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ACCREDITATION AGENCY

EXTERNAL EVALUATION REPORT

DEPARTMENT OF NAVAL ARCHITECTURE & MARINE ENGINEERING

NATIONAL TECHNICAL UNIVERSITY OF ATHENS

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External Evaluation Committee (EEC)

The Committee responsible for the External Evaluation of the Department of Naval Architecture and Marine Engineering of the National Technical University of Athens consisted of the following four (4) expert evaluators drawn from the Registry constituted by the HQAA in accordance with Law 3374/2005 :

1. Professor Michael M. Bernitsas, Ph.D. (Coordinator)
University of Michigan, USA
2. Dr. Dimitris K. Konovessis
University of Strathclyde, UK
3. Professor George Em Karniadakis, Ph.D.
Brown University/MIT, USA
4. Dr. George K. Maglaras
Hellenic Lloyd's SA, Greece

Preamble

The School of Naval Architecture and Marine Engineering (NA&ME) of the National Technical University of Athens (NTUA)¹, Greece, was established in 1969. Within a short 43 years, it has grown to one of the top and largest academic units of its kind in the European Union and the World.

The following important milestones are noted in the evolution of the School:

- (a) 1969: Established as a program within the Mechanical Engineering Department of NTUA with three Chaired Professors in Ship Theory, Design and Construction, and Marine Engineering.
- (b) 1982: Established as an independent department in NTUA.
- (c) 1993-2001: In 1993, four divisions were established within the Department: Ship Design and Marine Transportation, Marine and Ocean Hydrodynamics, Marine Engineering, Marine Structures. Operation of the four divisions was initiated in 2001.
- (d) 2002: The Department was classified as School of NA&ME in NTUA.

Presently, the School has grown from the original faculty of 3 to 28, with an additional 25 research and technical staff members², and a student body of about 600 undergraduates, 100 post-graduate, and 75 doctoral students. By international standards, it is among the largest schools in its engineering discipline and it is commensurate to the prominence of the Greek merchant fleet in the World. Its product, consisting of well-educated and sought-after graduates and high quality research output, reflects strongly on the international recognition of the School by the profession and academia.

In 2002, the School initiated the process of developing a 10-year strategic plan, which was never completed. At this point in time, the School has reached a turning point due to the Greek economic crisis and the world-wide economic recession. This external assessment process is most timely and necessary following a 2009 internal review.

The major conclusions of this report are: (a) The School of NA&ME serves Greece very well in this unique engineering discipline. It is a gem among NA&ME EU Schools reflecting well on NTUA. (b) The School deserves well the role of an independent and unique School within NTUA. (c) A comprehensive 5-10 year strategic plan is needed urgently for the School. This will help in creating a common vision for the future and overcome the challenges associated with the looming financial crisis. (d) In light of the new vision and mission to be set in the new strategic plan, the undergraduate curriculum needs to be further focused on the unique NA&ME discipline and trimmed from broader engineering knowledge. (e) A research focus area to identify the School world wide – such as green ships or energy – should be established in the strategic plan.

We would like to commend the faculty of the School for being among the first NTUA School to complete this lengthy and laborious process and for providing us, the EEC,

¹ Hereafter referred as the “School”

² ETEP, EEDIP, IDAX categories

with all needed data with clarity, assistance, and collegial courtesy, which made our task pleasant. This is in line with international practice, which includes periodic strategic planning, 5-year internal followed by external evaluations, and 6-year periodic accreditation reviews.

We would also like to clarify that this process is an evaluation process and not an accreditation process. In that sense, it is broader as it evaluates all aspects of academic life of the School and not simply those aspects supporting undergraduate education. On the other hand, it does not analyse in depth the educational program, as an accreditation process would do.

N.B. The structure of the “Template” proposed for the External Evaluation Report mirrors the requirements of Law 3374/2005 and corresponds overall to the structure of the Internal Evaluation Report submitted by the Department.

The length of text in each box is free. Questions included in each box are not exclusive nor should they always be answered separately; they are meant to provide a general outline of matters that should be addressed by the Committee when formulating its comments.

Introduction

I.1. THE EXTERNAL EVALUATION PROCEDURE

The EEC visited the School on March 26 and March 27, 2012 and kept open communication through e-mail and video-conferencing with the faculty throughout the evaluation visit.

Following a briefing session held during the morning of 26 March 2012 by H.Q.A.A. on the framework and procedures of the Greek Academic Quality Assurance Review, the EEC visited the NTUA Zografou campus where an opening meeting with the Head of the School and the Internal Evaluation Team was initially planned. However, the meeting was obstructed by a very small group of students, who stated their opposition to the external evaluation process and demanded that the process be cancelled. Following a suggestion by the Head of the School the meeting continued at a different location.

This report was drafted on 28 and 29 March and finalised on 30 March 2012.

During the site visit, the EEC met with the following people:

- Rector of NTUA, Prof. S. Simopoulos and Vice-Rector for Academic Affair, Prof. A. Moropoulou
- Head of School, Prof. G. Triantafyllou
- Members of the School’s Internal Review Committee, Profs. Georgiou, Grigoropoulos, Samouilidis, Papanikolaou
- Director of Undergraduate Programme, Prof. Samouilidis
- Directors of the 4 Divisions, 6 Laboratories and of the Independent PC Lab
- Director of the Graduate Programme, Prof. Mavrakos
- Practical Training Coordinator, Prof. Zarafonitis

Furthermore, the EEC met a number of academic faculty members, undergraduate and postgraduate students, School’s administrative staff, technicians, library and gym staff.

Due to the aforementioned student incident, the committee was unable to perform the scheduled meeting with student representatives. However, we were successful in obtaining the student input, of paramount importance for our task, through a video conference with a group of six fourth year students, which was held on March 28th.

The EEC was given access and consulted the following documents:

Internal Evaluation Report (of December 2010 with updates as appropriate) prepared according to H.Q.A.A. guidelines by the School; program of undergraduate and postgraduate studies including courses syllabi and specifications; reports and presentations of teaching and research activities of School's divisions and laboratories; samples of textbooks and lecture notes used and samples of past exam papers.

The EEC visited all 6 laboratories of the School as well as the PC lab, NTUA library, restaurant and gym.

I.2. THE INTERNAL EVALUATION PROCEDURE

The internal evaluation report of 2010, comprising data of the period 2001-2006 with updates until 2009, was based on extensive data provided by the School faculty and staff accompanied by detailed tables and graphs. The data were collected in an efficient manner using state-of-the-art techniques. A gap was noticed between the completion of the report and the visit by the external committee, however, this is not due to the School itself but rather to the lengthy process of arranging external reviews. To cover this gap, selected data updates for the period 2010 to date were provided by the School per our request. Overall, the material presented was of good quality.

The objectives of the internal evaluation process were fully met and the School was among the first NTUA schools to complete the internal evaluation process and apply for the external one, demonstrating overall a strong commitment to the evaluation process.

A. Curriculum

A.1. APPROACH, IMPLEMENTATION & RESULTS

UNDERGRADUATE PROGRAM

The goal of the undergraduate curriculum is to educate highly qualified engineers in the fields of naval architecture, marine engineering, and associated disciplines (marine science and technology, maritime transportation). The curriculum comprises general engineering foundation courses (on mathematics, physics, mechanics) and the necessary specialized courses preparing the graduates for a wide spectrum of employment opportunities. The curriculum is developed as a typical 5-year engineering curriculum using an internationally accepted structure to achieve the stated goal. The curriculum is delivered through a combination of lectures and, where appropriate, tutorials, practicals, and laboratory work, a comprehensive ship design project, a well-established diploma thesis program, and the organization of industrial summer placements. The undergraduate curriculum is complete and very rich on all accounts – i.e. on the large number of electives offered, the balance between theory and laboratory work, and the integration of research findings into teaching.

The undergraduate curriculum has recently undergone a major revision. The curriculum comprises compulsory courses until the seventh semester of studies, with specialized courses offered in the eighth and ninth semester organized in five thematic areas covering knowledge needs on emerging fields of science and technology. Responsible for curriculum revisions is the School's Undergraduate Curriculum and Teaching Committee, which in revising the curriculum takes into account employment educational needs and proposals by the School's faculty members.

GRADUATE PROGRAM

The goal of the graduate curriculum is to educate graduates of the School and of other Engineering or Physical Sciences Schools (mainly graduate Mechanical Engineers, Physicists, and Naval Officers) to advanced topics of marine science and technology. There are three streams of studies offered (marine technology, ocean and coastal technology, marine science), with comprehensive curricula of studies and contributions from other Schools. There are suitable provisions in place for the appropriate selection of candidates to the various streams of studies, including arrangements for the provision of prerequisite knowledge in the form of attendance of the necessary classes from the undergraduate curriculum.

DOCTORAL PROGRAM

There are no established procedures for the Doctoral Program, however, the School

requires all new PhD candidate to successfully complete up to 5 graduate classes, relevant to the PhD subject.

A.2. IMPROVEMENT

The UNDERGRADUATE CURRICULUM and course content have served well over the past 30 years, offering a wide range of courses covering well classical naval architecture and marine engineering. The curriculum is certainly more extensive compared with undergraduate studies at other leading naval architecture undergraduate programs in European and US universities. The School definitely has the necessary resources to deliver such a competitive curriculum – the academic faculty are highly qualified, world-renown experts in their respective fields, with state-of-the-art experimental educational facilities available.

In light of the new vision and mission to be set in the new strategic plan (reference is made to other parts of the report), the EEC highlights the need for the undergraduate curriculum to be further focused on the unique NA&ME discipline and trimmed from broader or somewhat dated engineering knowledge.

Specific points of improvement include the following:

- Provision of general engineering knowledge in the first two years of the undergraduate curriculum need to be thoroughly reviewed in order to eliminate overlaps between different classes and result in a more coherent program of studies. As examples, the EEC would like to mention the two first-year mathematics courses on one- and multiple-variable functions (which can easily be merged into one course), the provision of a full semester course on statics and of three courses on mechanical and naval architecture drawing during the first year. On the other hand, the course on probability theory and statistics would be better offered as a stand-alone course during the second year.
- The undergraduate program is, as said, very rich in content and scientific rigor, however, it includes a very large number of courses requiring long hours of lecture attendance. There is a need for review of these provisions with a view to result in a more integrated program of studies.
- Emerging technologies need to be thoroughly addressed within the curriculum for the graduates of the School to be equipped with the necessary knowledge. To this end, the curriculum need to be revised to focus on existing and new courses relating to the marine energy and maritime transportation themes (such as, marine renewable energy; offshore oil and gas; safety, environment, energy efficiency).

As for the GRADUATE PROGRAM, it is the opinion of the EEC members that measures to improve the curriculum of the offered program should include delivery of the courses in English, as well as extending the curriculum to new and emerging

technologies (such as on oil and gas technologies, as the Director of the Program already contemplates).

B. Teaching

B.1. APPROACH, IMPLEMENTATION & RESULTS

The teaching philosophy of the School is to educate students with the theoretical and practical knowledge required to cover a wide spectrum of professional activities. This approach is generally implemented at all three levels of the School's educational activities (undergraduate, post-graduate and doctoral programs).

The undergraduate five-year program consists of 51 required courses and 11 elective courses. The teaching methods include traditional lectures supplemented by laboratory practice where applicable. A summary of course descriptions is given in the "Study Guide." The last semester of the program is dedicated to the diploma thesis.

As per the internal evaluation report, the total number of undergraduate students is 626 and the number of faculty 27 (year 2009 data). Thus the nominal ratio of students to faculty is approximately 23. However, since a significant number of students are absent from classes, as unfortunately is the case in most Greek universities, the actual ratio is considerably lower.

Student representatives expressed their satisfaction with the availability of their professors/instructors in and out of classroom.

The laboratory facilities are well maintained by trained technical personnel. Student representatives stated that their first-year Physics laboratories were hands-on and very well organised, while third-year laboratories were of a limited educational value. However, the undergraduate program includes in the eighth and ninth semesters of study two courses with a total of eight hands-on labs, two from each of the four School Divisions.

Student evaluations of teaching are very positive, also the questionnaire developed by the School is very comprehensive and well-designed.

Information technologies are in use. Many faculty members use them in teaching and a number of them post the course lectures on the internet. There are also courses which introduce or incorporate the use of specialized software packages and databases which are used by a naval architect in his professional life. Teaching of computer programming comprises of two first-year courses, on MATLAB and on FORTRAN and object-oriented programming, which is adequate.

In most cases the students are graded based on their examination at the end of each semester. The use of mid-term exams is very limited and, when happening, it accounts for approximately 10%-20% of the grade. Based on international standards, this is considered a weak point. It is also believed that the introduction of weekly homeworks and mid-term exams would increase the presence of students in the classrooms. It should be appreciated, however, that this would require a large number of graders, an activity which cannot be funded presently.

B.2. IMPROVEMENT

- Effort should be expended in reducing the average time for graduation from 7.5 years to at most 6 years. Reasons leading to such long graduating times should be rigorously investigated.
- Student attendance should increase in order for their overall educational experience to improve.
- Short-term projects and coursework should be introduced, with graders selected from doctoral students.

C. Research

C.1. APPROACH, IMPLEMENTATION & RESULTS

The diverse research programs at the School of NA&ME in NTUA are recognized as some of the best in the world. NA&ME has the highest funding level per faculty among all schools of NTUA, which amounts to twice the mean level and ten times the level of the school with the lowest funding per faculty. The publication record is equally impressive with the number of papers published in refereed journals and proceedings exceeding eighty per year on average. Collaborations have been established with some of the best research teams in the world in Universities (MIT, ETH, and members of the West European Graduate Education Marine Technology (WEGEMT)), as well as in industry (Wartsila, MAN Diesel, ABB). Faculty of NA&ME are leaders in several projects in the European Commission Funded Framework Programs, and serve as advisors for the Greek government and the Greek maritime industry but also for the International Maritime Organization on environmental and safety issues.

The School's emphasis is on fundamental research as well as on providing technical expertise to industrial and industrial sectors, ranging from marine technology to maritime transport. There are six established-by-law Laboratories on (a) Ship Design; (b) Marine and Ocean Hydrodynamics; (c) Shipbuilding Technology; (d) Marine Engineering; (e) Maritime Transport; and (f) Floating Structures & Mooring Systems. The laboratory infrastructure is more than adequate with some facilities, e.g. towing tank, marine engines, among the best in the world. The research equipment has been bought primarily with external funds. For example, a new laboratory on the all-electric-ship is being established with funding from the infrastructure program of the European Framework (FP-7); similarly, state-of-the-art computer clusters for parallel computing have also been funded by the FP-7 program. Recent research awards include five new different ARISTEIA grants, through a highly competitive process involving international referees.

Research is performed by the faculty assisted by: undergraduates, through the execution of the diploma thesis by each student; masters students pursuing their thesis; PhD students conducting research for their doctoral thesis. In particular, several of the undergraduate diploma theses are published in international journals or conference proceedings on fundamental science (e.g., Physics of Fluids) as well as on applied research (RINA award, paper published in 26th CIMAC world congress on combustion engines, 2010). A recent publication based on a diploma thesis was given the Best Paper Award by the Microturbines & Small Turbomachinery Committee of ASME (American Society of Mechanical Engineers). Several other undergraduate students have received awards for best diploma thesis by SNAME (Society of Naval Architect and Marine Engineers), RINA (Royal Institution of Naval Architects), and IMarEST (Institute of Marine Engineering, Science and Technology).

The PhD program has 79 students with 10 doctoral students graduated in the last

four years. They are funded by eleven fellowships from research overhead funds, three fellowships provided by Det Norske Veritas, and two fellowships by Lloyds Register Educational Trust. Many of the faculty have received prestigious awards including fellowships by SNAME, RINA & IMarEST, and more recently one of the faculty received one of the highest honors by SNAME, the K. Davidson award and medal (2010). Faculty and labs of the School have also won several industry awards in recent years (for example, 3 Lloyds List awards).

There is no specific central research direction in the school but instead the research priorities are set by the Directors and the other faculty of the six research laboratories. The School has not set any formal internal standards and metrics for assessing research. However, there is a routine evaluation of the researchers for promotion reasons and of PhD students for ensuring sufficient progress towards completion of their PhD work. There are no specific mechanisms for incentives in conducting research for the members of the School other than publishing papers and the possibility of increasing their remuneration by external funding. Increasingly problematic has become the participation of researchers, especially for the younger members, to international conferences due to budget cuts and lengthy bureaucratic procedures even for a partial reimbursement of their expenses.

C.2. IMPROVEMENT

- While the School has established many diverse research areas implemented by the six aforementioned laboratories, there is currently no comprehensive long-term research plan that will further strengthen the School and provide the necessary momentum for the next ten years. This is especially important at this juncture, where new technologies and regulations on renewable energy, floating offshore structures, and clean environment are emerging. Specific research focus areas within this context should be identified and pursued as part of a strategic plan for the next ten years.
- Mechanisms that promote technology transfer to industry and to the government have to be put in place by NTUA. It is important to promote a culture to pursue patents and start spin-off companies. Such research output has the highest potential for technological and financial impact, and should be accounted in the evaluation/promotion process for faculty and technical staff. This is a strong culture in top research Universities worldwide.
- More University assistance should be provided to younger faculty members in order to establish new laboratories so that they do not rely exclusively on external funding at the beginning of their career. This could be implemented by the University in funding specific equipment items, by providing fellowships to PhD students supervised by the young faculty, and by reducing their teaching load in the first few years.
- Similarly, specific incentives and flexible mechanisms should be given to all researchers and especially to technical staff with PhDs (IDAX) so they may increase their remuneration. The heavy bureaucratic procedures related to conference participation should be immediately eliminated and replaced by

reasonable simplified procedures followed in the rest of the European countries.

- Finally, in order to be made more visible internationally the research conducted at NA&ME all research reports, diploma theses, MSc theses and PhD theses should be written in English. We note that some theses have actually been written in English.

D. All Other Services

D.1. APPROACH

The services needed for a smoothly running University and School are available to a certain degree. The EEC has tried to categorise them by the provider of a particular service.

Central administration

Student records; free or subsidized food; library, gymnasium, doctor's office, parking (for both students and faculty); student transportation

School

Classrooms; laboratory & associated equipment; budget; office space regular faculty; office space for visitors; secretarial help

D.2. IMPLEMENTATION & RESULTS

Central Administration

- The student registration procedures as well as records, transcripts etc. are fully electronic and considered effective and satisfactory.
- Free or subsidized food is available to the student body. Subsidized food is available for the faculty as well.
- Library facilities are fully equipped with all necessary publications. All diploma theses and PhD dissertations are kept in an electronic format. NTUA library has synergies with the libraries of other Greek Universities and make common subscriptions to main journals and periodicals to reduce the associated cost. However, lately, this funding has been discontinued by the state. As per the librarian's statement no book has been procured in the past six months.
- Doctor is available on campus.
- Gymnasium facilities are modern and in good condition.
- There is ample parking space for faculty, students and staff.
- Wireless internet access is available on campus.

School

- Office space, classrooms, laboratories etc. appear to be adequate.
- The budget is centrally controlled by the University and this creates inefficiencies in proper and timely fund allocations. Examples include the very lengthy process for procurement of equipment, unavailability of funds to renew laboratory consumables, lengthy process for the approval of salary for technical support staff.

D.3. IMPROVEMENT

- Improvements related to the simplification of budget and fund allocation

procedures have been identified, however, changing those is not easy as they are based on State laws and subsequent bureaucratic processes.

- During the meeting with the students it was brought to the attention of the EEC that the transportation to the campus is done through one bus line with frequency of one bus every half an hour. This is not considered adequate and the intervention of NTUA to the appropriate public services should be sought.
- During the tour of the EEC in the NTUA campus it was noted that the majority of the exterior walls were covered by graffiti and paper-posters mostly of political nature. The central administration of NTUA should seek ways to improve and contain this situation.

Collaboration with social, cultural and production organizations

The School has long standing co-operation with many domestic and foreign production organisations such as shipyards, shipping companies, the Hellenic Navy, classification societies etc. where the majority of the faculty and a number of student (mostly post-graduate) participate. There are also well established links of cooperation with the Ministry of Development, Competitiveness and Shipping, and ship owners associations.

As per the internal evaluation report there are no established processes and procedures for such collaborations and these are mostly based on personal contacts.

Furthermore, the School has developed collaboration with similar departments abroad in Europe as well as Japan, China, Korea, USA etc. The School is one of the most active members of WEGEMT (European Association of Universities in Marine Technology & Related Sciences) and for 9 years has the chairmanship of that organisation.

The School has hosted a number of national and international conferences such as:

- a. 8TH International Marine Design Conference, 2003
- b. SNAME
- c. Symposium of the International Maritime Association of the Mediterranean, (HKAK2002)
- d. 24th Offshore Mechanics and Arctic Engineering Conference (OMAE2004)
- e. International Conference on Maritime Safety, Security and Environmental Protection (2007)
- f. 19th International Conference on Efficiency, Cost, Optimization, Simulation and Environmental Impact of Energy Systems (ECOS 2010)
- g. FAST International Maritime Transportation, 2009
- h. 11TH International Conference on Stability of Ships and Floating Vehicles, 2010

E. Strategic Planning, Perspectives for Improvement and Dealing with Potential Inhibiting Factors

E.1. INTRODUCTION

The NA&ME School initiated the development of a 10-year strategic plan in 2002, which was never completed. This has some elements that are valuable and can be used in developing a new strategic plan. At this turning point in the history of the School, when the economy of Greece is in turmoil and the EU is in economic recession, a 5- to 10-year hierarchical strategic plan is needed urgently to prepare for the hard-to-anticipate impact, with a strong vision on the apex of the pyramid, as illustrated in Figure 1.

We acknowledge of course that the School's faculty is best qualified to set a vision. The School may want to adopt, modify, or totally discard the committee's suggestion but the faculty is urged to establish a vision at the earliest possible time.

E.2. URGENT NEED FOR STRATEGIC PLANNING

We understand that a strategic planning process is not presently mandated by law and that political, economic, and social conditions are in a state of flux setting a highly uncertain ground to navigate. That makes long-term planning hard and short-term planning practically impossible. On the other hand, lack of such a plan may prove disastrous particularly given the looming threat of school mergers discussed at the state level for unspecified benefits. It is a well-known international phenomenon of business-driven reorganization failures that are time-consuming and yield no benefits.

A proactive approach with a well thought-out plan will place the School in a position to readily demonstrate to NTUA and Greek-state authorities the value of changes, mergers, loss of faculty, or other state-imposed constraints to meet their financial or politically driven objectives. Based on such a 5-10 year strategic plan, the School will be in a position to readily propose more beneficial alternatives to meet the State-imposed constraints. This will also place the School in a strong position on emphasising the uniqueness of the NA&ME discipline and its importance to the maritime industry, and the profession.

In the next 6-7 years, 8 out of 14 of the School's full professors will retire. The School is urged to look at this period of the on-going financial and social turmoil and uncertainty as an opportunity to plan and prepare for the long term while facing the short-term needs by self-imposed trimming and reorganization.

We hope that the committee's recommendations stated in Section E.4 will be of value to the School during the strategic planning process.

E.3. DEVELOPMENT OF A STRATEGIC PLAN

This is not an easy process and requires professional assistance. Following are the committee's recommendations:

- (1) In the committee's opinion, faculty may not have a clear understanding of the terms in the generic strategic planning process as depicted in Figure 1. As a School, seek and receive professional training on what is a strategic plan, how it is developed, what is its value, and its life expectancy. Worldwide faculty are not aware of this process until they have received proper training.
- (2) Strategic planning is a three-stage process. First, collect appropriate data from all your constituencies (students, faculty and staff, alumni, employers, government, peer institutions). Second, analyse the data and establish a vision statement by faculty broad consensus and participation. Third, have a 2-3 day retreat of faculty away from home, work, e-mail, cell-phones, and other distractions and focusing of the strategic plan itself. Given the urgency of the need, our EEC recommends that the School jump ahead to stage-3, develop a 5-10 year strategic plan, and update as needed after data have been collected.



Figure 1. Generic strategic planning

- (c) The benefits of Strategic planning are numerous, such as: establishing a vision that transcends time and is a source of pride for the School; a mission that will identify the School and its uniqueness; understanding and appreciating the work and contribution of colleagues; being able to remain flexible in pursuit of major research thrusts and goals as they evolve worldwide.

E.4. RECOMMENDATIONS FOR STRATEGIC PLANNING

- (1) Initiate the new strategic planning process immediately. Seek professional help if available in Greece to be trained in the development of a strategic plan. Alternatively, seek assistance from colleagues in peer institutions.
- (2) It is true that the overbearing, State-imposed regulations are inhibiting factors to planning. However, this is the reality of Greek society and will not be changed overnight. You cannot possibly use that as excuse to defer planning. Neither can you afford deferring strategic planning in an environment where people use non-quantified, intuitively-driven notions that merging saves money.
- (3) Define the uniqueness of your engineering discipline in the context of Greek maritime industry and academia. You may find of help the process developed by your sister Department at the University of Michigan in 1994-1995, which helped that Department survive – and consequently thrive - the merger craze that hit USA Universities at that time. This merger trend eventually resulted in merging

of other sister departments in top engineering universities in the USA and the UK. This also led SNAME to adopt the term “Engineering for the Marine Environment” to identify our engineering discipline.

- (4) Some of the aspects that make NA&ME a unique engineering field are the following: It is engineering for the marine environment, ocean structures and vehicles are systems of systems, water is a high density medium, the interface between water and air results in highly random excitation, 93% of the world trade is transported by ships, 95% of the energy the Earth receives from the Sun is stored in water which is the best natural storage medium for energy; food, water, minerals, oil/gas abound in the marine environment.
- (5) Establish the Vision for the School.
- (6) Establish the Mission for the School.
- (7) Identify one, at most two, areas of excellence in research that are broad enough to embrace the majority of the faculty and drive the School into the future. The EEC would recommend ***Energy and the Environment***, encompassing oil/gas, marine renewable energy, green ships. As a consequence, the array of employment opportunities would be expanded beyond the traditional, and always strong, employment opportunities offered by the shipping industry.
- (8) Under this broad and most timely area of excellence to pursuit, the School can provide a leadership role in the EU and provide opportunities to other Schools in NTUA to collaborate and contribute. That will make merger-seekers realize that they are out of their league when it comes to engineering for the marine environment.
- (9) Identify the goals to support that area of excellence. Those goals will include reformulating of the undergraduate curriculum, enhancing the graduate curriculum, better marketing of the Schools human output and intellectual product.
- (10) A well thought out strategic plan will establish the framework for new cross-division, cross-school, and cross-university (e.g. energy policy, infrastructure, and law) research ventures.
- (11) A well thought out strategic plan will establish the framework for a long overdue curriculum reform. That requires: (a) Reducing load on students to no more that 25 lecture hours per week. (b) Focus the curriculum to be dedicated to the unique discipline of naval architecture and marine engineering. (c) Eliminate traditionally mechanical engineering courses such as heat transfer and internal combustion engines. (d) Modernize the math requirements by eliminating projective geometry, merging basic calculus courses, and expanding the probability/statistics/random-process context, which is of paramount importance to a curriculum in this engineering discipline.
- (12) Strengthen the links and establish strategic collaboration with the Greek Shipowners’ Associations.
- (13) Establish strategic collaboration with the Hellenic Navy in providing technical support, and in training Naval Officers who otherwise would study abroad at considerable expense.

- (14) On the basis of the strategic plan, which will make clear the uniqueness of the engineering discipline at the concept level, the importance of the area of excellence, the uniqueness of the revised curriculum, it will become very clear to all good-faith authorities that merging the School would be irrational.
- (15) On the other hand, acknowledging that it is the duty and responsibility of every Greek citizen to trim expenses during these times of financial turmoil, the School is strongly urged to calculate the financial benefit to the State of a possible merger and work out an alternative plan. Should the order for a merger be considered at a high level in the government, the School would be ready to present that alternative plan to the State that will save an equal or higher amount of money.
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F. Final Conclusions and recommendations of the EEC

Several conclusions and recommendations have been presented in each of the sections A to E of this evaluation report. The general conclusions of this report are listed below:

- (a) The School of NA&ME serves Greece very well in this unique engineering discipline. It is a gem among NA&ME EU Schools reflecting well on NTUA.*
- (b) The School deserves well the role of an independent and unique School within NTUA.*
- (c) A comprehensive 5-10 year strategic plan is needed urgently for the School. This will help in creating a common vision for the future and overcome the challenges associated with the looming financial crisis.*
- (d) In light of the new vision and mission to be set in the new strategic plan, the undergraduate curriculum needs to be further focused on the unique NA&ME discipline and trimmed from broader engineering knowledge.*
- (e) A research focus area to identify the School world wide – such as green ships or energy – should be established in the strategic plan.*

We would like to emphasize the importance of comprehensive periodic evaluations, both internal and external, on remaining at the forefront of education and research and providing leadership.

The Members of the Committee

Name and Surname	Signature
1. Professor Michael M. Bernitsas, Ph.D. (Coordinator) University of Michigan, USA	
2. Dr. Dimitris K. Konovessis University of Strathclyde, UK	
3. Professor George Em Karniadakis, Ph.D. Brown University/MIT, USA	
4. Dr. George K. Maglaras Hellenic Lloyd's SA, Greece	