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Navigation Simulator: Professional and Academic Learning Tool for the Students of the Portuguese Naval Academy

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ABSTRACT: The Portuguese Naval Academy is a military school with an university status and is equipped with one modern navigation and maneuvering simulator. The Navigation Simulator (NAVSIM) plays an essential role in the academic training for the Naval Academy and for its cadets, that are using this capacity since their first academic year as a learning tool. Identifying the non-technical skills that could be trained and focusing on the specific training of the technical skills is paramount, in order to maximize the training sessions for each cadet's year. The assessment of statistical data referring to the last 6 years is important to identify where there are gaps in the exercises, as well as how the midshipman are prepared to perform functions of watch keeping on the ships fleet.

1 INTRODUCTION

The Portuguese Naval Academy as a military school with an university status, is integrated in the framework of the public higher education system in Portugal (Assembleia da República, 2014). Its main objective is to prepare highly qualified graduates students to the Portuguese fleet ships. The training provided by this academy to the future Navy Officers is not restricted to academic components. The Naval Academy students, the "cadets", are endowed with academic knowledge and with military and naval skills that are needed for the accomplishment of their future functions.

The Naval Academy have installed a modern radar, manoeuvring and navigation simulator since 2004/2005. The Navigation Simulator (NAVSIM) have an essential role for the academic and military training. First of all, it helps to consolidate all the theoretical knowledge previously learned, at the classrooms. Then, it allows to training in scenarios more similar to what will be found on board. And last but not least, it helps to improve the team building and relationships among the members of the team that are training, which allows to achieve the sessions goals faster and more efficiently.

The NAVSIM is mainly used by the cadets of the Naval Academy, over 65%/75% of the time, excluding the maintenance periods (see table 1) (Bué, 2016). The teams of the warships and some external entities to the Portuguese Navy are also training in NAVSIM which is a crucial tool to leadership purposes and team building improvement. The correct use of the maximum capacities of the NAVSIM allows the training teams to expand their expertise and minimize the errors associated with the lack of practice, with benefits to their daily lives on board.

Table 1. The users of NAVSIM. Source (Bue, 2016)

The users	Hours 2010/2011 (Total = 409 hours)	Hours 2011/2012 (Total = 500,5 hours)	Hours 2012/2013 (Total = 435 hours)	Hours 2013/2014 (Total - 690 hours)	Hours 2014/2015 (Total - 843 hours)	Hours 2015/2016 (Total - 640,5 hours)
Naval Avademy Students	106	155,5	238,5	294,5	357,5	306,5
Maintenance/Repairs	15	200	47,5	159	145,5	200
Naval Units	70	36	23	83	69	5
CEON	66	0	44,5	37	169	44,5
Other Courses	67,5	19	5	58	45	40
Visitors	75,5	54,5	54	43	54	29,5
Rotines	15	47,5	43,5	16	3	15
TOTAL HOURS	**415**	**512,5**	**456**	**690,5**	**843**	**640,5**

The NAVSIM has immeasurable capabilities and is available 24 hours per day. Still, is vital to produce a model to clarify the academic and professional training for the cadets. In this context, this study will provide one conceptual basis, substantiated on 6 years of exercises records at the NAVSIM and in national references that address this issue. The Naval Academy historical context will be presented, as well as its educational military and civilian offers.

The simulation as a training and learning tool will be discussed, followed by a more comprehensive approach to the reality of the education in naval academy. The military training in simulated environments will be presented, with specific definitions and models, which will conduct to the development of technical and non-technical skills. Finally, the statistical data from the exercises conducted in the NAVSIM for the last 6 years will be analysed and the results and conclusions of this study will be presented.

2 NAVAL ACADEMY

The Naval Academy is a Military higher education establishment, with the mission of teaching the cadets to be the future navy officers, enabling them to carry out the military duties assigned, conferring the necessary competences to carry out the missions of the Portuguese Navy and promote the individual development for the exercise of the functions of command, direction and leadership (Assembleia da República, 2001).

2.1 *Historical context*

The first "school" of Portuguese navigators was the school of Sagres, which is a legendary institution that symbolizes all who studied the arts related to the sea and with maritime navigation (Salgado, 2013). Later, in 1779, the "Academia Real da Marinha" (*Royal Academy of the Navy*) was established in Lisbon, with academic training purposes for the military and merchant navies. Due to the not existence of a military framework for the future Navy Officers, the "Academia Real dos Guarda-marinhas" (*Royal Academy of Midshipman*) was established (Salgado, 2013). In the 23rd April of 1845 the Naval Academy was created by D. Maria II (Portuguese Queen), and later on, in 2001 is recognized as a military university (Sousa, 1945).

2.2 *Military and educational programs*

The Naval Academy offers an Integrated Masters Course (IMC) with five academic year duration, according to the provisions of the Bologna process, giving the graduate students a master's degree in Naval Military Sciences in one of the following courses: Navy, Naval Administration, Marines, Medicine and Naval Engineering, regarding the Mechanics and Electronics fields.

During the IMC, the naval academy develops in its students several skills, such as: Naval Military Training, Sailor Training, Physical Education and Sports, Leadership Training, Cultural and Social Activities and Sea Training. The specific training areas are conducted at sea, during the weekends and in the summer classes dispersal, in the fleet ships. This institution is a subscriber of the ERASMUS letter, with more than 70 military and civilian teachers, who have a wide professional experience.

The Naval Academy made available some specific degrees and courses, and they are not exclusive for the military staff, such as:

- PhD in Naval History;
- Masters in Naval History, in association with the Faculty of Letters of the University of Lisbon;
- Master in Information, Security and Law in Cyberspace, in association with the Faculty of Law of the University of Lisbon and Instituto Superior Técnico (Civil Engineering Faculty);
- Masters in Hyperbaric and Underwater Medicine;
- Masters in Hydrographic Engineering;
- Master in Navigation and Geomatics;
- Masters in Military History, in association with seven institutions (Escola Naval, 2016).

Finally, the Navy Research Centre (CINAV (*Centro de Investigação Naval – Portuguese designation*)), whose mission is to promote Research, Development and Innovation in the areas of interest to the Navy, is physically installed in the Naval Academy. Its main research lines are: signal processing, mobile robotics, decision support systems, maintenance management, naval history, naval strategy and naval health (CINAV, 2015).

3 THE SIMULATION

According to the Interactive Learning Society and the International Association of Simulation and Games, the simulation is defined as *"a working representation of reality; It may be abstracted, simplified or an accelerated*

modelling of the process. It allows students to explore systems where reality is too expensive, complex, dangerous, fast or slow. " (LOPES & Oliveira, 2013).

From the perspective of Captain Roque, the simulation is a method of implementing a model for a real-world phenomenon through training, analysis or experimentation of objectives (Roque, 2010). A navigation simulator is a device, computer program or simulation system capable of reproducing on land and under controlled conditions some of the activities executed aboard the ship. The simulation allows to increase the training volume, improving the performance achieved in real operations and reducing the total time of learning and training, being able to have a complete repetition of actions and procedures (Roque, 2010).

3.1 *Simulation at the Naval academy*

The first simulator in the Naval Academy was implemented in 1984 and had only the radar component. Later on, the simulator TRANSAS 2000 was installed. Despite of its small dimensions he already has two visual bridges. In 2002, the update was made for the TRANSAS 3000, with five visual bridges.

In 2004 a contract was signed with the Norwegian company *Kongsberg Maritime*, which resulted in the installation of a *state of the art* of the navigation simulation. This simulator, the NAVSIM, have the capacity to reproduce and training seven different ships in the same scenario or in seven distinct scenarios or exercises (Bué et al., 2015).

Since 2010, during the training sessions in the NAVSIM, cadets perform basic exercises of navigation, manoeuvring and positioning of ships, to advanced tactical training exercises, sessions in multi-threat scenarios and even maritime search and rescue (SAR) operations. Each year of the IM have different modules and training sessions to be played. The modules applied differ depending on the learning area with the possibility of be more advanced or not. These training areas are navigation, communications, seamanship and tactics and operations. During the exercises, navigation techniques are trained, along with specific methods of positioning the ships, and the practice of the Naval and Technical language, normally in English.

During the 4th year of the IM, more specifically for the navy cadets, the training sessions at NAVSIM are more regular and with a higher level of requirement, more less 150 hours of training just in the simulator.

The training at the NAVSIM take special attention to the duration of the exercises and to improvement of the difficulties and critical situations, which involves the application of more advanced techniques and manoeuvres, most of the cases involving a greater number of ships in the same tactical scenario. The top areas that are trained are: coordinated exits and entrances of naval forces in ports, under different meteorological and oceanographic conditions (METOC); emergency procedures training; anchor and weighing anchor exercises; Replenishment at sea (RAS) and RAS approaches; Towing operations (urgent and/or planned); Tactical operations; communication exercises and leadership and training of bridge team exercises.

The cadets during their 4th academic year, execute two long-duration exercises in the NAVSIM, where all the techniques learned and skills developed in previous years are put into practice. At the end of the first semester the cadets are divided into four groups (four ships) and for at least 36 consecutive hours they perform functions on the ship bridge for 6 hour watch, according to an extensive list of events or exercises. By the end of the 2nd semester, and immediately before their sea training of two weeks, the cadets will return to NAVSIM for another long-term exercise. During this last training in the simulator, cadets are pushed to the limit, not only by the requirement of the exercises, but also by the increase of stress situations and the fatigue level, due to the duration of the exercise itself.

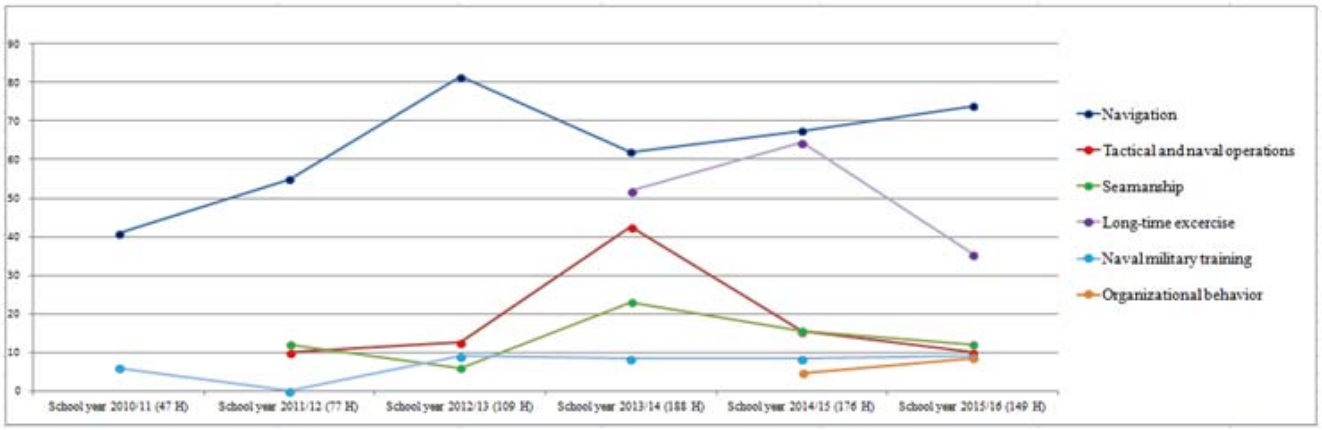

Figure 1. Hours of use of NAVSIM by 4th year students. Source (Bue, 2016)

3.2 *The Simulator*

The NAVSIM is divided in two simulation poles, and there are 4 of the seven bridges, at the Naval Academy. The others 3 bridges are located in the Integrated Centre for Naval Training, but the 7 bridges are connected through optical fibre which allows the connection between them and results in a single simulator. The NAVSIM can be operated from one of the six existing instructor consoles, evenly distributed over the two locations. The entire system is operated through Polaris software, which supports all ship models, scenarios and environmental conditions, allowing the execution of several simulated exercises. All seven rooms have the same equipment, which perfectly simulate the bridge of a ship. Each bridge has the steering and manoeuvring console, a navigation radar, Electronic Chart Display Information System (ECDIS), Differential GPS (DGPS), odometer, anemometer, rudder angle indicator, binoculars, magnetic needle, gyro compass, navigational charts, the communication Global Maritime Distress Safety System (GMDSS), NAVTEX and Automatic Information System (AIS), internal and external communications capability (visual and auditory) and an alarm and navigation lights console (Bué et al., 2015).

4 TRAINING AND SKILLS MANAGEMENT

4.1 *Teams*

According to Smith, a team is a group where individuals have a common goal and the functions and skills of each member fit into a single piece, producing together a global standard. The two main ideas of this definition (common task and complementary contributions) become fundamental in the team concept. It is said that a team is effective when it can, if necessary, perform challenging tasks (ADAIR, 1988).

According to the Naval Navigation Instructions 3 (INA 3), the bridge team is composed by the bridge elements that perform tasks or actions of the specific area of the navigation, driving the ship from one point to another, through safe manoeuvres. Who runs this team is the Officer of the Watch (OOW) except in situations where the execution of the navigation is provided on the bridge, in that case the Navigation Officer (NAVO) that commands the bridge team (Estado Maior da Armada, 1998). This team, the *Piloting Team*, is a group of elements that command the ship, always with special safety cares, in restricted waters, the navigation team is an integral part of the piloting team. The constitution of these teams becomes variable according to the type of ship, the conditions of the navigation practiced and the specific situation resulting from the mission and activities of the ship (Estado Maior da Armada, 1998).

4.2 *Training in simulated scenarios*

Simulation is not a new concept. Though centuries this learning process has been used and is capable of making the experts able to transmit their knowledge to their students. The created scenarios should be real or can be simulated specific imitations, allowing the student to experience and develop new skills in a safe and controlled environment.

The simulation is not, by itself, a technic of instruction but a tool that allows an effective transference of knowledge (Carson-Jackson, 2015).

According to Captain Roque, the simulated training has enormous advantages, such as: training in high risk situations, reduce the coast with training at sea or allowing practicing very hard situations that can be dangerous in reality (Captain Roque, 2010).

Simulation also allows to expand the volume of training, improving the performance reached in real operations and reduces the total time spent in training and formation, even though there can be an exhaustive repetition of procedures and actions. Among the various studied models, Captain Roque has presented a training model, based in a pyramid consisted of four different stages, in which in the author's perspective should be the model to follow up (Captain Roque, 2010).

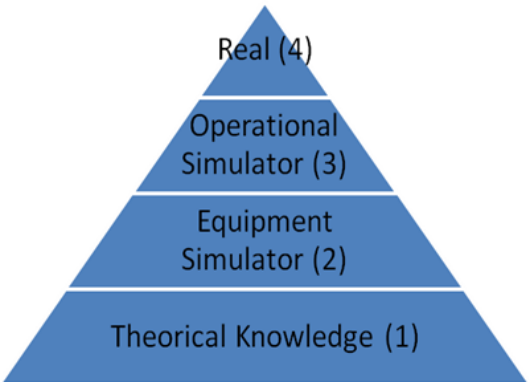

Figure 1. Training model. Source (Captain Roque, 2010)

According with figure 1, for the point (1), in the base, there should be an understanding of the subjects through formal and abstract concepts, but this process is insufficient to the interiorization of practical procedures.

In point (2) occurs the partial simulation of the equipment or components of a system. This point covers the theoretical learning process and the operational procedures of the equipment are assimilated. In point (3) there is already an integrated team training in terms of the operational exploration of the simulated system. At the top of the pyramid, point (4), is where the training is more advantageous operationally but is subject to some constrains.

4.3 *Competences*

According to Ceitil, competences are designed as structured modalities of action, required, exercised and validated in a determined context. Then, the competences become behaviours that persons highlight continuously and regularly in their professional work, having a character of non-universality (Ceitil, 2010).

Boyatzis affirm that competence is an ability that shows the capability of an individual, describing what he can make and not necessarily what he does no

matter the circumstances, in other words, ''competence is an intrinsic characteristic of a person that results in an effective or superior performance in the realization of an activity.'' (Ceitil, 2010).

The competences can be divided in specific and transversal competences. The transversal competences are those that are more universally required, being common to many contexts, immune to any technical or professional specificity. These can be also called of non-technic competences and the capacity of leadership, teamwork and autonomy are some examples to this kind of competences (Ceitil, 2010).

Specific competences are those that are required for more restrictive activities or contexts, essential to a certain function that demands knowledge and technical abilities so that a person can realize his work with success. These competences are also known as technical competences and the technical knowledge on how to handle or operate the diversity of the equipment on a ship are an example of these competences (Ceitil, 2010).

Training in pre-created teams these 2 different kinds of competences (technical and non-technical) they can be tuned and the mistakes could be reduced. The NAVSIM is an excellent tool to perform these kind of training, in order to improve the acquisition of these competences.

4.4 *Management of Competences*

In Boyatzis work, The Competent Manager, skills are divided into five categories (Ceitil, 2010):

- Motivation: necessity, responsible for conducting, leading and selecting the behaviour of an individual;
- Traces of character: the way that one individual behaves or responds;
- Concept of self-values: attitudes and values. It resumes to the idea of what each person does or would like to do;
- Knowledge: notions, technical procedures and personal experiences (technical skills);
- Cognitive and behavioural competences: can be more visible on active listening and interpersonal relationships, or less visible when referring to deductive or inductive reasoning (non-technical skills);

From this study (Ceitil, 2010), a new model explaining the various competences was born in a form of an *Iceberg*, as shown in the figure 2 below.

According to this model, there is a line that separate the competences of character that are more internal from the ones more external. Regarding the internal competences to an individual, known as inputs, these are related with the personality of the person, what this person gives of himself to the task or function at hand (Ceitil, 2010).

Regarding the external competences, the outputs, they have become the visible part of the *Iceberg*, where the skills are what the individual shows in his performance and the knowledge is the most important productive factor (Ceitil, 2010).

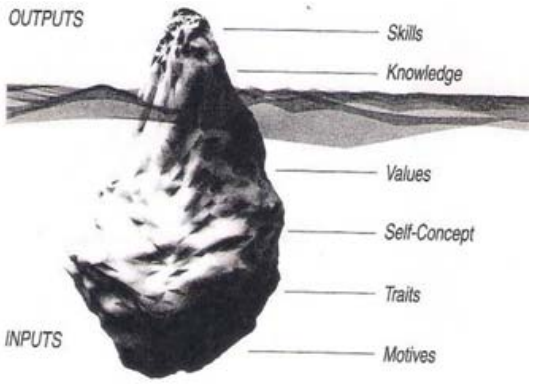

Figure 2. Iceberg of Competences. Source: (Ceitil, 2010, p.100)

According to Ceitil, it becomes fundamental that the human resource managers establish a connection between the transversal competences and the specific competences for the development of those that are necessary to achieve organizational objectives, as well as adding value to the individual himself (Ceitil, 2010).

4.5 *Components of the competences*

Ceitil defends that there are components that are inherent to the behaviours associated with competences so that an individual can exercise a certain function. These components are (Ceitil, 2010):

- Knowledge: determined set of knowledge that allow the realization of behaviours associated with competences by the individual that has a determined function;
- Knowing how to do: set of skills and abilities that make possible the application of the knowledge that an individual possesses, which translates in the solution of problems that may appear in his work;
- Knowing how to be: beyond the tasks being performed efficiently and effectively, it becomes necessary that the attitudes of the individual are aligned with the rules and regulations of the organization and the group work with whom this individual works. Therefore, there is a correlation between the behaviours and interests of the individual;
- Want to do: related with the motivation, in which the individual will want to achieve and develop the behaviours that compose the competences;
- Can do: the organization must have means and resources necessary for the performance of the behaviours related with competences.

4.6 *Competences developed in the subjects learned in Naval Academy*

In the Naval Academy, during the Master's course (5 years), the cadets develop competences and knowledge that become essential to their life as a Naval Officer. Next, will be described the competences and knowledges that the different master courses in the naval academy acquire:

Common competences: analysis and synthesis; communication and discussion of results; resolution of multidisciplinary problems; practical application of

the knowledge acquired; computing; team leadership; team and individual work.

Common knowledge: process instruction; knowledge of the organization; knowledge of the Regulation of the Military Discipline; being a military; being a sailor.

Once more, all of these competences and knowledge's can, should and are trained on the NAVSIM, and training is the right way to get conscious of the theoretical concepts and helps to apply them in real situations.

5 NAVSIM STATISTIC DATA

5.1 *Training in NAVSIM*

In the Graph 2 depicted below, we show the total time spent in training using the NAVSIM, distributed over several academic years. The blue columns represent the total time (in hours) that NAVSIM was established only for training purposes, and the red columns represent the periods of maintenance. The sum of the hours, per academic year, in the two columns corresponds to the total time that the NAVSIM was established (switched on).

For a better comprehension of the time spent in training, the reading of this graphic should be done simultaneously with the data presented in Table 2. This table discreetly presents the total time that NAVSIM was established in each academic year, the maintenance time and the mensal mean value spent on training sessions. This reference values could also be seen in the graph of the Graph 3.

It is important to emphasize that to keep suitable the simulator training standards, the monthly mean value should be up to 160 to 176 hours per month. These values were achieved for 5 days of use per week with 8 hours per day. It's obvious that the NAVSIM training is quite below of the normal standards for this type of systems and training capacities.

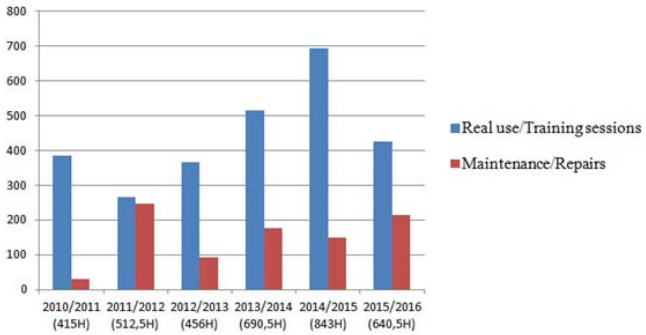

Figure 2. Training sessions in NAVSIM. Source (Bue, 2016)

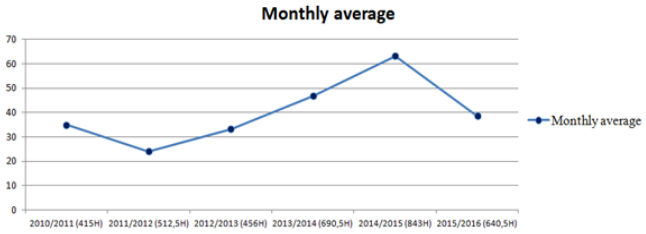

Figure 3. Training m NAVSIM. Source: (Bué, 2016)

Table 2. Total hours training in NAVSIM. Source (Bue, 2016)

	2010/2011 (415H)	2011/2012 (512,5H)	2012/2013 (456H)	2013/2014 (690,5H)	2014/2015 (843H)	2015/2016 (640,5H)
TOTAL (NAVSIM established)	415	512,5	456	690,5	843	640,5
Real use/Training sessions	385	265	365	515,5	694,5	425,5
Maintenance/Repairs	30	247,5	91	175	148,5	215
Monthly average	35	24,09090909	33,18181818	46,86363636	63,13636364	38,68181818

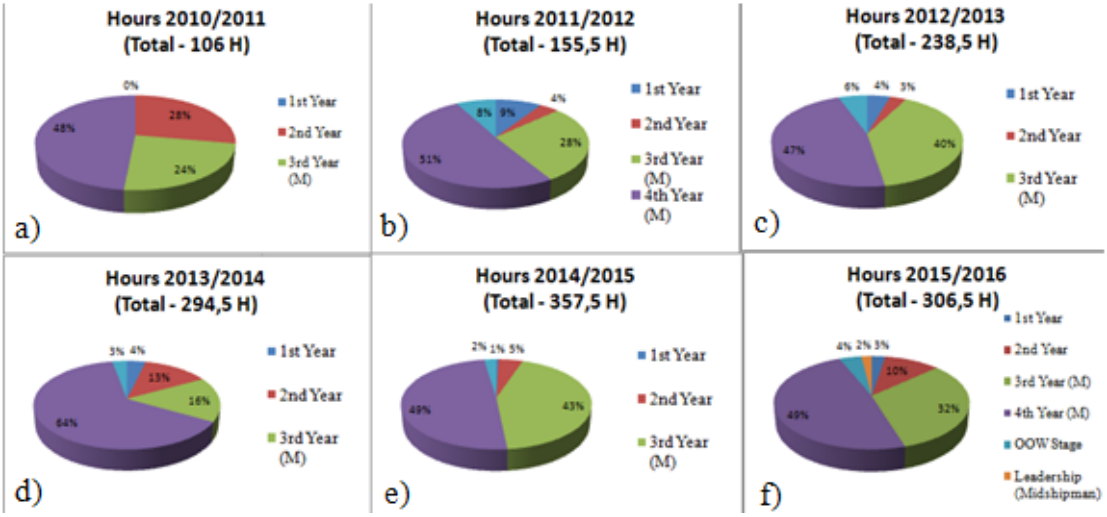

Figure 3. Distribution of training hours by students. Source (Bue, 2016)

Analysing the data in Table 2, for the time window of the presented values, the academic year which the maximum values were achieved was in 2014/2015, with 843 hours use, which correspond to 694.5 hours of effective training.

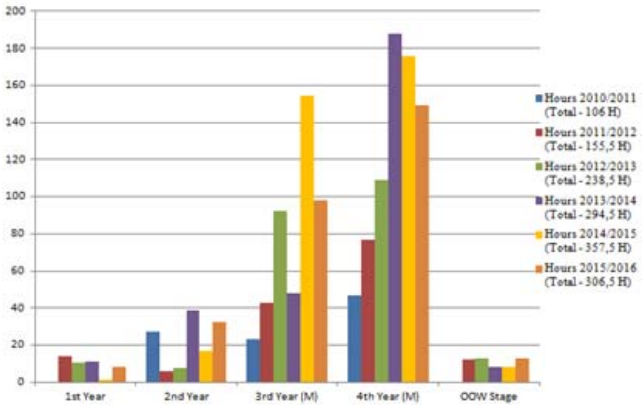

Figure 4. Distribution of training by the cadets in NAVSIM. Source (Bue, 2016)

Some of the facts that can contribute to the underutilization of the NAVSIM, taking into account the standard values, could be, among others:

- Insufficient number of trainers (Navy Officers);
- Insufficient number of system operators (Chief Petty Officers and Petty Officers);
- Operational limitations of the system itself.

5.2 *NAVSIM training for the cadets*

The graphs depicted in Graph 4, represent the distribution of the training sessions through the cadets, during their IMC.

The cadets of the 4th year (The navy cadets) are obviously the elements that spend more time training is the simulator, using near 50% of the training time for all the students, through all the academic years (Figure 3 (a, b, c, d, e and f)).

Beyond the specific academic programs that could be trained in the NAVSIM for every IMC, the cadets also use the simulator in activities scheduled as Naval Military Training. These sessions also contribute for the statistics.

One OOW two week lectures and training sessions in NAVSIM occurs every year in early September and is specific for the Midshipman. This special training has 60H (2 weeks) of navigation lectures and the students will be prepared to execute the functions of the OOW.

The normal IMC is taught in the naval academy for five years. At the end of the IMC the navy cadets reach to 300/400 hours of training in the NAVSIM (see graph yyyy). Outer cadets, from different backgrounds (logistic area, engineers) training much less hours in the simulator (around 120H), which is relatively little for the functions that will perform as OOW. But these cadets have the specific course that was mentioned before (two week training for OOW).

6 ANALYSIS AND DISCUSSION

When the simulator was implemented in the naval academy (in 2005), only exercises concerning the ship maneuver were performed, where only some technical skills were achieved and developed. Over the last few years, new subjects have been introduced in the NAVSIM training sessions program, including organizational behavior our lidership, where NAVSIM has also started to develop non-technical skills training.

As the future Navy Offices has to be a part of the bridge team and have to deal with all the navigation equipment and instruments and with another team elements, it is essential that they are prepared to act in any kind of situations. These situations should be trained in order to get good practice skills. To achieve this main goal, the Naval Academy must adopt a most effective method, to be able to training the cadets and the midshipman for these stressful situations.

To achieve the objective above enunciated, and after the revision of the conceptual basis, adopting the captain Roque's perspective, it will be necessary to focus on acquisition of the theoretical knowledge and in the practice skills to handle the equipment itself. Only after these knowledge acquisition, the students could initiate the training in the NAVSIM and practice to respond fast and in a conscious way when the stressful situations happens. Based on Ceiil's, there should be demonstrated motivation from the trainers, during the sessions, in order to the students get also motivated and respond in an assertive way to the inputs

The trend is to use the NAVSIM more often by the students, and the lack of theoretical unknowledge, and with equipment operation, will be reduced. In addition, while only technical skills are developed, more emphasis will be placed on the development of non-technical skills, which will increase the time used for training.

As a conclusion, the right way to create the link between the different authors ideas and the correct use of the NAVSIM, should be gathered with the help of the trainers and the achievement of skills (technical and non-technical). This information should be collected and made available to all students, in order to get clear of the simulator training objectives and to they know where they should really focus the training.

7 CONCLUSIONS

Resuming all the issues presented in this study, in order to achieved how the navigation simulator is used as professional and academic learning tool for the students of the Portuguese Naval Academy, we concluded that:

- A simulated and controlled environment is paramount to acquire and improve technical and non-technical skills. This type of learning tool has several advantages:
  - Correction of systematic errors, in real time;
  - Creation of scenarios as realistic as possible;

  - Training all the procedures;
  - Reduce training costs. Not necessary to go to sea for specific training purposes;
  - Ideal environment to improve team building.
- Is essential to the simulated training and to achieve some standard of evolution during the sessions, to be motivated and motivate all the parts in the exercises, students and trainers;
- The training in the NAVSIM should not occur if the theoretical knowledge is not perfectly understood by the students, as well as the skills to operating all the bridge equipment;
- Concerning the data available of the training sessions:
  - The NAVSIM is being used below the standard, concerning the time spent on training. The desired utilization is up to 160H/176H per month. These standards were never accomplished and the maximum value achieved was 66H (per month).
  - The 300H to 400H of training in NAVSIM, during the 5 years of IMC, are acceptable values that allows to increase the acquisition of knowledge and systematize procedures. Following this assumption, and facing emergency situations, the student will react faster and in a more accurate way. On the other hand, the 120H of training for the logistic and engineers IMC are slightly below the desired levels, and this should be increased.
  - Is vital to increase training in a simulated and controlled environment (NAVSIM) in areas that were previously neglected, such as leadership and team building.

8 FUTURE WORKS

The next step of this study will result in a proposal of a training model for the operational use of the NAVSIM. This proposal will be combined with the analysis of questionnaires that will be filled by the cadets and midshipman, as well as the teachers who have conducted practice sessions in the simulator and with the conceptual basis described by the *International Maritime Organization* by the *Standards of Training, Certification and Watchkeeping*. In the end the model will describe the use of the NAVSIM as an academic and professional training tool for the Naval Academy cadets.

REFERENCES

ADAIR, J., 1988. *A gestão eficiente de uma equipa*. Publicações Europa-América, Lda.

Assembleia da República, 2001. *Decreto-lei nº 88/2001 of March 23*. Lisbon.

Assembleia da República, 2014. *Decreto-Lei nº 185/2014 of December 29*. Lisbon.

Bué, I., 2016. *Relatório sobre a utilização do Simulador de Navegação, Manobra e Radar da Escola Naval (SIMNAV EN) (2010-2016)*. Report. Alfeite: DCM Escola Naval.

Bué, I., Lopes, C. & Semedo, A., 2015. The use of the Portuguese Naval Academy Navigation Simulation Leadership training Purposes. In.: A. Weintrit & T. Neumann (Eds), *Safety of Marine Transportation, Marine Navigation and Safety of Sea Transportation,* Chapter 2: Maritime Education and Training, CRC Press/Balkema, London, UK, pp.83-88.

CARSON-JACKSON, J., 2010. *A Simulation Instructor's Handbook - the Learning Game*. London: The Nautical Institute.

CEITIL, M., 2010. *Gestão e Desenvolvimento de Competências*. Lisboa: Edições Sílado, Lda.

CINAV, 2015. *Plataforma das Industrias de Defesa Nacionais*. [Em linha] Disponível em: http://btid.iddportugal.pt/listing/cinav/ [Consult. 14 november 2016].

Escola Naval, 2016. *Escola Naval*. [Em linha] Disponível em: http://escolanaval.marinha.pt/pt [Consult. 24 octuber 2016].

Estado Maior da Armada, 1998. *Instruções de Navegação da Armada 3*. Lisbon: Instituto Hidrográfico.

LOPES, N. & Oliveira, I., 2013. *Videojogos, Serious Games e Simuladores na Educação: usar, cri-ar e modificar*. Educação, Formação & Tecnologias.

Salgado, A., 2013. *Escola Naval - Talant de Bi-en Faire*. Alfeite: Escola Naval.

SOUSA, B. de. (1945). Formação dos Oficiais da Armada. *1º Centenário da Escola Naval*.