M.” There were only 21 shops. In the 2013 profiling study, for a total of 36 surveyed HT shops; the top range is from “P1 M to P10 M,” with 21 shops; next range is “P10 M to P40 M,” with 6 responses; and the remaining falls under “greater than P40 M” and “less than P1 M.” Based on 2018 data, with 53 respondents, majority (25 shops or 47 percent) of the surveyed companies fall under P15M to less than P200M, 13 shops or 25 percent fall on range “P3M to P10M,” 11 shops have total assets of “greater than P200M” and the rest-4 shops fall under “less than P3M” total assets. The growth is a big leap.

Table 4 presents the regional distribution of HT shops based on assets size. As presented, majority of the small-scale shops with a total asset of from 3 million to 15 million are located in the NCR; majority of the medium-sized shops are located in Calabarzon; similarly, majority of the large shops with an asset of greater than 200 million pesos are based in Region IV-A Calabarzon.

Table 4. Regional Distribution of Shops, According to Assets Size

Location	Micro	Small	Medium	Large	Total
NCR	2	4	6	2	14
CAR			1		1
Reg. I	1	1	-		2
Reg. III			3	3	6
Reg. IV-A	1	3	9	5	18
Reg. VI		1	1	-	2
Reg. VII		3	4	1	8
Reg. X		1			1
Reg. XI			1	-	1
Total	4	13	25	11	53

Table 5 shows the classification of shops according to type of operation. As shown, majority (45.3 percent) of the establishments are into manufacturing. Only 22.6 percent of the total respondents offer jobbing, while 32.1 percent perform both jobbing and manufacturing.

Table 5. Classification of Shops, According to Type of Operation

Type	No. of Shops	% Share
Manufacturing	24	45.3
Both	17	32.1
Jobbing	12	22.6
Total	53	100

Employment

Employees are the most important resources of any company. In the HT industry, there are a total of 2,589 personnel based on data from 48 respondent shops. Figure 5 shows the distribution of heat treatment shops based on employment. As shown, more than half of the total number of shops (32 shops or 60 percent) fall under small-sized companies ranging from 10 to 99 personnel, followed by micro-sized (9 shops or 17 percent) with less than 10 personnel. Large (with less than 200 personnel) and

medium (with 100 to 199 personnel) categories have 7 shops (13 percent) and 5 shops (10 percent), respectively.

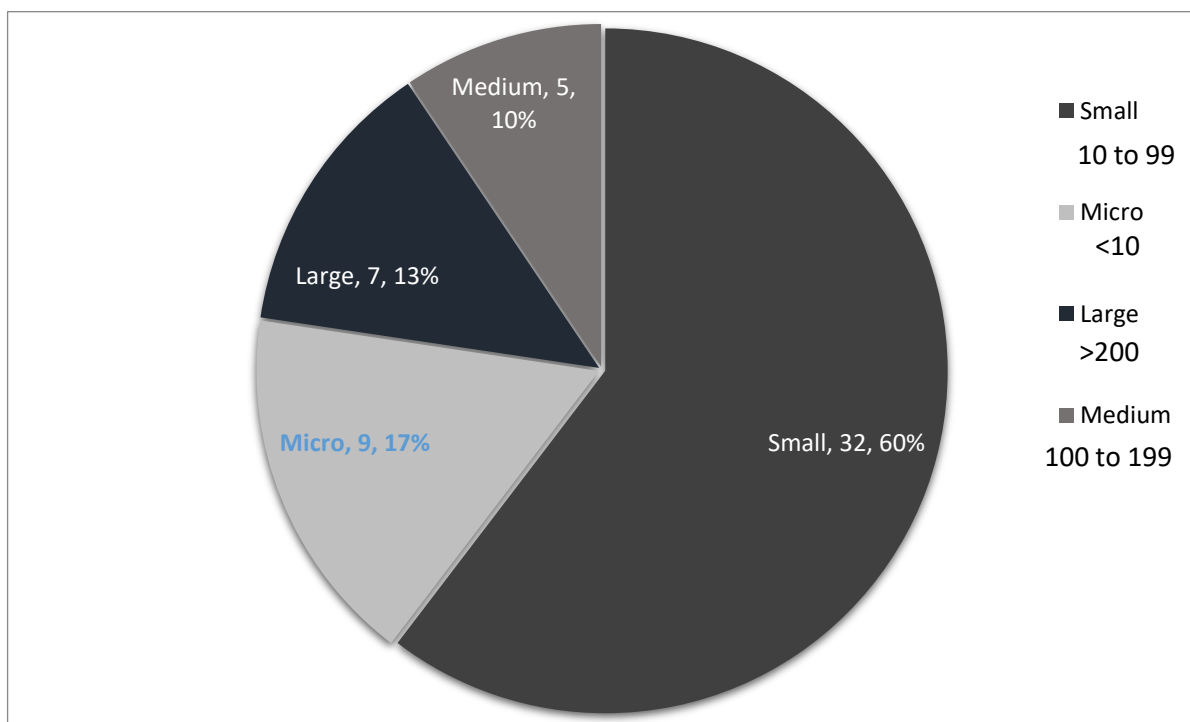


Figure 5. Distribution of HT Shops, Based on Employment

Figure 6 illustrates the distribution of production personnel with or without formal training. As illustrated, a higher number of managers (72) are equipped with training; also, majority of their workers are formally trained in heat treatment especially the machine operators (1,030 personnel), including furnace technicians that are estimated to be 103 or 10 percent of the total machine operators. 67.5 percent of the total number of personnel (2,136) claimed that they have undertaken formal external training and 32.5 percent are only trained in-house. 44 respondent shops provided answer to this particular question.

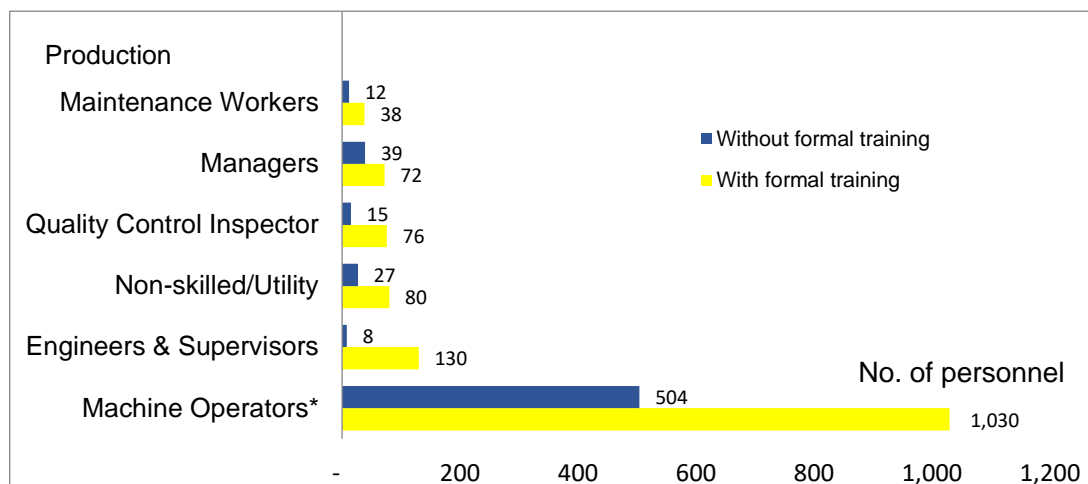


Figure 6. Training of Personnel

Figure 7 indicates the number of years of experience of production personnel. As indicated, 40 managers have “more than 20 years” of experience in this kind of business. Majority of the machine operators who are directly involved in production are the ones with “less than 5 years” and “5-10 years of experience,” including furnace technicians. Only 40 out of 53 respondent shops provided answer to this particular question.

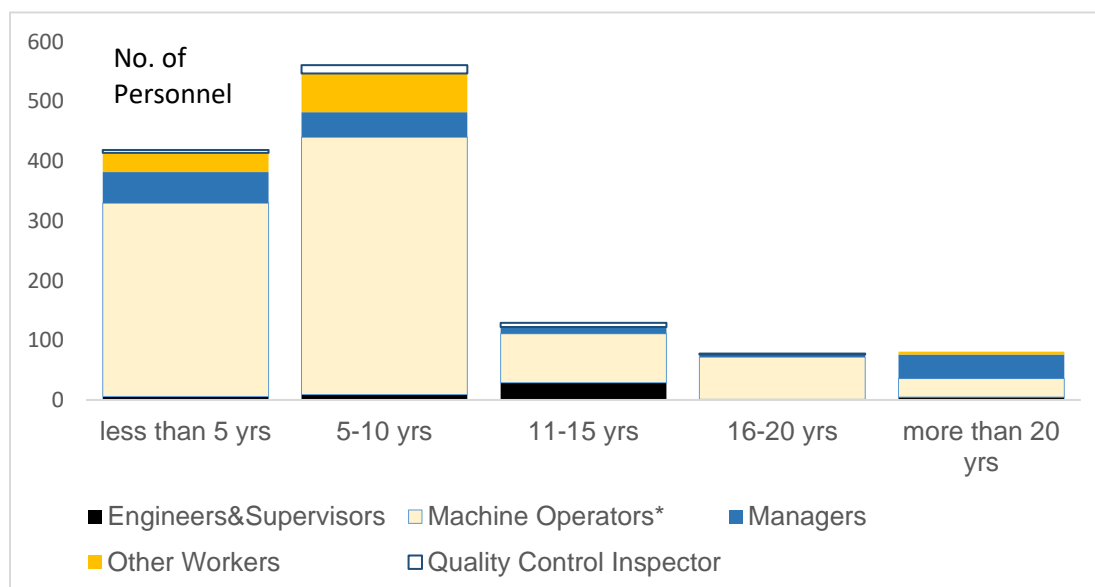


Figure 7. Years of Experience of HT Production Personnel

Level of Proficiency of Production Personnel

Proficiency means advancement in knowledge or skill; other term is progress*. Figure 8 shows the level of proficiency of production personnel. As shown, in terms of their skill and workmanship, 867 (68 percent) of the 1,265 machine operators and furnace technicians are categorized as “very satisfactory,” while 217 personnel (17 percent) are rated as “satisfactory.” Other workers include maintenance workers and non-skilled workers.

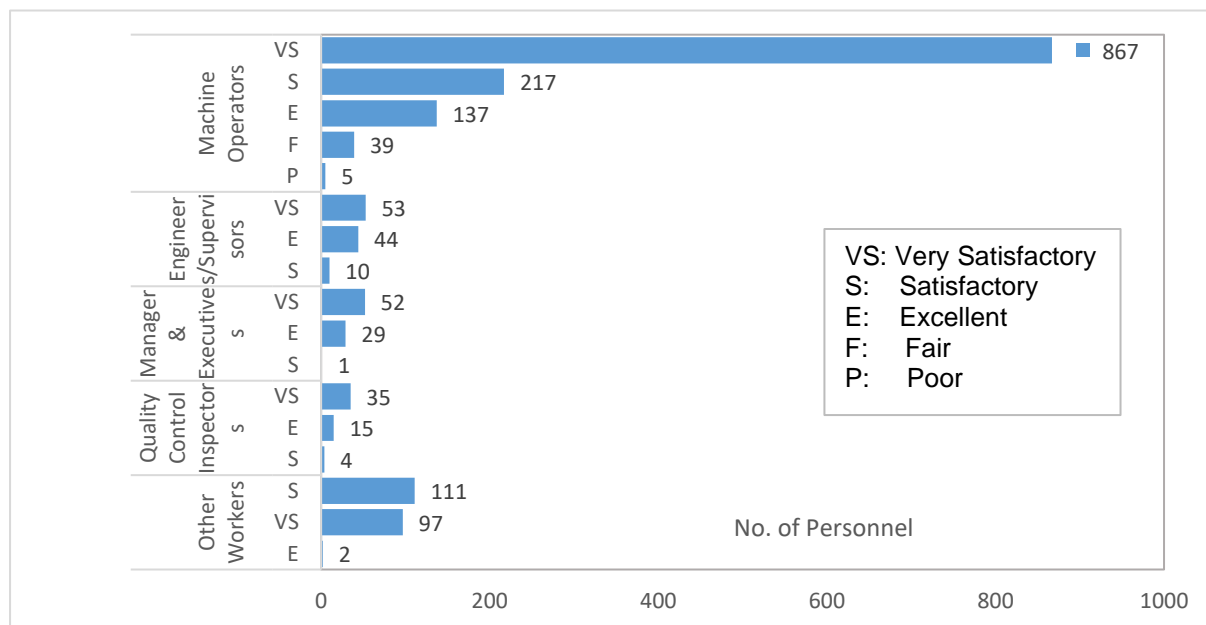


Figure 8. Level of Proficiency

Initial Capitalization

The initial capitalization of respondent-shops is presented below. The top answer is “1 million pesos and below” with 23 respondents (43 percent). Followed by “1,000,001 to 3 million pesos” has 10 respondents (19 percent). Capitalization of “more than 3,000,001 to 15 million pesos” with 7 responses (13 percent). The remaining 5 have 2 responses (4 percent) of “more than 15 to 40 million” and 3 responses (6 percent) of “more than 40 million pesos.” 85 percent of the surveyed respondent shops divulged their answer to this question.

*Merriam-Webster Dictionary.

Table 6. Initial Capitalization of Respondents

Range (in Peso)	Number of Respondents	Percent Share
1,000,000 and below	23	43
3,000,001-15,000,000	10	19
1,000,001-3,000,000	7	13
40,000,001 and Above	3	6
15,000,001-40,000,000	2	4
Did not divulge info.	8	15
Total	53	100

MARKET PROFILE

The heat treatment industry in the Philippines continues to increase its total sales from 2014 to 2016. “The global heat-treating market size was valued at USD 90.7 billion in 2016 and is estimated to expand at a CAGR* of 3.5 percent from 2017 to 2025. The growing heat-treating services demand of the client industries such as aerospace, automotive, construction, machining, and electrical and electronic industries is projected to act as the key market driver over the next eight (8) years.”**

Figure 9 shows the annual production from 2014 to 2016 estimated using sales figure, i.e. export and local sales. As shown, a large share of annual production goes to the local market.



Figure 9. Annual Production, 2014-2016

* compound annual growth rate (CAGR)

** Grandview Research, In (US), <https://www.grandviewresearch.com/industry-analysis/heat-treating-market>

Table 7 shows the heat treatment shops annual production in 2016. As shown, annual production is dominated by large-sized companies with annual production of 3.05 billion pesos (P3.05B).

Table 7. Annual Production, Based on Capital Size, 2016

Size According to Capital	Large	Medium	Small	Micro
Annual Production (2016)	3,049,760,000	920,027,567	396,735,477	37,308,361

Figure 10 tabulates the sectors served by HT shops. As tabulated, the respondents have varying products, thus serve different sectors in the market. The top customers for heat treatment shops are heavy equipment and industrial machine, followed by automotive or transport, then metalworking. Both construction and semicon/electronics have 19 responses.

Automotive and aerospace are two crucial sectors being served by the heat-treating services. Only one (1) is indicated for aerospace because most aerospace companies did not disclose information. The increasing market demand for heat treating services in these two sectors can be ascribed to the booming demand for commercial transport units due to high land transport and aviation requirement and rising air passenger traffic. The construction sector also increased in heat treating services. Others include medical, cement and/or aggregate plant, sugar, paper, heavy industries-mining, wood sectors, marine motor industries, industrial plant/machineries.*

* Grandview Research, In (US), <https://www.grandviewresearch.com/industry-analysis/heat-treating-market>

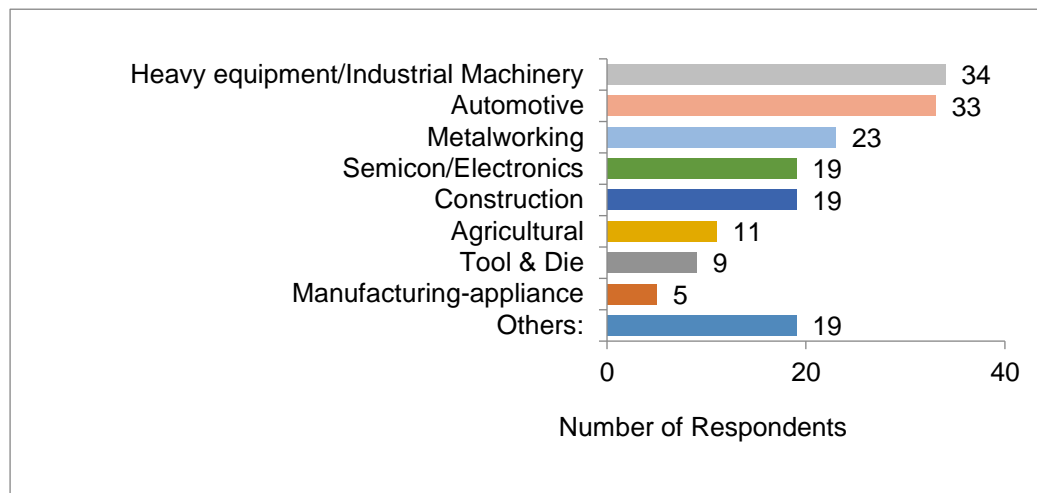


Figure 10. Sectors Served

Export

Figure 11 shows the export of heat-treated products from 2013 to 2017. As shown, the FOB values (in million dollars) increased from 2013 to 2014 and dropped from 2014 to 2017. The 2016 top commodities of heat treated export products are bolts for metal, with or without nuts, screws, screws for engines of vehicles and hydraulic steering gears; reverse reduction, hammers (H) and sledge hammers (SH), H & SH for earth moving machinery, gear boxes and other speed changers and other sets of assorted articles. The top partner-countries are Japan, Germany, United States of America, Republic of Korea, Italy, Belgium, UK of Great Britain, and Northern Ireland, Netherlands, France and Mexico. Note that the representative products that require heat treatment* are as follows: gears, shafts, fasteners, bolts and nuts, roller chain, coil spring, leaf spring, cutlery, hand tools, plastic and rubber molds, and tools and dies.

* Unido-World Bank Study, "Comparative Advantage of the Philippines Metalworking Sector (1983-84)

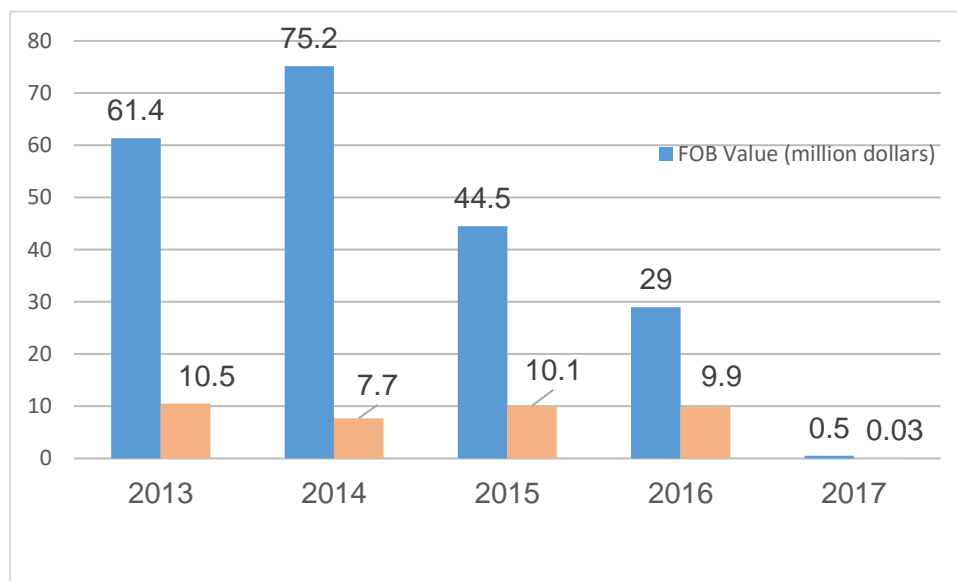


Figure 11. Exported Heat Treated Products

Import

Figure 12 shows the CIF+ values (in million dollars) and quantity (in hundred thousand kilograms) of imported heat-treated products from 2013 to 2017. Unlike export, import is steadily increasing from 2013 to 2015 then rose aggressively in 2016. However, the value of import dropped to about 62 percent from 2016 to 2017.

The 2016 top import commodities are screws for metal, cam shafts and crank shafts; razors; bolts for metal, with or without nuts, for the engines of earth moving machines-gear boxes; and other speed changers (including friction gears) and fliers (including cutting pliers), pincers, tweezers, and similar tools. The 2016 top sources of imports are Japan, China, Singapore, Taiwan, Thailand, Hongkong, Republic of Korea, Germany, USA, and Malaysia.

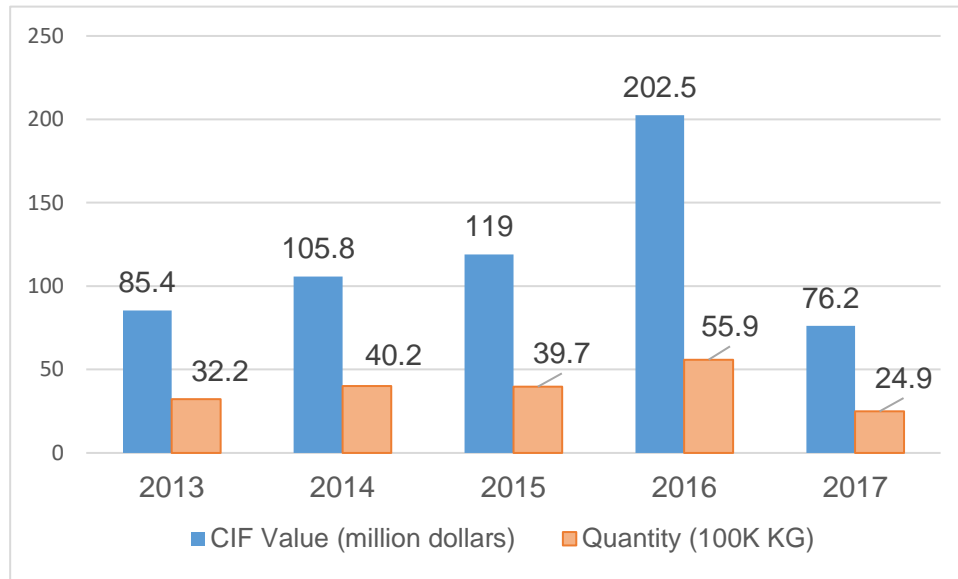


Figure 12. Imported Heat Treated Products

Other commodities which were top imports are gears, shafts, screw, bolts and nuts, colt and spring, leaf springs, cutlery, hand tools, plastics and rubber molds, tool and die and roller chains.

TECHNICAL PROFILE

The heat treatment process consists of the following: annealing, tempering, direct hardening, case hardening, stress relieving, normalizing, solution heat treatment, spheroidizing, and others. Hardening, tempering and case hardening are the most commonly used heat treatment processes in the US. Case hardening accounted for the largest share by process – over 25 percent in 2016*. It is expected to gain the highest growth over the forecast period. However, in the Philippines, survey shows (Figure 15) that the processes which are commonly used are annealing, tempering, and direct hardening. Improved mechanical and chemical properties resulting from these processes have aided segment growth.

*Grand Review Research, USA.

Equipment

The availability of a good set of equipment is essential for successful operations in a HT shop. Shown in Table 8 are the equipment utilized by the respondent-shops. 38 out of 53 respondents provided answer to this topic; others did not give answers due to marketing reasons. Chamber furnace is the most common equipment used by the respondents, while hardness tester is the commonly used instrument to control quality that includes Rockwell, Brinell and Vicker.

Table 8. Heat Treatment Equipment

Equipment	No. of Equipment
Chamber Furnace	43
Vacuum HT Furnace	12
Metal Treatment Oven	4
Vertical Shaft /Salt Bath Furnace	4
Hi-Frequency Heater	10
Equipment (Tempering, Normalizing, Case & Flame and Direct Hardening, Solution HT and Spheroidizing)	11
Quality Control Equipment	
Hardness Tester	54
Thermocouple/Thermocontroller	45
Radiation Pyrometers	5
Others (ultrasonic test, dye & fluorescent and magnetic particle inspection)	6
Shore Scleroscope, XRF, Spectrometer	4
Micrometers & Calipers	436
Other Equipment/Facilities	
HT Forklift & Pneumatic Rammers	4
Vacuum Pumps	5
Shot Blasting Machine & Sand Reclaimer	5

Figure 13 reveals the different metalworking processes employed. As revealed, the processes that are commonly employed are machining, welding and die and mold.

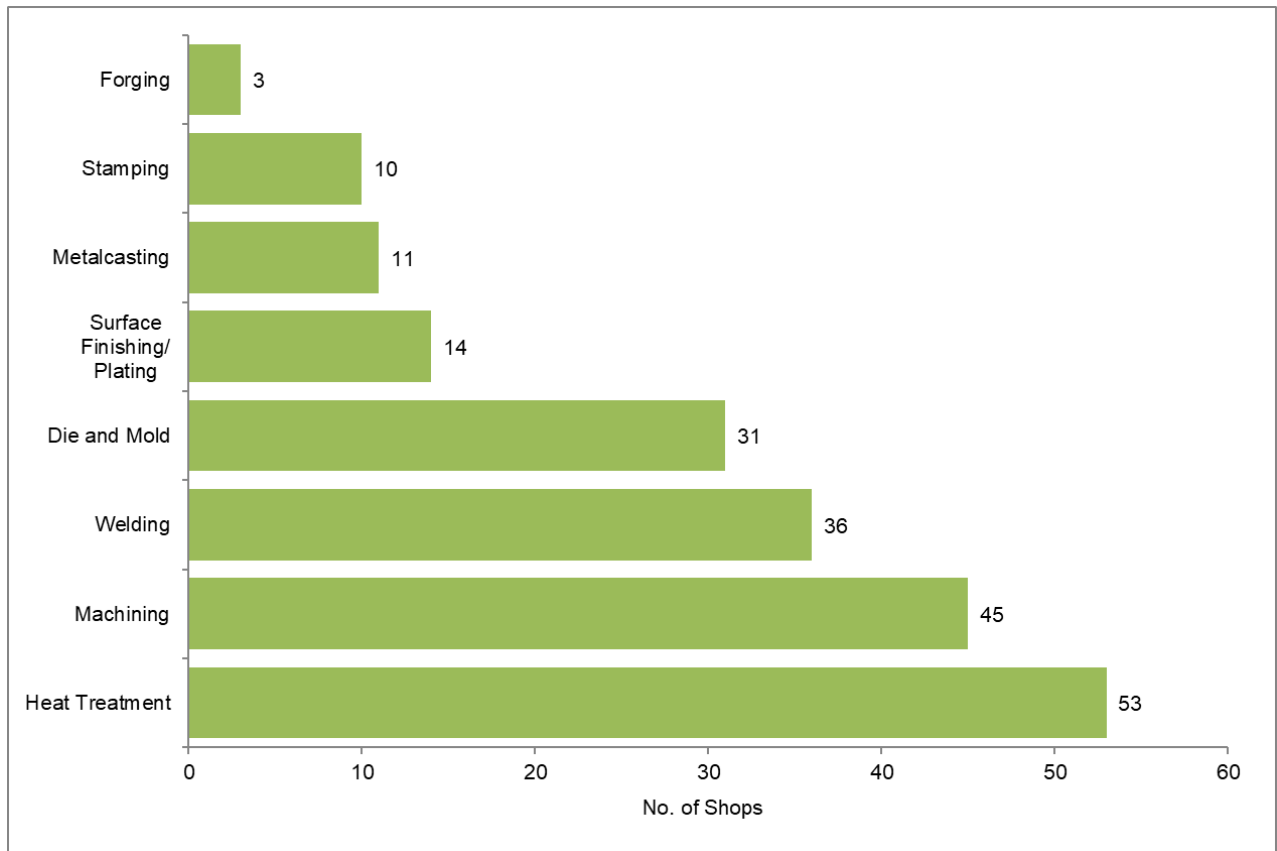


Figure 13. Metalworking Processes Employed

Raw Materials

The materials for HT are usually machined products, or customer- supplied materials. Majority of the respondents are sourcing their metal requirements through local suppliers especially for a few metals which are only available abroad. Metals, particularly steels, have numerous applications in various industries such as automotive, industrial machineries, construction, aerospace, etc. Their diverse uses depend on their composition, mechanical properties, and microstructure.

Types of HT Process Employed

There are various types of heat treatment processes, namely: annealing, tempering, direct hardening, stress relieving, normalizing, case hardening, solution heat treatment, and spheroidizing. Annealing is a heat treatment process that consists of heating to and holding at a suitable temperature followed by cooling at an appropriate rate, primarily for softening of metallic materials, while tempering is a process in which previously hardened or normalized steel is heated to a temperature below the transformation range and cooled at a suitable rate, primarily to increase ductility and toughness.* Figure 14 shows the types of HT process employed. As shown, the usual process utilized in HT shops are annealing, tempering, and direct hardening. The heat-treated products undergo hardening or softening process.

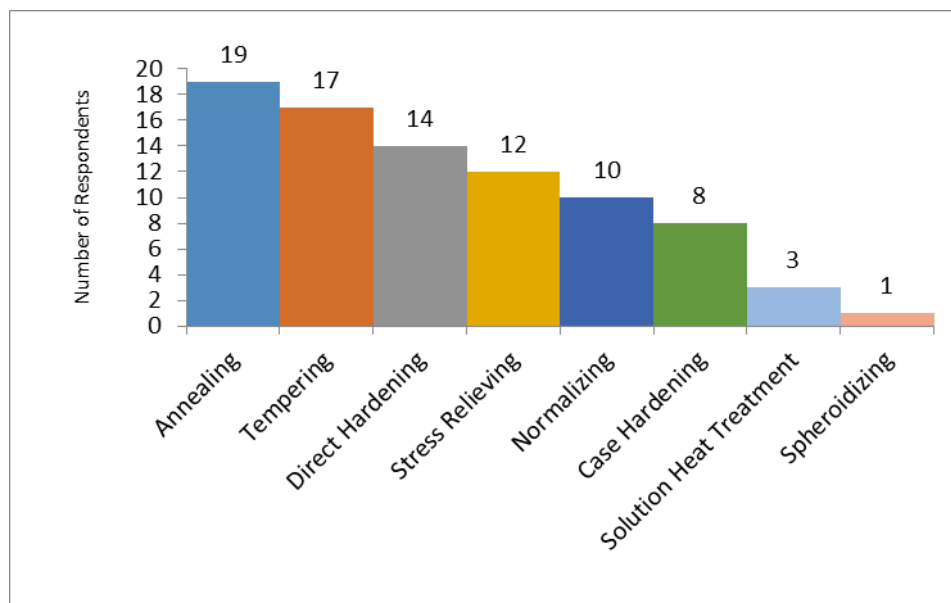


Figure 14. Types of Heat Treatment Process Employed

Figure 15 presents the quality requirements of HT customers. As presented, the basic requirement of customers is the accurate result of the HT which is measured by its hardness, followed by specified dimension such as physical and mechanical tests. Others include microstructure, accuracy of test, on-time delivery, and quality.

* Heat Treating of Steel, ASM

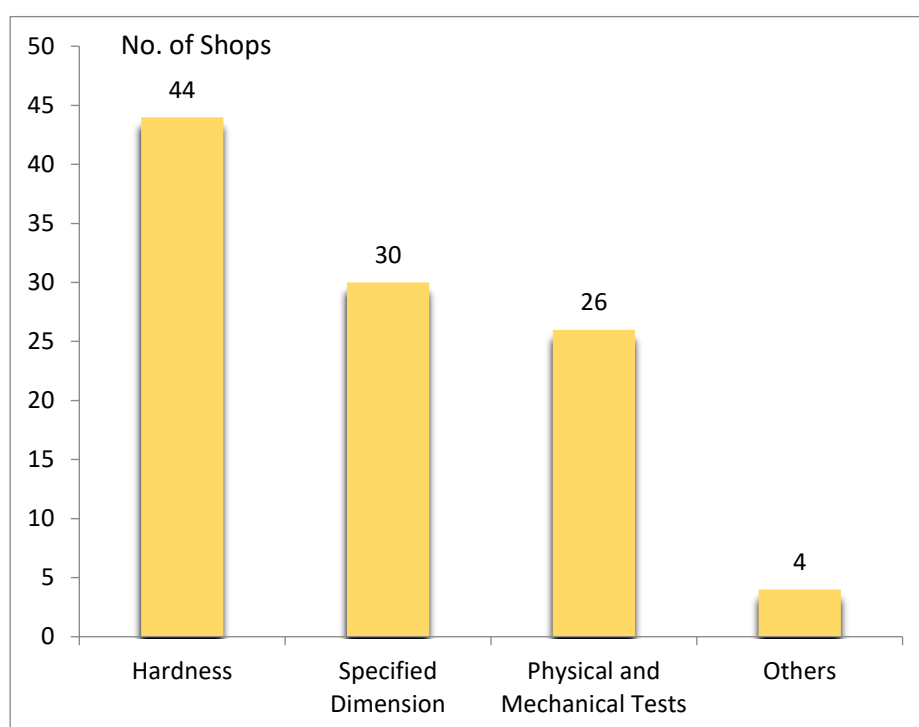


Figure 15. Quality Requirements of HT Customers

PROBLEM AREAS

The top current problems identified by the respondent shops are on equipment, materials and human resource as shown in Figure 16. These are followed by quality control and quality assurance and lay-out of facilities. Others include waste treatment, output rate, stock availability, China-made products, technical support and testing, and delayed deliveries. The problems encountered by the shops under equipment include: low rate of utilization, inadequate maintenance, lack of upgraded equipment, and power interruption. The specific concerns in materials are: substandard quality, high cost and difficulty in sourcing out, while human resource include issues on lack of skilled workers, attitude and absenteeism. Lastly, some respondents cited problems in marketing strategies and financing.

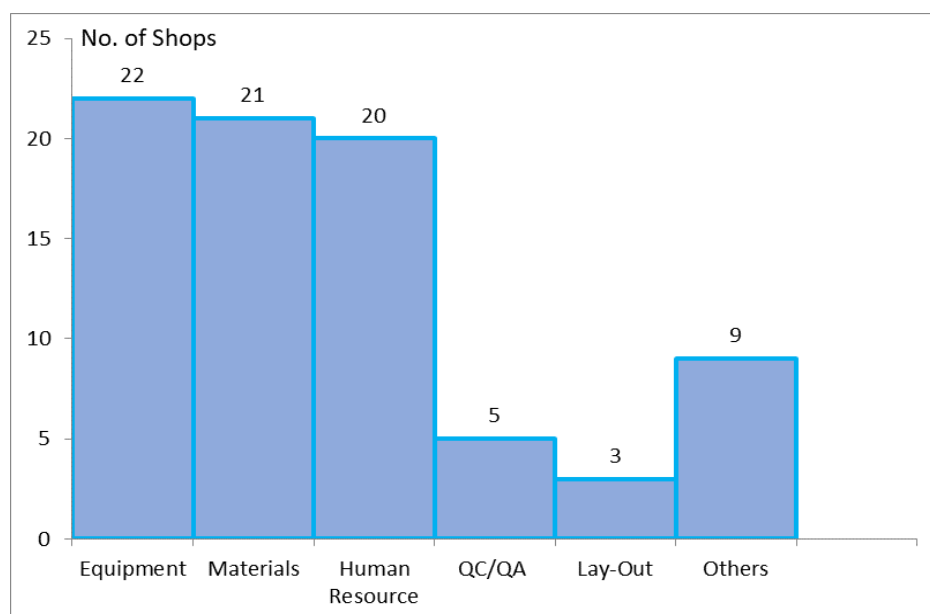


Figure 16. Problems Encountered

Note: multiple responses

Business Outlook

Table 9 shows the respondents' business outlook for the previous and current year. Majority of the respondents said that their businesses are improving. Three shops said that their businesses have not changed compared to the past year. Other shops kept their answers to themselves.

Table 9. Business Outlook

Outlook	Current Year, 2017	Previous Year, 2016
Improving	38	39
Deteriorating	8	7
No Change	3	3
Not Disclosed	4	4
Total	53	53

Figure 17 shows the expectations and future actions of the respondents. As shown, most of the respondents show positivity when asked about the volume of business activity and condition this current year and for the next five years. Export and import data reflect few are undertaking such activities, nevertheless, there is a positive affirmation that business is up.

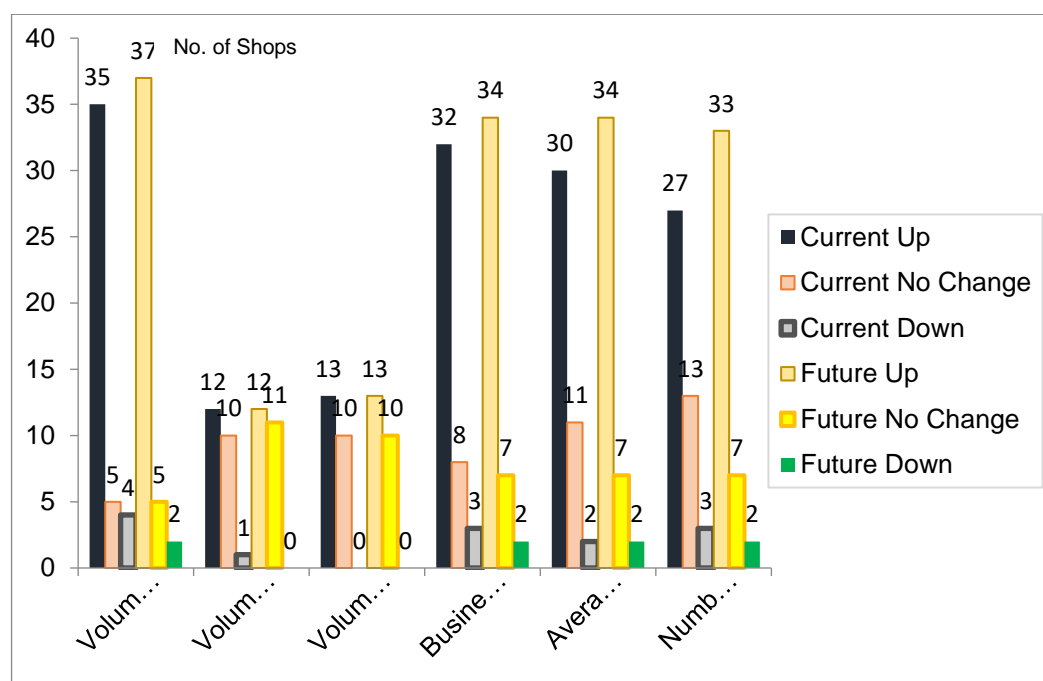


Figure 17. Expectations and Future Actions

For the selling price, there is a common stand to increase; some shops are willing to lower their price just for them to get the job order. Increasing the number of personnel employed is a must, but some respondents plan to have the same size of workforce due to its impact on production cost.

Expansion Plans

Figure 18 reflects the Expansion Plan of the HT respondents for the current year and for the next five years. As reflected, more than half of the companies have plans to expand through acquisition of additional equipment; majority are not planning to add branches. However, more than half of the total respondents are planning to add product lines and services offered this current year and for the next five years. Although the respondent companies have a positive outlook and perceive an improving business this year, they are still watchful on how the economy is performing. Moreover, some of the company-owners have no heirs to pass on the management of their companies.

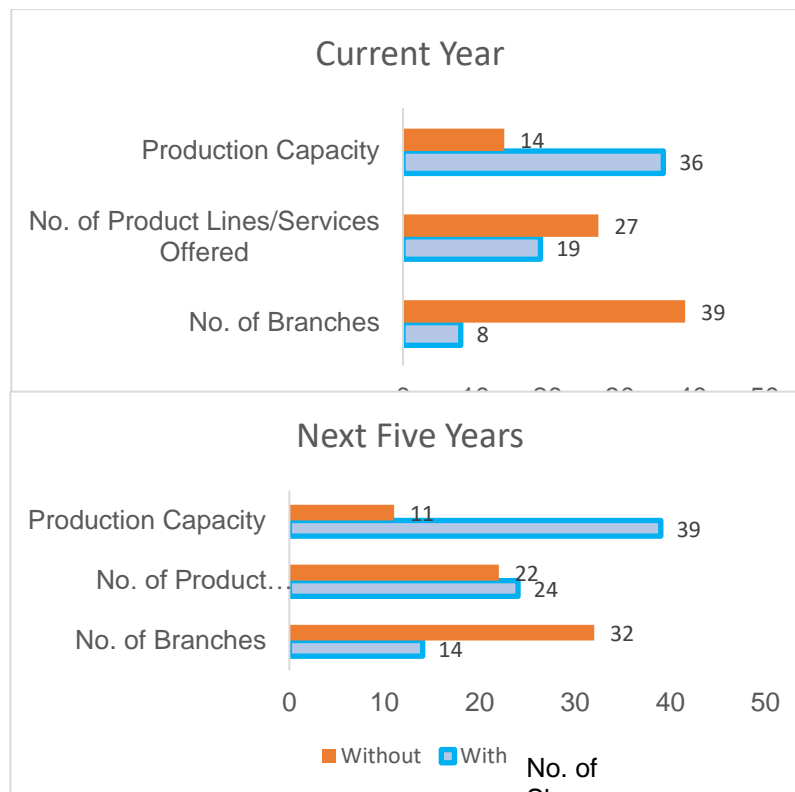


Figure 18. Expansion Plans for the Current Year and Next Five Years

CONCLUSION

1. The status of the heat treatment industry is as follows:

a) In terms of manpower requirement:

Overall, the heat treatment sector is facing the problem on inadequacy of skilled workers.

Although various programs on metalworking technology are offered by DOST-MIRDC and TESDA to train workers, but still these are not sufficient.

Table 10 shows the frequency of the Seminars and Training Programs conducted by MIRDC from 2015 to 2017 related to heat treatment.

Table 10. HT Training Programs Conducted by MIRDC, 2015-2017

Training Programs	Year					
	2015		2016		2017	
	Freq	#Trainee	Freq	#Trainee	Freq	#Trainee
HT of Steels (P+R)	5	66	5	95	4	90
HT & Material Testing+Infoseminar	3	45			1	28
Total	8	111	5	95	5	118

Between 2015-2017, a total of 472 training programs were conducted by MIRDC including seminars on Metalworking Technology, Metalcasting Technology, Analysis and Testing, Engineering, Production and Planning and Management/Productivity Improvement, among others, and covering 16 regions and with a total of 11,297 trainees.

TESDA as a training provider also conducts technical trainings similar to the training offerings (in metalworking) of MIRDC.

For HT machine operators, in terms of experience, majority belongs to “less than 5 years” and “5-10 years experience” (refer to Figure 8). Those with more than 10 years of experience usually look for greener pasture abroad or establish and manage their own business. As shown in Figure 9, for level of proficiency, 867 or 68% of the machine operators are categorized as very satisfactory. Overall, the heat treatment sector is facing the problem on inadequacy of skilled workers.

b) In terms of facilities requirement:

As gleaned from the survey, the heat treatment sector is facing problems on maintenance of equipment. Facilities of the heat treatment sector includes chamber furnace and vacuum heat treatment furnace. The rest are HT equipment, hi-frequency heater and heat treatment oven & furnace. The data was disclosed by 38 out of 53 respondents.

As to the government support facilities, DOST-MIRDC has both conventional and vacuum furnaces housed at its Surface Engineering Facility in Bicutan, Taguig City. The Center acquired a new Vacuum

Carburizing Heat Treatment Furnace through the “Establishment of a Gearmaking and Assembly Facility” project aimed to support the heat treatment needs of gears developed by MIRDC. Targeted year for MIRDC to accept jobs utilizing the new heat treatment facilities is 2019. The technology is more advantageous because this is a high mass production facility, short processing time, high reproducibility, proven technology, high flexibility, automation possible and many more.

c.) In terms of investment requirements:

The small and micro enterprises (SMEs) are those that could not afford investments to expand business and upgrade capabilities.

By annual sales: The annual sales in 2016 is dominated by large and medium companies with about Php4B (90 percent) of the total (Php4.4B). This follows that Php400M is shared by micro and small companies.

2. The needs of the HT in terms of technology requirements can be seen in Figure 19, the companies across the HT industry are planning to expand in technology requirements to maintain their competitive position, both this current year and for the next five years, as to what equipment, there were no mention.

In terms of technical capability of manpower, though MIRDC regularly conducts management and technical seminars especially Heat Treatment, there is a need to train more workers, especially machine operators and technician. As the workers become trained, they go out to start their own business or to find a greener pasture either local or abroad.

3. Analysis of 2013 to 2017 import and export data

The export of heat-treated products for five years shows an up and down trend, but the 2017 figure has the lowest FOB value and the lowest in volume for the five-year period. Import figures show an increasing trend from 2013 to 2016, but also dropped in 2017. The possibility of the unexpected drop is probably due to the global trend of shift from mass production to batch and one - piece

flow production model. This is due to the customer's increasing demands for customized product, and production flow traceability at low cost.

Based on the available data, if the performance of export and import continue, the immediate future of the industry is at stake. But, since the limitation of the study that large companies of aerospace and shipbuilding industries are not included in the survey, the hope is still there that the industry will still be able to recover.

As to the mid-term and long-term future of the industry, according to one of our MIRDC HT experts - the HT industry is still in the deteriorating stage, although majority of the respondents hope that the present condition will just be temporary.

4. The HT industry is still facing the same issues and problems:
 - a. For human resource- in 2005 study, the problem on skilled workers is included in the top survey respondent answers, the same is true in the recent study referring to Figure 7 and Table 10.
 - b. The raw material problems raised in the previous study is still reflected by the current study focused on inadequate supply of raw materials, the sub-standard quality and difficulty in the supply of metals.
 - c. The financing of a new equipment, the maintenance of an acquired equipment and low utilization of equipment contributed to the issues and problem still experienced by the HT sector.
5. To strengthen the local HT industry of the metalworking sector significantly, the most appropriate programs to be implemented are focused on human resource, raw materials and equipment. Included also is the academe-industry linkage and recommendation of Aerospace Roadmap for HT which are focused on Professional Training and Technology Promotion including MIRDC Services and Supply Chain Integration.

RECOMMENDATION



Dr. Danilo N. Pilar discusses the Focus Group Discussion structured questions.



Ms. Lina B. Afable presents the heat treatment sector survey results.



FGD participants listen attentively while Dr. Pilar explains the structured questions.

The DOST-MIRDC conducted a focus group discussion (FGD) on November 28, 2018 with the aim of validating the survey results. The FGD participants recommended possible solutions to address the problems, issues and concerns.

The following programs and activities were recommended to enhance the global competitiveness of the local heat treatment sector:

Human Resource Development

- Identify needed training programs on HT to improve the skills of personnel in the industry. Saturate the industry with the importance and various processes employed.
- Solicit grants for foreign training in the field of HT technology.
- Conduct local study tours for metalworking entrepreneurs from the regions to progressive HT facilities in NCR.

Raw Materials Sourcing

- Addressing the perennial problem of cost and availability of raw materials is a unified effort of both industry and concerned government organization.
- Reduction in tariff duties on industrial grade salts for HT.
- More researches on localization of industrial grade salts and HT raw materials that could minimize importation.

Facilities Upgrading

- Encourage modernization of HT facilities to incorporate the process in the design of their production.
- More tax incentives for HT shops to encourage modernization program under BOI's investments Priorities Plan (IPP).

Academe-Industry Linkage

- Encourage partnership of regional industry associations with technical schools offering heat treatment courses.
- MIRDC to establish linkage with schools and associations for them to have access on equipment, not only for facilities sharing, but also for training of heat treatment personnel.

Aerospace

The Philippine aerospace industry roadmap from 2013 to 2022 include challenges about heat treatment*. This is addressed to heat treating companies nationwide. The government can support in the following areas:

1. Professional Technical Training

MIRDC to spearhead provisions of training and development of critical processes to bridge gaps in the supply chain on heat treating processes such as nitriding, vacuum heat treatment with sub-zero and carburizing.

2. Continuous promotion information and upgrading of the MIRDC services for all metalworking industry specifically the automotive, aerospace, and construction sectors.

3. Supply chain integration

Encourage development of local businesses conforming to aerospace standards.

Photos of HT Equipment

MIRDC Vacuum Furnace



Update for MIRDC Vacuum Heat Exchanger
As of March 2016, there were more than 10 customers availing the services of the vacuum heat treatment furnace and almost one ton of ferrous alloy has been heat treated. D2 and H3 ferrous alloys are mostly process in the MIRDC Vacuum Gas Quench Heat Treatment Furnace.

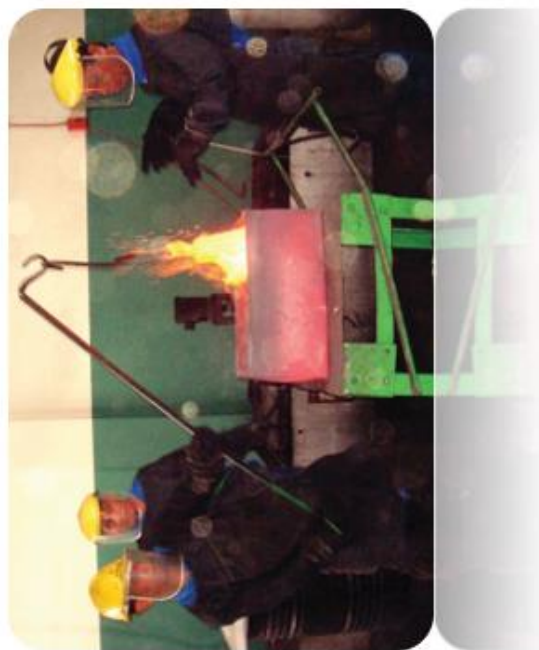
p.14 (Puerto, 2016) [Philippine Metals 2016](#)
Volume 3



Engr. Nelson I. [Tumibay](#) discusses how the furnace operates, while a technician in the right charges parts for heat treating.

Photos of HT Equipment

CHAMBER FURNACE



Chamber furnace as operated by MIRDC technicians.

Table 11. Identified Heat Treatment Companies in the Philippines, 2018

Region	City/Province	No.	Company
NCR	Caloocan	1	Industrial Heating Corporation
		2	Maximetal Industries, Inc.
	Mandaluyong	3	Oriental Toolmaster Corp. ^{1**}
		4	NER Industrial Services Corp.
		5	NETL Industrial Services Corp.
		6	Don Bosco Technical College ²
	Marikina	7	ARMSCOR
	Muntinlupa	8	La Rota Tools & Die Services, Inc.
		9	Makati Foundry, Inc.
		10	AC-10
	Pasig	11	Evapia Precision Toolings Co.
	Taguig City	12	Metals Industry Research & Development Center (MIRDC) ³
		13	NSB Engineering, Design and Fabrication
		14	Gerbag Industrial Technologies
		15	Uveex Corp.
		16	Nachi Pilipinas Industries, Inc.
	Valenzuela	17	Arty Ferro Cast, Inc.
		18	Mega Samsotite
I	Pangasinan	19	Philgerma Manufacturing, Inc.
	La Union	20	De Guzman Machine Works
CAR	Benguet	21	Top Ace Motor Works
III	Bataan	22	Government Arsenal, DND ⁴
		23	Bataan Peninsula State University ⁵ (Bataan Polytechnic State College)
	Bulacan	24	Jocelyn Forge, Inc.
		25	Formosa Forge, Inc.
		26	Perezonic Engineering Services
		27	Galvanizing Specialist Manufacturing, Inc.
IV-A	Batangas	28	Citizen Machinery Phils.
		29	Metals Engineering Resources Corp. (METERCOR)
	Laguna	30	Metalcrest Technologies, Inc.
		31	Philippine Precision Technology, Inc.

		32	Kinergy Phils., Inc.
		33	ARREM Industries, Inc.
		34	Acme Tools, Inc.
		35	VJF Precision Toolings Corp.
		36	FVC Philippines
		37	AGM Ventures Enterprises
		38	Penta Technological Products, Inc. ⁶
		39	Air Water Philippines, Inc.
		40	Nogalos Enterprises
		41	Mold Parts Manufacturing Asia, Inc. (MPM Asia Inc.)
	Cavite	42	Riclet Technological Manufacturing, Inc.
		43	P. Imes Corp.
		44	Amvel Metal Fabrication Services
		45	Castem Philippines, Inc. ⁷
		46	Harmo Technology Corp.
		47	Choryo Toolings Systems, Inc.
VI	Negros Occidental	48	Apollo Machine Shop, Inc. ⁸
		49	Victorias Milling Company ⁹
VII	Cebu	50	Precision Machinist Corp.
		51	St. John Bosco Systems, Inc.
		52	Center for Cebu Light Engineering & Metalworking, Inc. ¹⁰
		53	Suarez Bros. Metal Arts, Inc.
		54	Cebu Micro Technologies & Metal Products Corp.
		55	Makoto Metal Technology, Inc. ¹¹
		56	Castalloy Technology Corp.
		57	San Gabriel Metal Concepts, Inc.
		58	Fil-jap Trading ¹²
		59	Don Bosco Technology Center
		60	Precision Forming Corporation
X	Misamis Oriental	61	Mindanao Forge Co.
XI	Davao City	62	MA Foundry
		63	JAS Machine Shop & Engineering Works

** 12 were respondents of the previous industry study (2005).

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