

# The draughtsman of architecture and engineering in the naval, maritime and fluvial industry of Cartagena

El delineante de arquitectura e ingeniería en la industria naval, marítima y fluvial de Cartagena, Colombia

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## Abstract

Careers and industry tend to go hand in hand with the references that are formed throughout their history, but there are careers hidden from them, without demeriting their importance in their process and growth. The Architectural and Engineering Draughtsmen are professional technologists who are active in the Naval Industry and little is referred to them as an associated profession. However, for all those who are immersed in this industry, the work they perform and their recognition in supporting the achievement of projects in the different design and construction stages is very clear. What is really worth highlighting in them, is the growth and evolution they have taken in this industry.

The times when the draughtsman transcribed ideas into drawings and plans is on the verge of extinction. Today, trained personnel is required and available to develop virtual models giving characteristics associated with the properties of each element and its integration into the total function of the project. These technologists have the experience and specific knowledge in the industry, and become the right hand of designers, engineers and builders, to develop designs from their basic stage to the closure of projects, with the confidence that they can receive alarms and ideas that make possible the completion of each job. For this reason, they take the name of designers or modelers according to the particular case of the company for which they work.

**Key words:** Naval Industry, Draughtsmen, Draftsman, Modellers, Drawing

## Resumen

Las profesiones y la industria tienden a ir de la mano en relación a las referencias que se van formando a lo largo de sus historias, sin embargo existen profesiones que se quedan ocultas ante estas, sin demeritar su importancia en el proceso y crecimiento de las mismas. Los Delineantes de Arquitectura e Ingeniería son tecnólogos profesionales activos en la Industria Naval y poco se referencian como profesiones asociadas a esta, sin embargo para todos los que están inmersos en esta industria la labor que ellos ejecutan y su reconocimiento en el apoyo a la consecución de los proyectos en las diferentes etapas del diseño y la construcción es muy clara, lo que realmente vale la pena destacar en estos, es el crecimiento y evolución que han tomado en esta industria.

Los tiempos en que el delineante transcribía ideas en dibujos y planos está en vía de extinción, hoy se cuenta y se requiere personal capacitado para desarrollar maquetas virtuales otorgando características asociadas a la propiedades de cada elemento y su integración en el total de la función del proyecto, estos tecnólogos que ahora cuentan con la experiencia y el conocimiento específico en la industria, se convierten en brazos derechos de los diseñadores, ingenieros y constructores, para elaborar los diseños desde su etapa básica hasta el cierre de los proyectos, con la confianza en que de ellos se puedan recibir alarmas e ideas que vayan haciendo posible la culminación de cada trabajo, es por esta razón que toman el nombre de proyectistas o modelistas según el caso particular de la empresa para la cual laboren.

**Palabras claves:** Industria Naval, Delineante, Dibujantes, Modelistas, Dibujo

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## Introduction

Throughout history, the branches of engineering have stood out for their specific application of knowledge, providing solutions to human needs, becoming recognized for the specialization of the study and application of technologies, leaving aside the diversity of skills that are immersed in the implementation of each project. However, multidisciplinary is a great contribution within management, although specific and inevitable, not necessarily visible to the external community.

Within Engineering, the Navy is responsible along with Naval Architecture for the design, construction and maintenance of marine and river vessels, as well as their systems. In the industry outside this sector, the tendency is only to relate this area of knowledge with the construction of the ship itself and the design aspects that make it viable. However, there are other important aspects that make up the construction of a ship; this is how Architecture and other Engineering specialties take importance in the contribution to the development of these projects is given way. These are some examples:

1. **Architecture and Interior Design:** it is perhaps the least recognized but the one that actually confronts the external community in terms of comfort and aesthetics; today we can speak of areas related to Architecture but with a specific character such as Naval Interior Design, this being the branch responsible for the distribution and design of living spaces and accommodation in work spaces, ensuring better performance of the tasks determined in the operation of ships, vessels or naval artifacts, considering their function, ergonomics and comfort as main design characteristics.

In accordance, the Naval Design offices have trained personnel for this function such as: Architects, Industrial Designers, Architectural and Engineering Draughtsmen. (1) or Technical Draughtsmen, who meet the specific needs of their area in each project.

2. **Engineering: Electrical, Electronic, Electromechanical, Mechanical and**

**Mechatronic** among others, are in charge of the design, management, construction and commissioning of the ship's functional and operational systems.

Their work teams include Engineers related to specific branches, Architectural and Engineering Draughtsmen or Technical Draughtsmen.

## Historical framework

### Design offices

The offices dedicated to design have remained throughout history as the main project managers in the industry, however technological advances have changed their appearance according to the needs dictated by the execution of their tasks, previously the designs were presented in paper form (blueprints) and physical models made in offices equipped with drawing tables and tools for manual use such as pencils, technical pens, square rulers, parallels and compasses among others, see Fig. 1. in response to what was then considered to be the design process consisting of the steps described in the document "Computer Aided Design of the Universidad de Valencia". (2) which can be seen in Fig. 2.

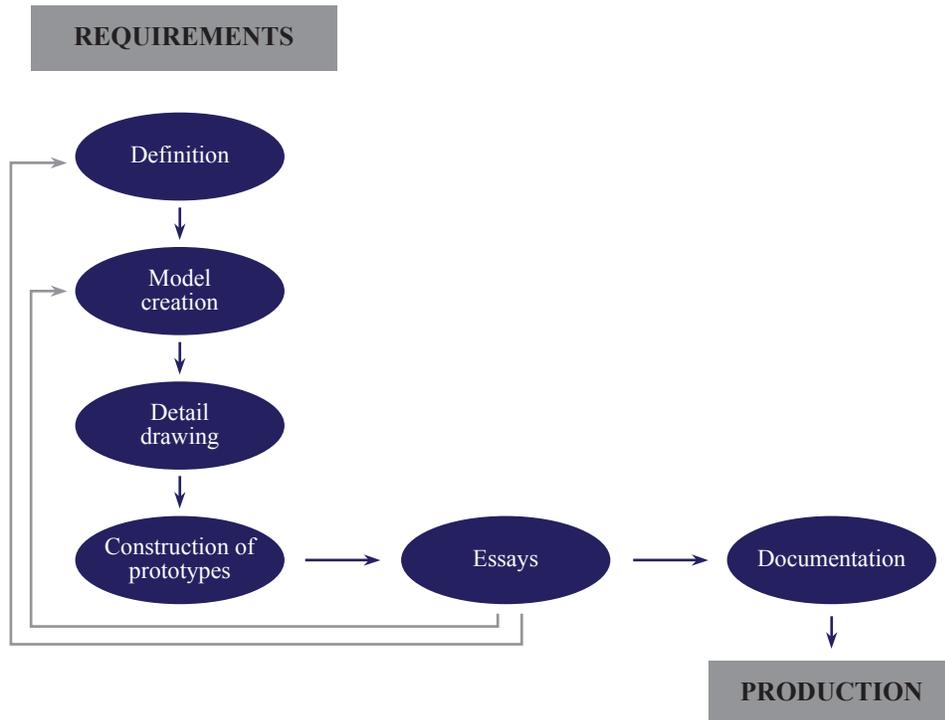
Thanks to the emergence of CAD systems which went commercial since the 1960s with the first

Fig. 1. Former Design Offices



Source: Taken from [https://www.picgrum.com/media/1200980706114963202\\_174351312](https://www.picgrum.com/media/1200980706114963202_174351312), access date: November 20, 2017.

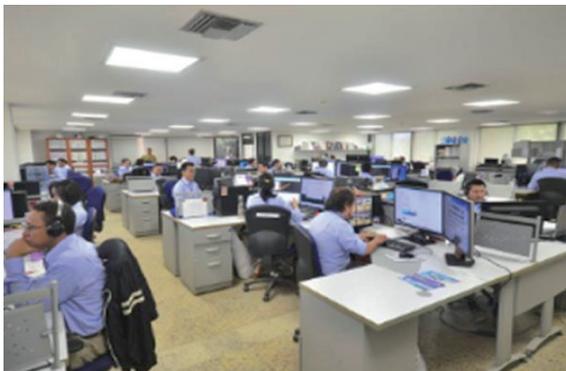
Fig. 2. Design Process



computer-aided drawing program, Sketchpad (3) The offices began to change their design processes due to the incursion of Computer Aided Design software. See Fig. 3.

In a broad sense, we can understand Computer Aided Design (CAD) as the "application of computing to the design process" (Salmon, 1987). Pointing out the

Fig. 3. Current Design Offices



Source: Taken from Retrieved from <http://www.cotecmar.com/services/design-engineering>, access date: 20 November 2017

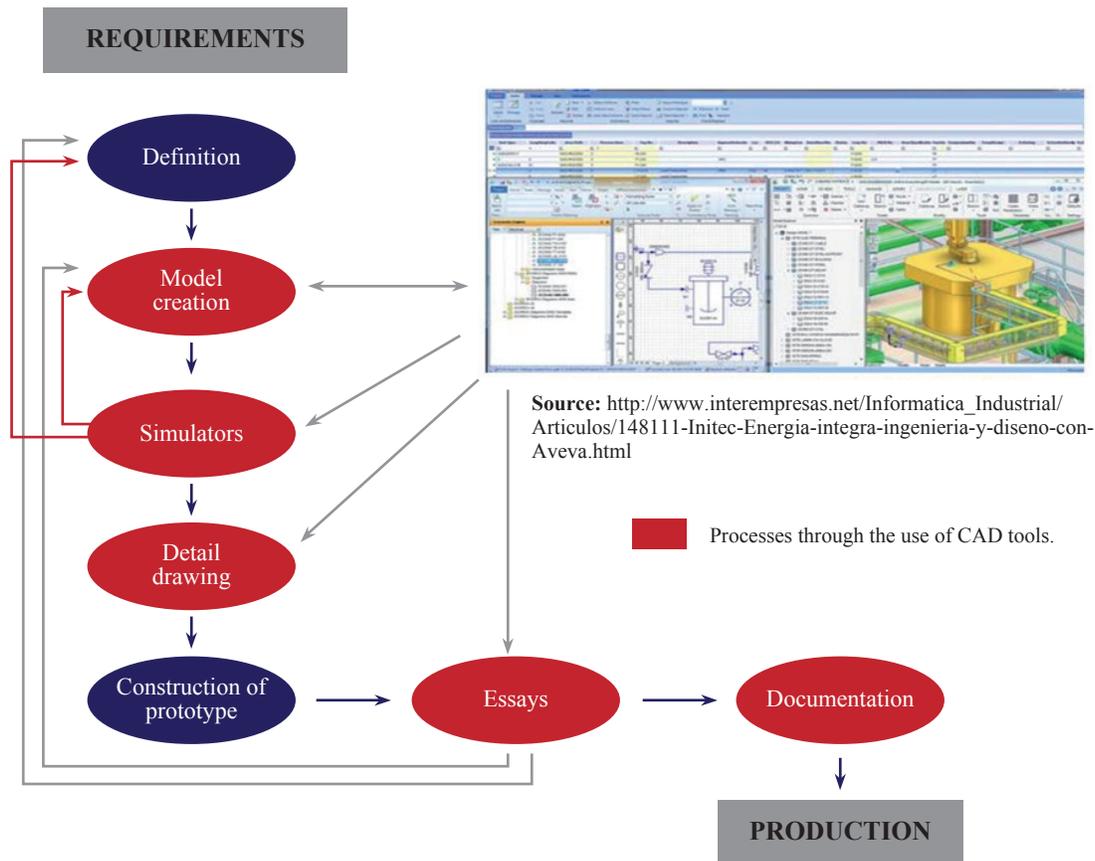
definition, we will understand by CAD System, a computer system that automates the design process of some type of entity, to discard as CAD systems the applications that affect only a specific aspect of the design process. The computer tool can be used in most of the tasks of the process, being the drawing where it has been most copiously used. (2)

This incursion of computer science in design offices gave way to the modification of the design process, reason why become are steps under the use of the CAD tools, as it can be visualized in the Fig. 4 based on the document "Design Assisted by Computer of the University of Valencia". (2)

### Impact of the architectural and engineering draughtsman on the naval design offices in the city of Cartagena de Indias

The measurement of this impact is the result of the research development of the teaching project "Measurement of the impact of the Architecture and Engineering Draughtsman in the Local

Fig. 4. Design Process with CAD Tools



Industry". (4) with a view to strengthening the academic program in question, which was used to take samples such as surveys, working groups with the productive sector and interviews with academic staff, representatives of the local industry and program graduates.

According to the different professions that intervene in the execution of projects in the naval industry it is possible to speak of multidisciplinarity in terms of applied knowledge, although knowledge becomes specific to the interior of the design and construction spaces, considering that the main branch (Naval) adapts to the requirements of the specific object (ships and naval devices); it is possible to evidence that there is an auxiliary profession that can adapt to each of these needs within the specifics of each engineering component of the different branches, as in the case of the technical draughtsmen or the draftsmen for Architecture and Engineering. These professionals

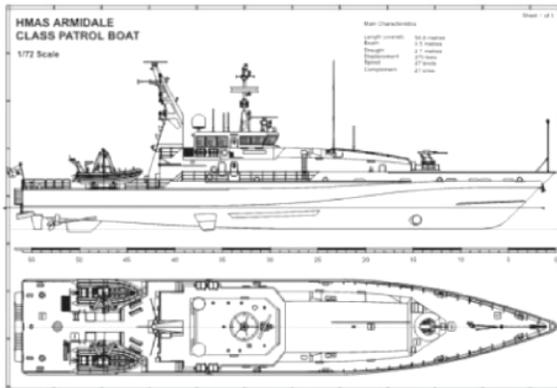
(technologists) are responsible for materializing the designs through electronic models and plans that accompany the design and construction process of ships, which strengthens their participation, allowing them to become true professionals of the naval industry, through the specific experience of multidisciplinary technologists.

Commonly called Draughtsmen today take the name of Designers, able to elevate an idea to a digital reality and land it in the construction stage, going through the design processes from the conceptual or preliminary idea to the evaluation and closing of the project, it is not uncommon to see how they intervene in the different aspects of all stages, highlighting the following activities as part of their functions:

- **Elaborating basic plans for the first stages of the design:** At this stage the Draughtsmen develop plans mostly in two dimensions (2D)

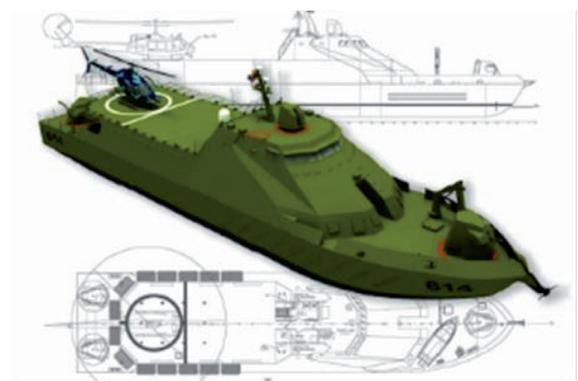
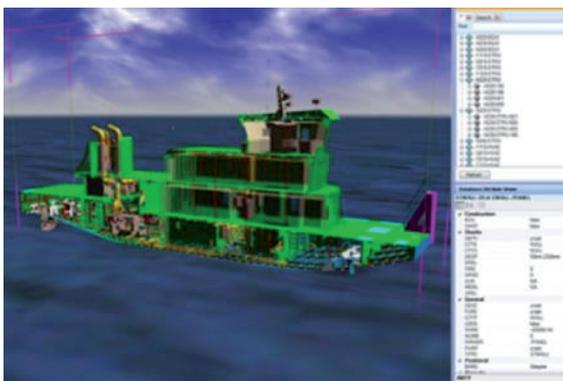
using CAD tools, under the instructions derived from the designer, these plans are mainly schematics or general arrangements, see Fig. 5 that determine the operation and equipment of the specific design.

Fig. 5. General layout plan of the Offshore Patrol Vessels (OPV). The HMAS Hammersley by Sea Patrol



- Modeling the virtual model to define the design:** It is here where the implementation of new technologies and skills takes place, the draughtsman becomes a designer or modeler who creates the virtual model of the project, giving each element its own characteristics to determine its real function within the final product, in such a way that this model becomes a prototype of what will finally be built, thus foreseeing inconveniences in the construction process. see Fig. 6.

Fig. 6. Works carried out by Architect and Engineer Draughtsmen of the Colombian Naval Industry



Source Taken from <http://www.cotecmar.com/servicios/disenio-e-ingenieria>  
<http://www.cotecmar.com/servicios/ciencia-y-tecnologia>. Date accessed: 22 November 2017.

- Elaborating the detailed plans to transfer them to the construction area:** After the creation of the model, the draughtsmen to use the electronic model, elaborating plans of the different systems or parts and all the necessary information for their elaboration (construction plans) and later assembly (installation plans), guaranteeing in this way, the total construction of the project.
- Field verification of construction under the As Built process:** at this stage draughtsmen review what is built under the instructions given in the plans or with the collection of data in relation to changes to the design during construction for the re-engineering process.
- Finally, supporting the evaluation and closure stage:** with all the data taken from the previous the re-engineering process begins by updating the model and plans related to the change. Even though these changes improved the product and it is necessary to have an updated database for future constructions, if they were relevant only for the current construction, the model is not updated, but the plans are updated so that at the end of the project it has accurate information. In general, at this stage the draughtsman supports the design team in everything concerning plans or models to ensure that the project database has all the information that was given at all stages of design and construction of the product.

Table 1. Competencies of the Draughtsmen of Architects and Engineers related to the naval Industry

COMPETENCIES ACQUIRED IN THE ACADEMY	SKILLS ACQUIRED IN THE LOCAL SHIPBUILDING INDUSTRY
Interpretation and elaboration of the naval drafting.	Interpretation of basic engineering design, materials handling and design standards.
Terminology, symbology and naval nomenclature.	Knowledge of the design and production process.
Management of basic naval architecture concepts such as: orientation and recognition of structural elements, regulations (classifying houses). etc.	Management of basic concepts of the different areas that intervene in the naval industry, (SWBS).
Digitization of general layout plans and construction details.	Elaboration of naval plans in all stages of design and production.
Drafting by Triangulation.	Modeling, generation and use of electronic models in specialized software.
2D and 3D scanning in AutoCad.	Modeling, generation and use of electronic models in specialized software.

It is clear that in all these activities these professionals carry out their work hand in hand under the instruction and review of engineers and professionals from different branches, however it is good to highlight that their work is important. These technologists achieve a specific experience, accumulate a number of skills additional to the academic training process, but strictly necessary in the development of the Naval Industry.

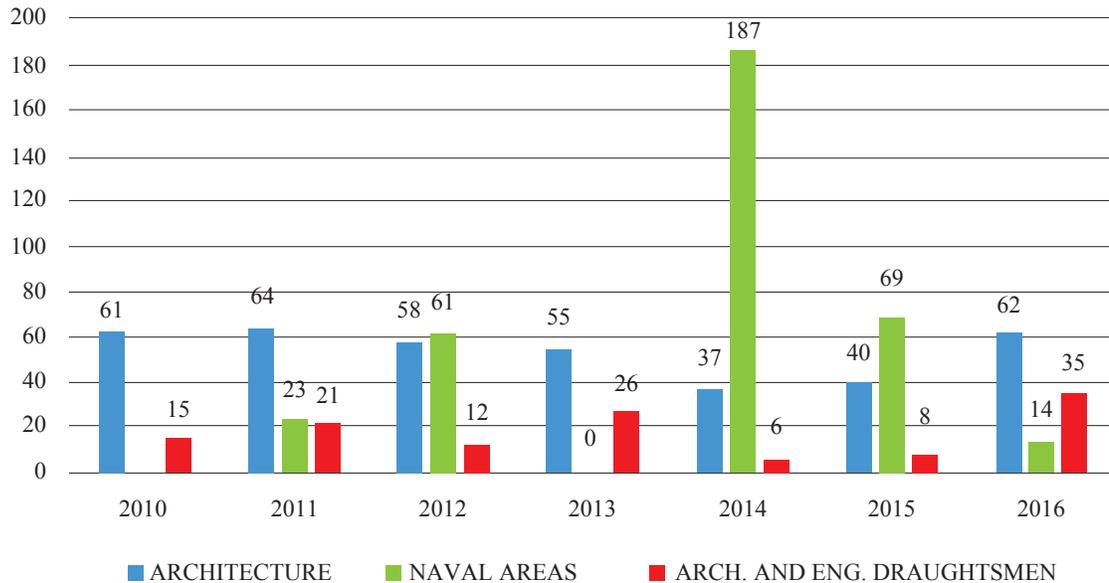
It should be noted that the Naval Academy in the country before 2011 applied only to military personnel in the Escuela Naval de Cadetes Almirante Padilla ENAP naval school, an institution that received the power to issue degrees related to Naval Engineering by the Ministry of National Education and the Colombian Association of Universities ASCUN in 1968 and which received recognition as a university in 1977. (5) Since then, it has been training professionals in the area, including the Master's in Naval Engineering that has Qualified Registration since July 2010. The academy for civilian personnel takes its first steps at the professional level with the Technological University of Bolivar which obtained its Qualified Registration for the undergraduate degree in Naval Engineering in August 2016. (6) and for the Master's in Naval and Oceanic Engineering in February 2011 (7) Therefore, a large part of the professions involved in this industry have taken

acquired knowledge through work experience within it.

The Institución Colegio Mayor de Bolívar was empowered to provide technical training as Draughtsmen Experts on March 22, 1947, however these technicians did not have skills in the naval area, later the contents of the program were expanded to include engineering areas and obtaining their first promotion as Technologists in Architecture and Engineering Draughtsmen in 1980. (8) with competences in the naval area acquired through the Naval Drawing subject, which, as of 2013, takes the name of Engineering Drawing IV. (9). Its microcurriculum is related to the Interpretation and elaboration of Naval Drawing and the development of basic contents of naval architecture. With it the graduates of the program enter the industry with the basic knowledge to guide themselves and appropriate the specific knowledge with greater agility, adapting to the environment and allowing them to increase their skills to a specific level, achieving positions as draftsmen, designers or modelers.

Considering these academic programs as trainers for the fulfillment of the functions in the naval industry, we will look at the data of the Labor Observatory in Colombia to evidence the reception and approach to the coverage of the labor

Fig. 7. Statistical data taken from the Labor Observatory in Colombia



demand in the city, assuming that engineering is multidisciplinary, we observe only the trend in Naval careers, Architecture and Draughtsmen. Here is the data taken between 2010 and 2016 highlighting that this is an increasing trend.

It is clear that each program has different needs and expectations towards the population and its demand, however, it is good to analyze that, despite being an auxiliary career the Tecnologist in Architecture and Engineering Draughtsmen are maintained despite the crisis suffered by the construction branch in the city. Much of this is due to the support provided by these auxiliaries in the local industry such as the case of the Navy, who gain strength daily and that according to the data reported by graduates of the program, COTECMAR is the leading company in this industry in the city, it is also in employing the largest number of graduates in its plant, reaching to have about 20 or more draftsmen within its employees and contractors.

### The Draughtsman seen as a Projector or Modelist

This professional has decisive functions in the Naval Industry since he is in charge of transferring

the basic design generally elaborated in a schematic way to the digital or virtual reality, through the process of detail engineering in modeling the virtual model. The model must be a prototype with the parametrically exact components and their specific properties in order to be able to determine in advance all the possible inconveniences of the construction process and to provide a solution to them before beginning construction of the project, in such a way that, at the moment of executing the model in the production engineering, they are confident of the delivered product (construction plans). This is how the design and construction offices of this industry carry out their projects and therefore, have trained personnel for this work.

At the moment in the Naval Industry of Colombia, exactly in Cartagena, these functions are carried out mainly by Tecnologists in Architecture and Engineering Draughtsman of the Colegio Mayor de Bolívar under the direction of the Engineers or Architects of each area, executing the competencies received during their academic formation but mainly the experience and specific training received in the industry. These professionals who fulfill the functions described previously within the stages of the design and construction, are qualified not only with the use of software of naval

Fig. 8. Virtual Model Vs. Ship Under Construction



design and modeling but also, they understand of subjects like management and processes of design and production, materials handling and design standards, symbology and interpretation of schemes, among others, Although these subjects are learned in the exercise of the function every day, it becomes more necessary to include them in the academic offer, clarifying that this would imply elevating the category of education passing perhaps from technologists to professionalization, taking into account the credits and scopes established by the National Ministry of Education.

## Conclusions

Today the Architectural and Engineering Draughtsman is a widely required professional in the Naval Industry, given the impact of his functions in the design and construction of ships and naval artefacts. The skills of the Draughtsmen have evolved with the technological advances in the area, and we no longer speak only of traditional blueprints and models, as we live the digital era. Therefore, the functions of the Draughtsman are now subject to the development of virtual models and the exploitation of these models. Thanks to the rapprochement of academia with the industry, it has been possible to determine that although it is necessary to maintain and reinforce the basic knowledge of the Draughtsman, it is also necessary to increase the skills related to the exercise of functions as Modelers or Designers and to grant them the character of graduate, closing, in this way, the existing gap between the profiles and

the current demand of the Naval Industry in the city. It should be noted that this profile is required by other branches of local industry such as petrochemistry and all those related to the design and construction of industrial plants, making it a need to offer programs that meet the local, national and international industry requirements.

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