Vice Admiral Jorge Enrique Carreño Moreno
Adan Vega Saenz
Luis Carral Couce
Jymmy Saravia Arenas *Editors*

Proceeding of the VI International Ship Design & Naval Engineering Congress (CIDIN) and XXVI Pan-American Congress of Naval Engineering, Maritime Transportation and Port Engineering (COPINAVAL)

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ISBN 978-3-030-35962-1 ISBN 978-3-030-35963-8 (eBook)
https://doi.org/10.1007/978-3-030-35963-8

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Foreword

The Pan-American Institute of Naval Engineering (IPIN) is a nonprofit institution intended to promote progress in naval architecture and marine engineering and water and water transportation in the Americas. IPIN holds a Pan-American Congress in one of the member countries every two years. The Congress allow the rejoining of members to discuss specific problems, to exchange valuable information and experiences and to live in a very intense way, the Pan-American confraternization.

The present edition issues some of the main papers that were discussed in XXVI COPINAVAL, held in Cartagena de Indias, Republic of Colombia, last March 2019.

The papers presented at this IPIN Congress include topics such as: ship deck design; building and exploitation technologies of most types of vessels; different port enjoyment for cargoes load and unload, like the equipment and technologies used in shipbuilding and naval industry now-a-day. In last years, the antipollution studies, technologies and new development equipment had been very interesting themes for the international community, and the IPIN members had not ignored this very important problem of the humanity.

Finally, I promise you will read a very interesting technical article and Why not? I hope to see you in next IPIN XXVII Congress in Havana in 2021.

José González Cobas
President of IPIN Américas

Foreword

One of the purposes of the Pan American Institute of Naval Engineering, established in its Statutes, is to promote internationally and especially in the Americas, the Progress of engineering and naval techniques, navigation, shipbuilding and port activities in all related sectors, including parallel and subsidiary activities. From all of the above, the COPINAVAL congresses contribute in a extraordinary way and since 1966 have become the meeting forum, of the creation of bonds of sympathy, friendship and affection, between professionals of these aspects of work and between countries. The gold brooch of the XXVI COPINAVAL held in Cartagena de Indias is reflected in this publication which has the best technical level, due to a periodic character, celebrating every two years in a different country and publishing by a publisher of recognized prestige.

José Ángel Fraguela-Formoso
University of A Coruña

Preface

In this opportunity, the *International Ship Design and Naval Engineering Congress—CIDIN*—joined with the experience of *Pan-American Congress of Naval Engineering, Maritime Transportation and Port Engineering—COPINAVAL*, to promote the development of the naval, maritime and river industry, within the framework of an academic setting, where industry, universities, companies and other institutions shared knowledge and experiences on progress of scientific and technological development in the sector, while creating cooperative networks.

Different activities were developed in this academic space: 60 scientific papers, 9 technical papers, 5 keynote lectures and 3 large forums that contributed to the construction of knowledge about the impact of the military industry on economic improvement, strategies for the development of the blue economy and the future of the Pan-American shipyard industry. Different academic lectures were highlighted on issues like: vibration analysis, risk, modularity in warships, autonomous ships, propulsion systems, hydrodynamics of ships, maritime logistics, multimodal transport and good practices and trends in shipbuilding.

Among the main conclusions of the event, we can detach the invitation to the researchers to think about sustainability, work on the preservation of seas and water bodies, focus on social and economic development, and reflect that the future of Pan-American shipyard industry is in alliances and technological cooperation for the development of transnational projects.

I take this opportunity to thank the Colombian National Navy, the members, presidents and general secretaries of the different chapters of the Pan-American Naval Engineering Institute—IPIN, for promoting this academic scenario around the naval and maritime industry.

Rear Admiral Oscar Darío Tascón Muñoz
President of COTECMAR

Acknowledgments

The publication of these congress proceedings shows the success of the union of the VI CIDIN and XXVI COPINAVAL congresses held in Cartagena de Indias,-Colombia, from March 13 to 15, 2019. We thank all the members of the Pan-American Naval Engineering Institute (IPIN) and members of the Corporation of Science and Technology for the Development of the Naval, Maritime and Fluvial Industry, COTECMAR, whose effort, motivation and commitment made this great event possible, allowing the generation and transfer of knowledge in the areas of design, naval, maritime and port engineering. The contributions of this congress are aimed at generating an impact on the development of the Pan-American naval industry, its companies and institutions and the consolidation of an economic growth platform for our countries.

In the same way, we especially thank the authors of each chapter, who attended our call for the conformation of the academic agenda, the young people who participated in the student competition, the exhibitors and in general the audience, whose interest and participation enriched the purposes of the congress.

Finally, I would like to highlight the excellent work of the organizers, which resulted in the satisfaction of the attendees and the generation of fruitful knowledge exchange spaces that strengthen our industry.

Vice Admiral Jorge Enrique Carreño Moreno
President of IPIN Colombia

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About the Editors

Vice Admiral Jorge Enrique Carreño Moreno is Naval Engineer from the Naval Cadet School "Almirante Padilla." He holds a master's degree in defense and national security, as well as a doctorate in naval architecture from the Polytechnic University of Madrid. His research interests focus on technological development and innovation in the naval industry, ship dynamics, shallow water maneuverability and experimental hydrodynamics.

He has worked in the shipbuilding industry since 1998, participated in the creation of the Corporation of Science and Technology for the Development of the Naval, Maritime and Fluvial Industry, COTECMAR, in 2000, leading the technology and design management for more than 10 years. He served as President of this corporation from December 27, 2013, until February 2018.

Dr. Adan Vega Saenz is Mechanical Engineer with a master's degree in materials science and another one in plant engineering, all from the Technological University of Panama. He holds a Ph.D. in marine engineering. He is Author of more than fifty scientific articles and a textbook. His professional experience includes, among others, being a university Professor for fifteen years at the Technological University of Panama and Visiting Professor at the Technological University of Bolivar and Uninorte, both in Colombia. He is Consultant of several national and international companies.

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Dr. Jymmy Saravia Arenas is a third year PhD student of the program of Technology and Innovation Management, MSc in Innovation Management from the Universidad Tecnológica de Bolívar (Colombia) and Systems and Technology Management Specialist. Since 2009, he has performed the roles of chief of Technology and Knowledge Management and chief of the Innovation Management Department of the Science and Technology Corporation for the Development of Naval, Maritime and Riverine Industries (COTECMAR). With more of 13 years of professional experience, he has worked leading and executing research, development and innovation projects in different sectors. He has as main knowledge areas technology surveillance, technology transfer, intellectual property, formulation and Research, Development and Innovation (R+D+i) project management, spin-off company creation, information system management and audit of management systems.

Argentine Shipbuilding Industry 100 Years (1937–2036)

Industry

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Abstract. Authors Raúl Podetti Sr. (87) and Jr. (60) add up to a century devoted to the shipbuilding industry, in which they have pursued their career as naval architects and marine engineers. Here they contribute their view as active players in the sector, having managed private and state-owned shipyards, as well as professional and industrial business entities.

This paper is about shipbuilding policies in Argentina. It is divided in three chapters: Industry, Policies and Future.

The first one, Industry, describes its evolution and the main players providing a thorough qualitative and quantitative analysis of the sector's performance.

Keywords: Shipbuilding · Marine industrial policy in Argentina · Shipyards

1 Introduction

Several are the reasons that led to the inclusion of the concept of "one century" in this paper's title: 100 years have recently passed since the famous publication by Cap. Storni, on "Argentine Maritime Interests". In 1917 started the first shipbuilding union organization. One hundred years is the period analyzed in this paper. Starting in 1937 – going back eighty years in history to the beginning of modern shipbuilding industry with the construction of a series military vessels by the local industry. Reaching up to 2036 – projecting twenty years into the future in order to achieve a consolidation of the nation's industrial activity at levels of employment and exports similar to the maximums reached in the past.

One hundred years is additionally the time added up by the authors in their professional maritime dedication to this engrossing activity.

This industry is very broad and in order to analyze it, it can be divided along at least three dimensions. According to the type of service, into Construction or Repairs; according to the type of vessels, into Heavy or Light; and according to position within the industrial chain, into Shipyards or Parts/Services Suppliers to the shipbuilding process. The focus of this paper is on the Heavy Construction industry of ships, from the standpoint of the Shipyards.

V. A. J. E. Carreño Moreno et al. (Eds.): CIDIN 2019/COPINAVAL 2019, pp. 1–10, 2020.
https://doi.org/10.1007/978-3-030-35963-8_1

2 Industry

The first shipyards in the region, gradually established along the basin of the River Plate, as well as inland, to make use of the rivers to sail their products down to Buenos Aires, and in the far southern region, to repair those ships that were wrecked while trying to make their way through the extreem South, around to the Pacific Ocean [1].

3 Industry Evolution

The last eighty years (1937–2016) of Argentine Shipbuilding Industry history fall into four stages. They are clearly seen when graphing (at Contract Dates) the values (MMusd - Millions of dollars) for newbuildings in argentine yards during the last 80 years (Fig. 1).

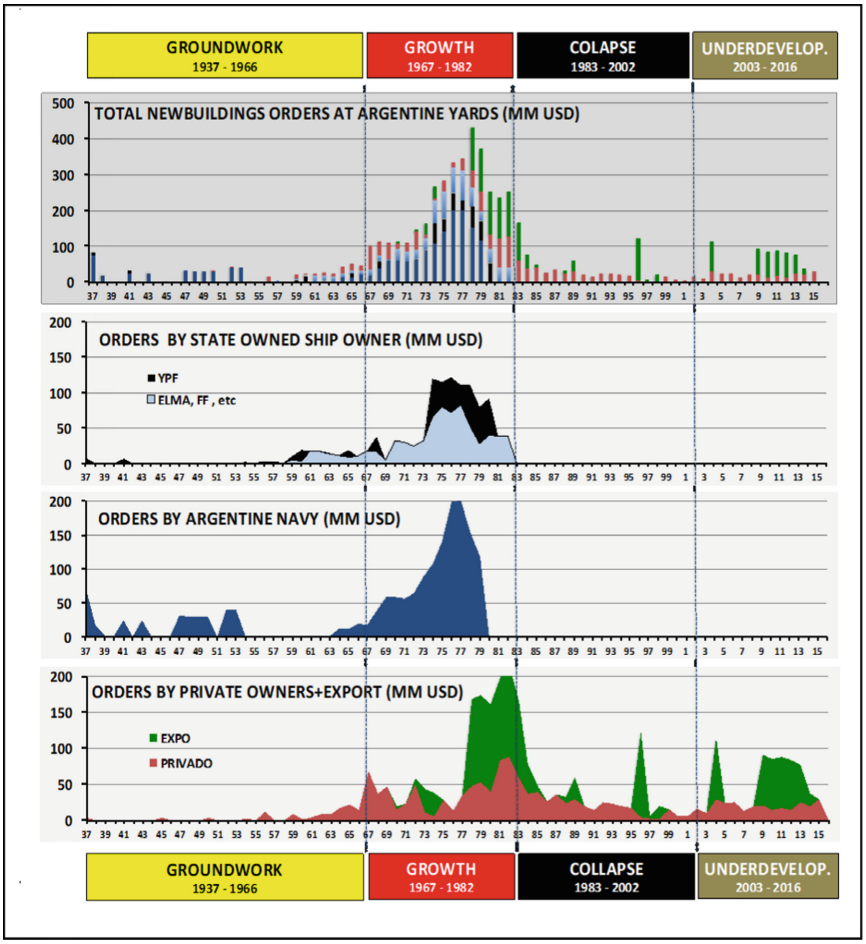

Fig. 1. Argentine newbuilding values at contratct date

First graph shows Total Newbuilding orders and in the others are shown the components of Carrier State (ELMA, EFFEA, YPF), Navy, and private and foreign shipowners. This helps to understand the classification into historical stages and the impact of the demise of the "Shipowning State", which altogether amounted to 45% of the total industrial value. The maximum commissioned rate was reached in the late 1970s, totaling over 400 MM US dollars annually.

The **Groundwork** phase starts with the first significant military shipbuilding project, in 1937, commissioned by the Navy from national private and public shipyards. On the basis of the Navy's attitude, momentum gathered, and infrastructure and institutions were created, laying the foundations for future development.

Only in 1966 did the then prevailing development minded intentions strengthen and result in suitable governmental policies for the times, which enabled a steady progress towards the second, **Growth** stage of the activity. Following a worldwide trend, promotion and protection schemes resulted in a great demand for ships from governmental and private shipowners, supported by ample public financing, similar to that in other countries, and with subsidies to match those received by foreign shipyards in their attempt to enter the Argentine market. It was a time of great development, which ended in the early 1980s.

Due to external reasons, internal crises and changes in policies, the government stopped buying ships in the country and suspended shipbuilding financing. Thus started the stage of the **Collapse** of this industry, during which the largest private shipyards died out. What's worse, as of the 1990s, a most dubious policy promoted the tax-free import of second-hand ships, which became the rule – and the most lethal sectorial policy – in the early years of the new century.

This course means that even to this date, the sector remains deeply sunk in undeserved **Underdevelopment** – the name of the fourth phase – from which this paper attempts to provide escape routes.

4 Value and Employment

In a distinctive contribution, the authors have worked on statistical shipbuilding archaeology, to identify the building data on thirteen hundred ships throughout the country since 1937 – excluding smaller (L < 20 m) and pleasure units. The work resulted in the industry's first ship production database in Argentina [2].

Using technical parameters, assessment was made of the Value (in US dollars of today) and the Direct (Adjusted Standard) Construction Man Hours applicable to each unit, which in turn made it possible to classify information under two criteria (Value and Employment) as applied to shipyards and vessels so greatly different from one another.

From the analysis of the constructed value by shipyard type, the authors found that the state-owned Río Santiago shipyard (ARS, in Spanish) delivered 40% of the total value, although in the last decade it contributed only 15%.

The large private shipyards delivered 24% of the total during their short lifespan and middle-sized shipyads have grown the most in relative contribution to the total value percentage, from 36% of the total to 85% this last decade (Fig. 2).

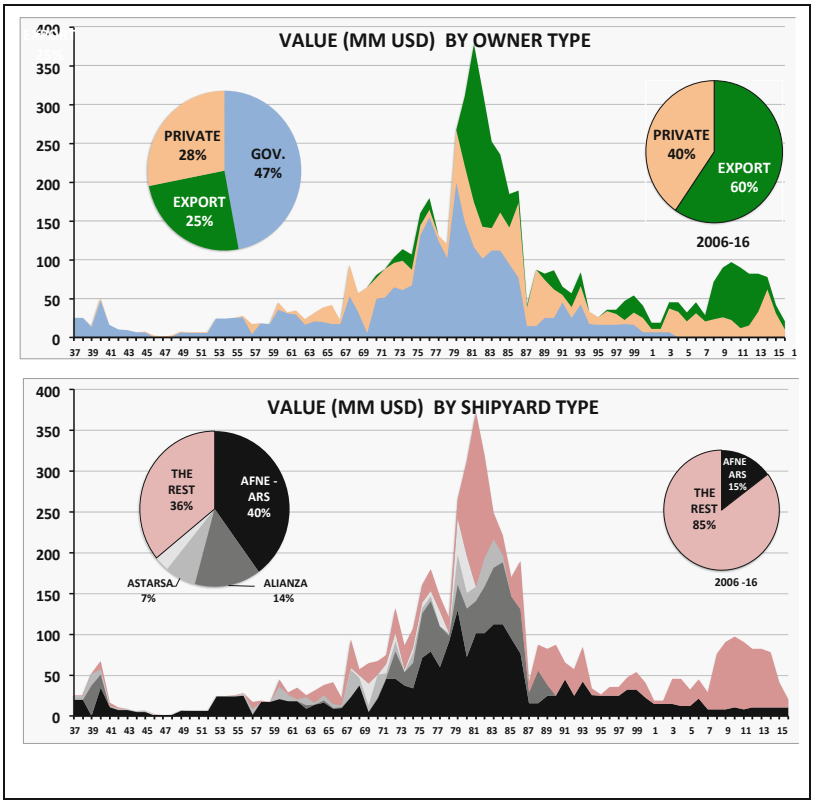

Fig. 2. Value of Argentine newbuildings

When combining this value contribution to the generation of employment, it is concluded that, at present, the shipbuilding industry increasingly depends on middle-sized private yards.

As regards the employment criterion, each ship was assigned the standard direct production hours adjusted by type of shipyard and construction period. This made it possible to reach an estimate of the necessary amount of productive staff needed for ships actually built at a given time, which is here defined as "Direct Newbuilding Employment".

"Total Employment in Shipyards" was reached by combining sources [3] (National Economic census, Shipyards publications, etc.) and also includes production workers in excess of actual building demand (for instance, idle or working in shiprepair), and indirect personnel. Direct construction employment necessary to produce what was really built reached a peak of 9,000 workers in 1979 (Fig. 3).

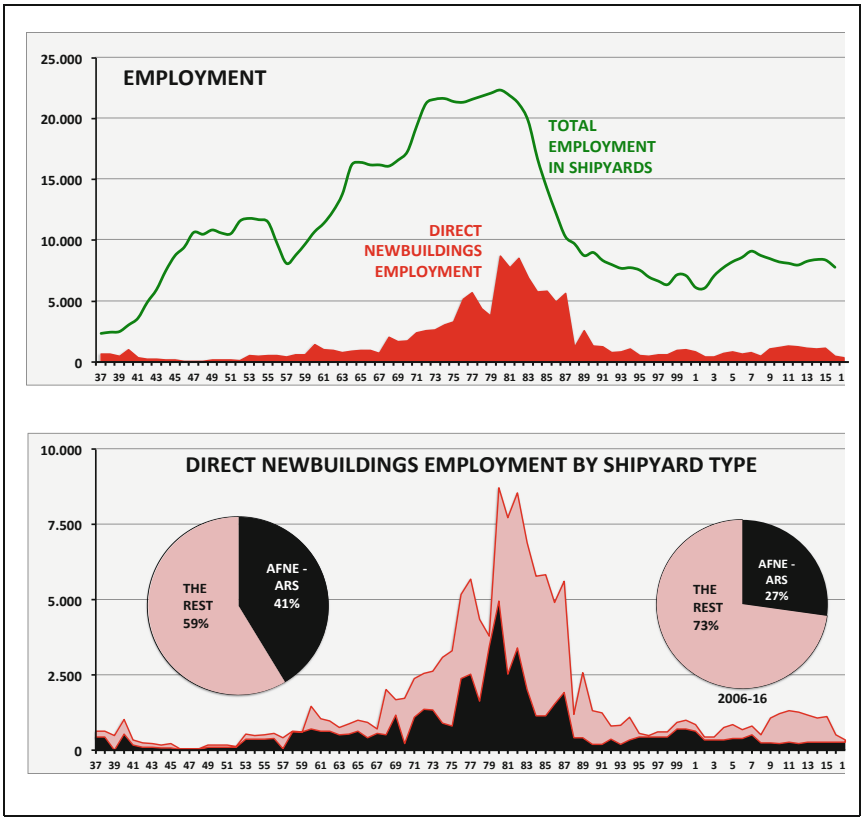

Fig. 3. Employment in Argentine shipyards

ARS provided 41% of the total productive workforce in the whole period, but only 27% in the last decade.

Total Employment in shipyards is much higher than Direct Construction Employment, for repair work has always been very sizable and requires large amounts of labor.

The ratio of Direct Jobs/MMusd produced is of certain use to compare productivity as it shows the amount of people "required" to produce a certain value of ship. This ratio is 23,2 for the whole period and 14,5 for the last decade.

It follows a statistical summary of Industry performance from 1937 to 2016 (Fig. 4).

Quantity of Vessels			Value MMUSD		by Yard type: Gov. yard	Private Yards: Large	Private Yards: Med.
1.295			5.855		2.351	1.395	2.109
		Markets					
7%	95	Sea transport	2.096	36%	44%	51%	5%
2%	29	Military	1.388	24%	97%	1%	1%
47%	611	Waterways	895	15%	4%	13%	84%
22%	286	Fishing	518	9%	0%	1%	99%
1%	12	Special (Offshore, Polar)	500	9%	0%	22%	77%
12%	155	Dredges / Towing	308	5%	9%	19%	71%
8%	107	Tourism / Passengers	150	3%	7%	7%	86%
		Financing					
17%	221	State Shipowner	2.718	46%	75%	20%	5%
27%	349	External Funds/ Export	1.537	26%	14%	27%	59%
42%	545	National Prive Funding	1.008	17%	6%	7%	87%
8%	110	National Merchant Marine Fund	517	9%	9%	71%	19%
5%	70	State Banks	75	1%			100%
		Type of Owner					
17%	221	Government	2.718	46%	75%	20%	5%
56%	725	National Private Owner	1.600	27%	7%	28%	66%
27%	349	External Owner	1.537	26%	14%	27%	59%
		Owners					
4%	46	NAVY	1.545	26%	88%	10%	1%
2%	30	ELMA	586	10%	70%	30%	0%
1%	19	YPF	375	6%	59%	31%	9%
1%	8	POLSKA ZM	249	4%		100%	0%
0%	2	READING & BATES (USA)	180	3%			100%
92%	1.190	Other 24 owners	2.920	50%	12%	24%	64%
		Type of Shipyard					
9%	114	State Owned (5)	2.351	40%			
11%	138	Large Private (3)	1.395	24%			
81%	1.043	Medium Private (54)	2.109	36%			
		Shipyards					
6%	73	AFNE- ARS	2.296	39%			
3%	45	ALIANZA	820	14%			
5%	68	CORRIENTES	465	8%			
3%	40	ASTARSA	390	7%			
18%	238	PUNTA ALVEAR	375	6%			
9%	115	SANYM	250	4%			
4%	53	PRINCIPE	185	3%			
51%	663	Other 55 shipyards	1.074	18%			

Fig. 4. Argentine shipbuilding statistics (1937–2016)

5 Argentine Shipyards

Most of the shipyards in Argentina are privately owned. Up to the 80's there were three large private yards (Astarsa, Principe and Alianza) and nowadays there are 16 private medium size yards.

The state owned yards are Astillero Rio Santiago (ARS), Storni and the shiprepairers Tandanor and ANPB (Base de Puerto Belgrano).

5.1 Astillero Rio Santiago-ARS

The Río Santiago shipyard was founded in, by president Peron as part of the *State Shipyards and Naval Factories* (AFNE, in Spanish).

Its concept, design and management was undertaken by the Navy as part of the leadership exercised by the naval force regarding the shipbuilding industry in foundational and development times.

ARS was the industrial expression of a time marked by the Soviet model of overstaffed mega-factories, with maximum vertical integration (from rivets to large marine engines), which also fulfilled a strategic role in training naval architects, marine engineers, technicians, craftmen and workers who would continue the industry over the years.

Originally, ARS played a military role, soon diversifying its focus in order to meet the needs of the state owned merchant marine fleet.

It built 73 significant vessels, standouts among them being the training tall ship ARA *Libertad*, virtually all the nationally built navy fleet, YPF's largest oil tankers, and merchant ships for ELMA. In the last years, construction was of bulk carriers and oil tankers, exclusively for export.

Traditionally, ARS was a major employer in the shipbuilding industry, representing 25% of total historical employment in shipyards, with a maximum record of eight thousand employees in 1970 and a minimum of eleven hundred in 1992. Remarkably, over the last decade it represented 47% of total shipyards employment, with some 3400 agents, despite its production being much reduced – providing only 15% of the period's total industrial value.

Fifty-nine percent of the shipbuilding value was made up by military vessels, followed by overseas merchant vessels for the state-owned ELMA and YPF.

Considering current shipbuilding operations, its exports amount to 9% value of its overall historical production, having also worked for private shipowners (4%).

From 1976 to 1983, it added value exceeding 100 MM dollars annually, understanding that in this analysis, value is split over the term of construction, as is employment.

The relationship between Total Employment and Value produced is a ratio (the lower, the better) that shows a shipyard's productive features. It is worth noting that from the mid-1950s through the early 1970s, for ARS, this index increased to high levels – 230 jobs per million dollars of value – on account of its high vertical integration, the training of apprentices, and the shipyard facilities construction by its own personnel. Then the ratio was reduced to a normal value under 50. But as of the "provincialization" process, in 1993, this index increased markedly, reaching the exorbitant level of 300 jobs per million dollars of value, thus pointing to a productivity ten times worse than the rest of the state-owned shipyards of the region. This resulted from the unfettered increase in personnel not related to production (the effect of the shipyard's politicization) and the reduction in real productive activity. This situation is deemed to cause a loss of 170 MM dollars annually, a situation that has lasted for over two decades, independently of the kind of government in charge of the shipyard (Fig. 5).

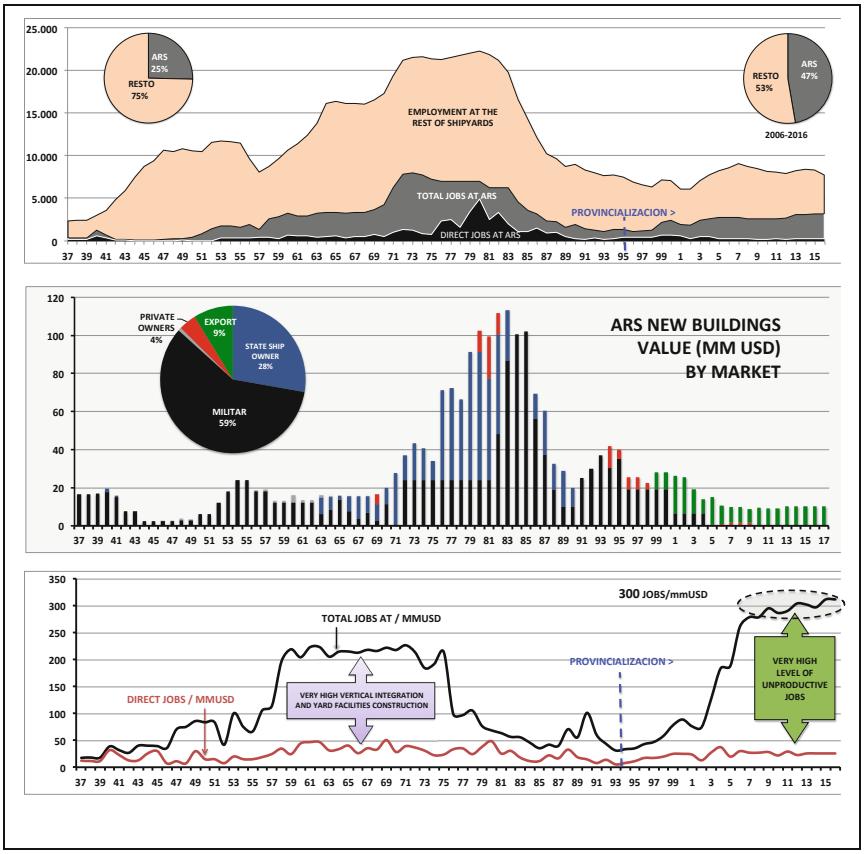

Fig. 5. Employment and value at Astillero Rio Santiago

5.2 Cinar: Tandanor + Storni

In 1972, many of the state-owned workshops and shiprepair docks were merged into one entity, named Tandanor. Six years later, it started work to install the largest ship lift system (Syncrolift), which enabled Tandanor to place large ships in dry dock and move them to workstations, thus providing the largest and very latest ship repair capacity in the region.

It was the center of one of the first and worst privatizations of the early 1990s, which ended up in a scandal, followed by bankruptcy and renationalization in 2007, with 10% of the shares held by employees.

Along with the construction of the Syncrolift, the Navy partnered in a mega-project, with a German shipyard which sold to Argenina a fleet of submarines and a highly modern shipyard that was supposed to build more of them, though this never actually happened.

This magnificent shipyard, under the authority of the Ministry of Defense was originally named Astillero Ministro Domecq García and then renamed Almirante

Storni. Of all shipbuilding facilities in the country, Storni is the best, with the highest potential, yet also the most wasted asset of all (Fig. 6).

Fig. 6. Tandanor + Storni (CINAR) aerial view

The aerial picture shows on the left (yellow line) the STORNI (ex Domecq García submarines yard) huge facilities.

The orange line marks the perimeter of TANDANOR, the largest repair facility in the region with a Syncrolift and ample wharfs.

The CINAR complex is located at a premium real estate area in downtown Buenos Aires city, only blocks away from the rich Puerto Madero zone and the Pink House (Government Headquarters).

5.3 Large Private Shipyards

Promising state policies of the mid 1960s fostered the modernization and enlargement of traditional shipyards from the district of Tigre and the Riachuelo in Buenos Aires province [1].

Astarsa: This was the first to appear, continuing the historical Hansen and Pucini (1927) in the district of Tigre, already a player in the modern shipbuilding industry since 1937. It built some 35 ships of considerable size, totaling 210,000 DWT. Apart from ships up to 30,000 DWT, it built locomotives and road equipment. Worth mentioning are the merchant ships of the *Río Limay* series, the bulk carriers of 11,500 DWT, the research vessel *Puerto Deseado*, as well as Ro-Ro and containerships.

Principe, Menghui y Penco: In the area of the Riachuelo – Avellaneda, partners Principe and Menghi associated with Penco to form the second large argentine private shipyard in 1967, which built some ten large ships, mainly for the Navy, the polar ship ARA *Bahía Paraíso* standing out among them. It also built a series of lash type barges for an American shipowner, and several river vessels for the regional market.

Alianza: A few blocks from Principe, in the early 1970s, naval architect and marine engineer Héctor Rodríguez Zubieta established the region's most efficient and state-of-the-art shipyard, Alianza. This yard built over thirty large ships, 750,000 DWT on aggregate, and raised the Argentine shipbuilding industry to the highest productivity standards in history (Fig. 7).

Fig. 7. View of Alianza

Alianza's sales to Chile were the first exports of large ships for the national industry, and a series of bulkcarriers to Poland were the largest exports. Altogether, it exported over 300 MMusd, representing 37% of its production.

It also delivered dredge *Capitán Nuñez*, reefers of the *Glaciar* series, *Freedom* ships and oil tankers.

Led by Alianza, the three large private shipyards taken together built 10% of the total of units, invoicing 24% of the value, and their clients procured 71% of the National Fund of the Merchant Marine (FNMM, in Spanish), conceived to finance and subsidize national shipbuilding.

5.4 Middle Sized Shipyards

The authors studied [2] the performance of some 54 middle-sized private shipyards from 1937 to our days, which on aggregate delivered 81% (1,043) of the units, generating 36% (2,109 MM dollars) of total sales, at an average of four vessels per shipyard per year, mainly supplying markets of fishing, river transportation, tourism and port services, with vessels that had an average value of 2 MM dollars per unit.

Today, there are 17 mid size yards along the maritime and river coastline of the provinces of Corrientes (1), Santa Fe (2), Buenos Aires (12), Chubut (1) and Santa Cruz (1). They are all SMEs combining shipbuilding and repairs.

Fifty-nine percent of the value of ship exports was created by this private industrial sector, and it provided 66% of sales to national private shipowners. Its market share to supply government needs was minimal. Middle-sized private shipyards were mainly financed with private and export funds, using only 19% of those available in the public funding system of FNMM [1].

Bibliographic References of this Chapter are presented in Chapter 'Argentine Shipbuilding Industry 100 Years (1937–2036): Future'.

Argentine Shipbuilding Industry 100 Years (1937–2036)

Policies

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Abstract. This work seeks to be a contribution and a respectful but firm demand to those in charge of governmental policies, which are required so that the ships argentinians need are built efficiently in national yards. Excluded from this respect are those officials, civilian and military, who have not fulfilled their obligation to guard Argentine work and who, on the contrary, have facilitated the shady dealings associated with the tax free mass importation of ships, particularly second-hand ones, which could have built in local yards at competitive prices.

Keywords: Shipbuilding · Marine industrial policy in Argentina · Shipyards

1 Introduction

Argentine shipbuilding industry has been immersed in a far too long depression stage due to the combination of the worst industrial policies.

This is the second chapter of a paper on shipbuilding policies in Argentina. Having described the Industry in a previous section, this one summarizes the study and discussion of cause and effect relationships between state policies and development, as presented in the book *Argentine Shipbuilding Industry, 100 years (1936–2037)* published in 2018 by the authors of this paper.

2 Policies

Effective actions, rather than discursive speeches, make policies that indicate what rulers really think and intend to see happen.

Ministers, following presidential guidelines, regulate, bid and contract for a certain thing to occur, allegedly in the nation's best interest. Legislators, following their convictions or the instructions of their political leaders, draft laws that rule and orient reality in one direction or another. This "given direction" towards which they tilt the balance marks the intention of a public policy and reveals whom it really benefits.

It is thus worth looking into the impact of state actions (or omissions) through the government's executive and legislative deeds. This enables finding out the relations

V. A. J. E. Carreño Moreno et al. (Eds.): CIDIN 2019/COPINAVAL 2019, pp. 11–20, 2020.
https://doi.org/10.1007/978-3-030-35963-8_2

among state policies and development, the latter being measured through concrete notions, such as employment, tax revenue and foreign reserves. To do this, the authors examine sectorial policies and their effects, the international context, financing, government roles and, finally, six specific naval cases of recent times, in each case assessing the impact caused by the policies.

Some nations travel the hard path to attain shipbuilding development, and after many years of striving only a few reach a noteworthy level. And still, many countries reach sufficient capacity to at least meet the domestic demand concerning fishing, defense, port services, and coastal trade. There is barely a record of nations which have gained such strength only to subsequently waste it. Argentina is a tragic case.

A recent study carried out by the OECD reveals the importance assigned by governments to the shipbuilding industry, concluding that 90% assigned great significance to its employment generation as well as to the increase in industrial and technological capacity.

After analyzing over twenty cases of shipbuilding nations on four continents, embracing over 97% of world output, virtually all of them have in common a resolute state involvement as promoter of the industry's development, through financing schemes, protection on the domestic market, and support for an increasing export-oriented competitiveness.

Among the reasons for state support are: the concept of strategic industry for defense, security in domestic trade, easy access to international markets, demand for diverse qualified jobs, protection of foreign reserves, and generation of technological development.

Although all these reasons are valid for Argentina, two are worth considering, and they both come from Brazil, namely, governmental policies endorsing the shipbuilding industry as a means to distribute natural wealth and as a way to add value to other economic activities.

Natural Wealth: In 2003, having found great offshore oil wealth, Brazil's President defined a vital state policy summarized as follows [4]:

> This oil does not belong to Petrobras, nor to the oil-field workers, much less to the government. It belongs to all the Brazilians. If the benefits of this natural wealth are to reach the highest number of people, ships and offshore platforms for their exploitation must be built in Brazil.

His speech didn't come to nothing. Brazil applied active policies regarding financing, support and supervision, so that the shipbuilding industry might play a role as competitively as possible. The outcome was an exponential industrial and employment growth; in only twelve years, employment rocketed from 2,000 to 80,000 jobs in the shipyards, and was three times higher when including concurring industries.

Argentina is blessed with extensive waterways and abundant aquatic life but policies promote massive imports of tax free second hand vessels.

Added Value: In a conversation with the author, a Brazilian government officer explained the reason of support to shipbuilding industry, helding up a soybean and stating that:

> At the end of the day, what Brazil and Argentina produce the most is this – soybeans. Almost without added value involved. But from the farm's gate to the end consumer market, the highest value added is freight by ship. Therefore, to add this extra share of value to our main production, we must build the ships to transport soybeans. It is simple. We do it, you do not.

In Argentina, at least we should build all barges and pusher to carry the soybeans to the shipping port; tugs and port service vessels to enable huge bulk carriers to maneuver; dredges and bouy tenders to help them take their load from our ports. It is simple.

3 Global Context

No correlation was found between countries' shipbuilding industries and their overseas merchant marines orders although local markets for fishing, defense, port service and coastal traffic are almost always reserved for national shipyards.

When analyzing the relative importance in each economy, it is noticed that, except for Korea and Croatia – whose shipbuilding industries reach 2% of the GDP – in the rest it is below 0.5%, while Argentina's is barely 0.007% – 38 times lower than in 1981 (0.26% GDP) (Figs. 1 and 2).

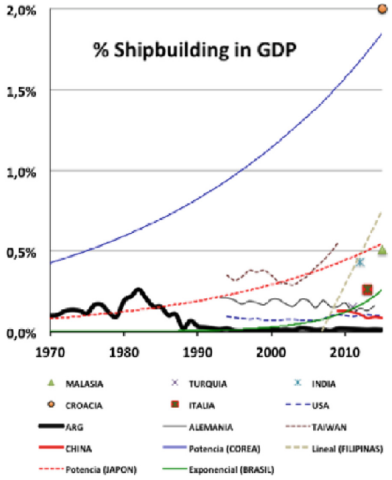

Fig. 1. % Shipbuilding in GDP

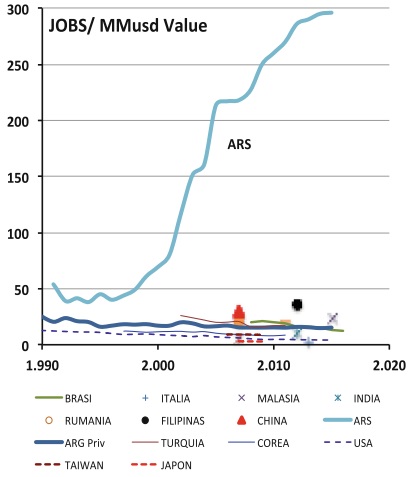

Fig. 2. Shipyard Jobs/MMUSd

To compare competitiveness, apart from the countries' labor costs, productivity was measured according to the amount of jobs required per production unit. ARS stands out, with a productivity over fifteen times worse than the rest of the world and local yards.

3.1 Naval World Map

It is proposed a new map displaying Wealth (GDP per capita) vs. Development (in shipbuilding) coordinates. A series of countries are charted, eventually forming the "continents" responding to given industrial models.

The countries in the Technological model (Germany, Holland, US, UK, etc.) are those of greatest wealth and development, selling marine equipment with high added value; Mega-producers (China, Korea and Japan) concentrate the highest volume, dominating the market in cost and capacity.

This right hand side hemisphere of the new map also embraces the Developed countries (Brazil, India, Portugal, Australia, Iran, etc.) which meet their own needs. Some crosses over to the group of ship Exporters, among them Romania, Taiwan, Ukraine, Croatia, Malaysia, Vietnam, Indonesia, etc.

Most of the Latin American countries are located in the Developing continent, where they strive to become self-sufficient in their marine needs.

The Importers (left) hemisphere has two continents. To the north, the more affluent countries, import new vessels. To the south, the poorer, less developed countries, lacking shipbuilding capacity (Africa, Haiti, Bolivia), get second-hand ships discarded by other nations. These countries receive them readily, because it's assumed that this is what they deserve: their structural poverty, government corruption or negative state policies keep them immersed in this "Scrap" model. Argentina has been forced, by bad policies into this undeserved world corner.

It is shows a navigation course followed by Argentina. In 1967 crossed the producers continent and reached the group of ship exporters. Since 1982 it was steered towards Underdevelopment were it is beached since then (Fig. 3).

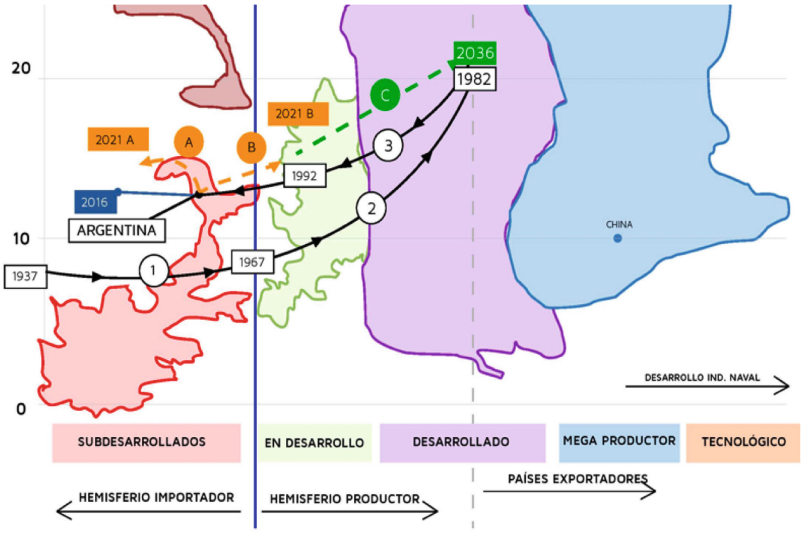

Fig. 3. Argentine navigation course un naval world map

3.2 Marine Financing

Without proper marine financing systems, there is no chance for a shipbuilding industry to function properly.

Given this understanding, all states that are determined to attain this development conceive mechanisms to ensure that shipbuilding projects will not lack financial flow. Sometimes the government intervenes by contributing any necessary collateral, so as to smoothen the access of shipyards and shipowners to the capital market; at other times, the state directly funds sound operations with promotional schemes.

State intervention is almost a constant, and moreover, it is one of the most common ways to provide incentives, subsidies and competitiveness enhancement to its maritime industries in the global context.

In Argentina, most ships have been financed by private funds (42%) or by export funds (27%), representing 17 and 26%, respectively, of the total industrial value. Public financing of shipbuilding came primarily from the National Merchant Marine Fund (FNMM, in Spanish), which provided barely nine percent of the built value. Other public financing sources, such as the BIRA, BIND, BND, contributed a mere one percent extra. Using all these forms of public financing, 14% of the units were built.

Several private owners (Astramar 17%; Ciamar 14%; Maruba 13%; Del Bene 9%; Esso 5%) used the FNMM for new constructions, almost exclusively at the large shipyards (Alianza, 48%; Astarsa, 17%; Príncipe, 11%; AFNE, 10%) [1, 2].

The US policy (guarantees provision) contributed an average of 600 MM dollars/year to the system, while Brazil went through two distinct stages. In the 1970s, Brazil and Argentina converged in setting in motion their Merchant Marine Funds, yet on a very different scale: Brazil (direct funding) assigned 400 MM dollars/year, while Argentina barely 40 MM dollars/year [4].

Brazil second phase started at the year 2000 and for more than fifteen years thereafter, contributed an annual average of 900 MM dollars to finance (and activate) the marine industry. Also evident is the link between ship financing and job generation in these countries. The same analysis shows that the complete demise of marine financing in Argentina since the mid-1980s is one of the main causes of the lack of employment in local shipyards.

There are other financing schemes involving less state intervention, as is the case with foreign marine industry groups. In these cases, the external group contributes any necessary imported equipment, technology and full financing, while the local shipyard provides labor, local goods and services, thus giving rise to a win-win situation among marine industrial players. In Argentina, SANYM used this financing system to build a series of containerships as well as inland pushers and barges (Fig. 4).

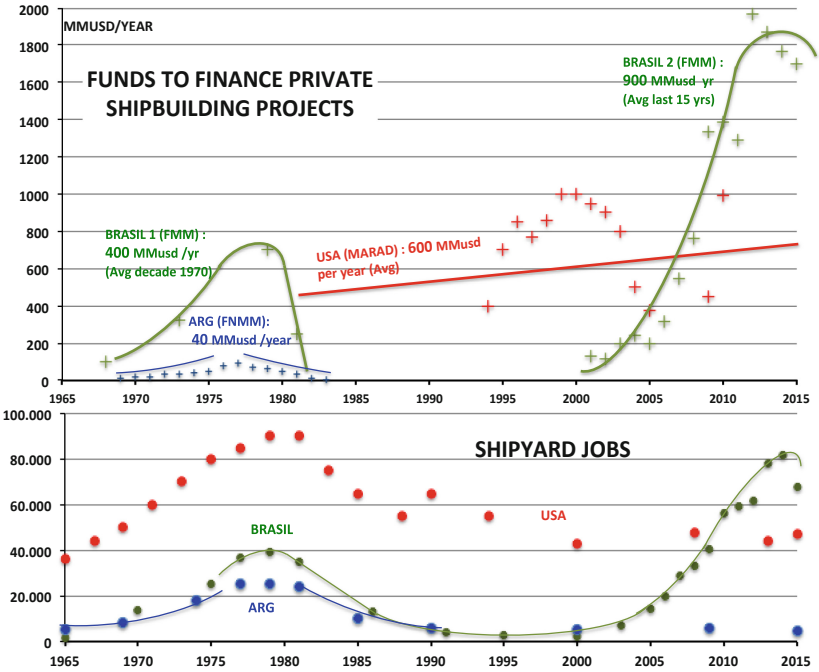

Fig. 4. Ship financing and employment in US, Brazil and Argentina

4 The State Roles

4.1 The Regulator State

Regulating the activity is done through Congress, in its legislative function, and through the presidency by way of the management exerted by the cabinet ministries related to the marine sphere.

For many years now, a marine regulatory framework has been under consideration, and at the end of 2017, Congress granted approval to legislative bills on the Merchant Marine and Shipbuilding Industry. These laws, very poor, became even worse by a governmental veto of the most critical articles (marine financing).

4.2 The Shipowner State

Argentine state played an active role as overseas carrier over the 1940–1980 period, with its height in the 1970s with the creation of the merchant marine company (ELMA) and the enactment of the Cargo Reservation Law [1]. The state also played this role through the YPF oil carrier fleet, until it gave up this function (mid 1980s) as a result of new rules governing the international market and in national politics and economy.

But there were other "shipowning" roles which the state logically kept for itself, for they are vested upon it and cannot be delegated, as is defense (ARA), security (PNA),