Journal of Research in Education and Society
Volume 13, Number 2, August 2022
ISSN(p): 2141-6753 ISSN(e): 2795-3033
Published By
International Centre for Integrated Development Research, Nigeria
In collaboration with
Copperstone University, Luanshya, Zambia

Industrial Mathematics and Maritime Business: Emerging Trends and Challenges

Olaoluwa O. Omotoso
Thlawur Dunya
Affiong I. Ndekhedehe
Sylvanus C. Amadiegwu
Effiong A. Adakama
Department of General Studies, School of Maritime Transport,
Maritime Academy of Nigeria, Oron, Akwa Ibom State, Nigeria.

ABSTRACT

This work reviews the relevance of mathematics in the changing trends of Maritime Business and Education. The paper also discusses the various occupational practices where maritime education and training practitioners encounter the use and application of mathematics. Maritime activities occupy more than three-quarters of the world's space and provide an occupational industry (Nahmias, 2005). Of late, ship construction and usage include space management onboard the vessels; the Ports have brought a dependency on mathematical principles or models such as time series, linear programming, and queuing theories. These models, however, hardly come as direct mathematics but embed in technology built on the advancement of mathematics. Moreover, it also identifies specific areas of mathematics applicable to Maritime Business, Education, and Training practitioners in their day-to-day activities. The paper recommends the curriculum considerations on issues bordering on mathematics teaching and learning for Maritime Business, Education, and Training.

Keywords: *Use of mathematics, MET industry, Maritime, Mathematics curriculum*

1. INTRODUCTION

With all the scientific discoveries, a man had to depend more on mathematics. To express the ideas of Science and mathematics has become much more than ever, the language of the scientist and technicians. The mathematics of science becomes more complicated as scientific discoveries and inventions become much complex. It is an inevitable part of science. It is used in almost every field of human endeavour, be it natural science, engineering, art, or economics. It deals with logical and quantitative calculations (Ilori & Akinyele, 1991). The importance of mathematics for potential careers cannot be over-emphasized. Students who choose not to take mathematics seriously or ignore it in secondary schools, high schools and universities forfeit many future career opportunities that they could have (Adesina, 1977). Mathematics is also useful in non-routine activities such as budgeting and accurate projections into the prospects of businesses (Stafford, 1979). There are illustrations that testify to the presence of mathematics in everything.

Since mathematics is the language of science, it is a necessary part of many other subjects (Page, 1970). The study of General Science, Physics, and Chemistry is becoming much more mathematical (Bronson, 1983). The relationships studied in light, sound, magnetism, electricity, mechanics, and heat are expression of mathematical formulae (Page, 1970). Aviation, shipping, and electronics require more than elementary knowledge of mathematics (Hearly & Sutherland, 1990).

Mathematics now enters fields of study such as Business Administration, Economics, Psychology, Sociology, Geography, which were wholly non-mathematical only a few years ago (Bronson, 1983). The ability to make an effective decision is one of the factors in successful business behaviour. Business mathematics is concerned with improving the quality of decision-making in industry and commerce. It is not surprising that a high degree of mathematical ability is a necessary for a manager's skills at every level of responsibility (Stafford, 1979). Entrepreneurial flair and the ability to take risks and distinguish acceptable risks from unacceptable ones are also imperative in running a successful business; mathematics has a part to play.

Mathematics may help one get a job (BLS, 2015). It is because an increasing number of firms hire new employees based on tests given by their personnel departments, and most of these tests are mathematical problems. Mathematics is a way of thinking (Ilori & Akinyele, 1991).

The same steps which we learn to use in analyzing and solving mathematical problems could be useful in analyzing and solving problems we meet in everyday life. A businessman has to gather and organize data, examine relationships, and draw conclusions (Ilori & Akinyele, 1991).

It must also be exact in defining the terms used, eliminate irrelevant or unnecessary facts and recognize the assumptions upon which his conclusions are based (Akakpo & Ngankan, 2015). In other words, he must think mathematically. Mathematics is a very technical subject and language (Page, 1970).

Every area of mathematics has its unique applications to the different career options. For example, algebra is applicable in computer sciences, networking, cryptology, a study of symmetry in chemistry and physics; Calculus (differential equations) is applicable in chemistry, biology, physics, engineering, molecular structure, rocket science, the motion of water, option price modeling in business and economics models (Gouba, 2008; Omotoso, *et al.*, 2011).

2. INDUSTRIAL MATHEMATICS

Industrial mathematics is a branch of applied mathematics and a well-established field within the mathematical sciences (Ross, 1985). It refers to all manufacturing and service, including business and engineering (Rappaz, 2003). But applied mathematics can include theoretical topics from physics, biology, economics, and computer science, for example, industrial mathematics focuses on problems that come from industry and aims for solutions that are relevant to the industry, including finding the most efficient (cost-effective) way to solving the problem (Friedman & Littman, 1994). Applied mathematics has always led to important discoveries and given birth to new disciplines (Ross, 1985).

The creation of mathematical and statistical modeling and the development of numerical methods and algorithms for computers to obtain solutions for problems in the industry have come to be called industrial mathematical sciences or, simply, industrial mathematics (Kneebone, 1963). There is a growing demand for mathematically trained individuals who can move into business and industry (Bojanic, 2014). Numerous reports and studies carried out by professional organizations show an increasing need in the workforce for mathematics graduates with the practical skills to work with managers, engineers, and the like (SIAM, 2016).

Industrial mathematics is a specialty with a curious case of double invisibility (Page, 1970). In the academic world, it is invisible because so few mathematicians actively engage in works on industrial problems (Ross, 1985). Research in industrial mathematics may not find its way into standard research journals, often because the companies do not want it to appear (Kneebone, 1963). Some companies do not encourage publication due to corporate policies; as such, advisors of graduates who go into the industry may not keep track of them as closely as they keep track of their students who stay in academia (Staford, 1979). Within the business world, industrial mathematics is invisible because it is often not called "mathematics" (Page, 1970). It is called analytics, modeling, or simply generic research. Credit for mathematical advances may go to "information technology" when it should go to the people who use the technology and figure out how to employ it effectively (Ross, 1985).

Industrial mathematics is an inherently interdisciplinary field (Page, 1970). In addition to mathematics, it includes subjects from business, computer science, engineering and trains mathematics students on how to apply mathematical analysis to problems arising in these areas (Rappaz, 2003). An industrial mathematician has strong analytical and problem-solving skills built upon a background in computing, mathematics, statistics, and basic science. In addition, industrial mathematics emphasizes written and oral skills with teamwork, which are valued highly in the industry but are not part of most traditional mathematics programs (Page, 1970). Since these skills are necessary for graduates to work effectively with less mathematically inclined co-workers, they are an essential part of industrial mathematics. With the increasing complexity and sophistication of modern industry, personnel who understand technical issues can formulate precise and accurate mathematical models to implement solutions using the latest computer techniques and convey these ideas to their co-workers, who may be managers, and engineers (Stafford, 1979). Examples of areas in the industry where industrial mathematicians can find employment are signal processing, computer graphics, risk management, system reliability, software testing and verification, database systems, production line optimization, and marketing research.

Manufacturing and service industries have changed drastically in modern times due to the explosion in the knowledge economy (Stafford, 1979). Fast and inexpensive computing, office products, and the development and utilization of large databases have necessitated sophisticated methods to meet new demands

(Page, 1970). Industrial mathematics is a factor in realizing and implementing these methods (Friedmann & Littmann, 1994). In recent years, the mathematical community worldwide has responded to this growing need for mathematically trained personnel in the industry (Page, 1970). Organizations such as the Fields Institute, the Mathematics of Information Technology and Complex Systems (MITACS), Pacific Institute for the Mathematical Sciences (PIMS) in Canada, and Society for Industrial and Applied Mathematics (SIAM), and The National Science Foundation (NSF) in the United States among others have been promoting the interaction of mathematics with industry and continue to develop ways to meet industries demand for mathematically trained personnel (SIAM, 1996).

It shows that mathematics stands an opportunity and a terrible stumbling block, depending on how it is handled. Every area of mathematics has unique applications to the different career options (Gauba, 2008). For example, Algebra helps in computer sciences, cryptology, networking, and study of symmetry in chemistry, biology, physics, engineering, and the motion of water, rocket science, molecular structure, option price modeling in business and economics. Again, if one wants to do a course in the physical sciences (chemistry, physics engineering); the life and health sciences (biology, psychology, pharmacy, nursing, optometry); the social sciences (including anthropology, communications, economics, linguistics, education, geography); the technology sciences (like computer science, networking, software development); business and commerce, medicine as well as the actuarial sciences used by insurance companies, one needs a huge friendly dose of mathematics to guarantee his or her progression (Gouba, 2008).

In professional and occupational settings, mathematics plays a major role in the day-to-day administrative activities of management officials. For instance, the head of a container terminal in a shipping port needs to assess the space of his yard using the theory of capacity and linear programming involving resource allocation before admitting containers of various types of cargo into them (Nahmias, 2005). An insurance company must study the actuarial computations before determining the payment of claims; a marriage counselor needs some knowledge in statistical rank correlation studies and Mendelian blood group mathematics to scientifically prepare the would-be-couple in understanding their compatibilities and the like (SIAM, 2015).

Journal of Research in Education and Society
Volume 13, Number 2, August 2022
ISSN(p): 2141-6753 ISSN(e): 2795-3033
Published By
International Centre for Integrated Development Research, Nigeria
In collaboration with
Copperstone University, Luanshya, Zambia

3. MATHEMATICS AND THE MARITIME INDUSTRY

Applied mathematics is a branch of mathematics that deals with the application of mathematics in other scientific fields; and inspires and finds the use of new mathematical discoveries, which has led to the development of entirely new mathematical disciplines, such as statistics and game theory. Mathematicians also deal with pure mathematics (Heilio, 2004), i.e., mathematics at the service of mathematics, without considering its application. There is no clear boundary between applied and pure mathematics, and often a practical application for discoveries that began as pure mathematics is found (Gouba, 2008), in maritime affairs.

Maritime affairs are an activity including all actions either directly or indirectly connected with the sea (Bojamic, 2014). Maritime affairs include not only marine navigation and the conduct of ships, but they also combine the concepts of ships, workers, and companies across the shipbuilding industry to trade, transport, and management (Bojamic, 2014). Mathematics, one of the oldest sciences, is used to calculate many items in shipping (Alderton, 2004). The stability of a tossing boat and financial budget applications in navigation are only a few problems that are solved with the help of mathematics (Gouba, 2008). The safety of navigation, improving navigation accuracy, optimizing costs, and how ship owners and employees in maritime affairs make more revenue and profit are only a fraction of maritime affairs, which is impossible to approach without the knowledge and application of both maritime affairs and mathematics (Gouba, 2008).

Trigonometric functions appeared in the post-classical Greek period (2nd Century B.C - 5th Century A.D) from the requirements of astronomy (Dula, 2014). So, the practice appeared first and then the theory mathematically introduced because something was needed (Ross, 1985). It was only in the late middle ages and the Renaissance that the complete trigonometric theory was set up (Omotoso *et al.*, 2021). Even spheres were more elaborated than plane trigonometry, and the latter generally used to the extent required to understand spherical trigonometry (Omotoso et al., 2021). The unknown dimension, tilt angle in mathematical and technical calculations can be determined using trigonometric functions, which is imperative in solving some practical and not just theoretical problems (Ilori & Akinyele, 1991). Precisely, this importance is reflected in the application of trigonometric functions in maritime affairs. Mathematicians took more than two millennia to make a leap from the definitions of trigonometric functions to their application and it will take another two millennia until a similar leap occurs (Omotoso et al., 2021).

Differential equations, part of numerical mathematics, are used for numerical findings and to improve the algorithms for calculating the value related to mathematic analysis (Omotoso et al., 2021). In maritime affairs, they are widely used, but the most important is the application in the calculation of the movement of a ship on the sea or in the linear theory of waves (Dula, 2014). The main aim of maritime affairs is to transport cargo and deliver that cargo; ships withstand heavy seas and the stress and strain of construction on the waves (Dula, 2014). Differential equations are also an integral part of the loop of all computer software for navigation aids, such as radar and GPS (Omotoso, *et al*., 2014).

Minor branches of mathematics are used by all people every day throughout life. Mathematics used to solving mathematical problems stimulate human thinking and the development of logic and logical conclusions (Ilori & Akinyele, 1991). The growth of maritime affairs relies on vessels that are growing in size, as agile and fast as possible (Ramana, 2007). In achieving this goal, mathematics has a role in the development and expansion of mathematical formulae; optimal goals in maritime affairs are reached (Bojanic, 2014). It is simply impossible to list all the places, dates, and parts where mathematics and maritime affairs meet. It is sufficient to say that there is an unbreakable bond between them and that maritime affairs cannot do without mathematics.

The maritime and offshore industries use advanced mathematical methods in the design of ships and mechanical analysis of offshore structures (Gupta, 2003). An example is the dynamical behaviour of floating structures under wave force effects and wind conditions. Individual technical tasks like the optimal design of an anchor cable or laying communication cables at the sea bottom lead to interesting mathematical problems (Stecke, 2005). One particular challenge is modeling the sea and the wave conditions for simulation purposes (Heilio, 2004). Akakpo and Ngankan (2015) claimed and developed a mathematical model for the determination of collision distance and collision zone between two ensuing ships on a collision course.

Maritime industries comprise companies whose activities supply innovative products and services related to the traditional maritime sector (Kneebone, 1963). Maritime industries include all enterprises engaged in the business of designing, constructing, manufacturing, acquiring, operating, supplying, repairing, or maintaining vessels, or parts; managing shipping lines, customs brokerage services, shipyards, dry docks, marine railways, marine repair shops, shipping, and freight forwarding services and similar enterprises (Evans, 1992). This emerging industry also includes a significant component of traditional oil and gas and renewable energy (wind and marine turbines) (Monfardini *et al*., 2012). Indeed, the maritime industry is a center of human endeavour and attracts professionals from all walks of life.

4. THE CONCEPT OF INDUSTRIAL MATHEMATICS

Cipra (2004) reported that in 2002, Virginia Concrete, the seventh-largest concrete company in the nation, began using optimization software to schedule deliveries for the drivers. The company owns 120 trucks, assigned to 10 concrete plants. However, a significant constraint is that a cement truck has roughly two hours to deliver its load before it starts hardening inside the trucks. Also, the construction business is very unpredictable; typically, 95% of a company's orders will be changed in a day (Cipra, 2004).

According to Cipra (2004), Virginia Concrete brought in mathematicians from George Mason University and Decisive Analytics Corporation to develop tools to automate truck dispatching. Among other changes, the mathematicians found that the company could improve delivery times significantly by moving away from the model in which individual truck was assigned to a "home" plant. Instead, they recommended that trucks should be able to go to whichever plant is closest. Also, in overnight planning, it turned out to include "phantom" trucks, representing orders that were likely to be cancelled. If the order was not cancelled, it could be reassigned to a real truck.

For testing purposes, the company used the software to make all the scheduling decisions. However, since the system's installation, dispatchers have been allowed to override the computer. The system has enabled Virginia Concrete to increase the amount of concrete delivered per driver by 26% (Cipra, 2004). Of course, to SIAM (2012), it will be no revelation to read that mathematics can make a huge difference for private enterprises and for society. Several colleges and universities began building centers and programmes in mathematics and computational science with a real-world focus (Cipra, 2004). Finally, the business process has discovered the importance of mathematics, statistics, and computer science to innovation (Hardy, 2010).

The software industry is making a big bet that data-driven decision-making is the wave of the future (Healy & Hoyles, 2001). The drive to help companies find meaningful patterns in the data that engulfs them has created a fast-growing industry in what is known as "business intelligence" or "analytics" software and services (Healy & Hoyles, 2001). Major technology companies - IBM, Oracle, SAP, and Microsoft have collectively spent more than $25 billion buying up specialist companies in the field (Lohr, 2011).

The modern toolbox of analytic and numerical methods has made mathematics a real-power tool for design engineers, production engineers, and architects (Page, 1970). One can bypass costly trial and error prototyping phases by resorting to symbolic analysis and numerical models. Mathematics is a natural tool to handle geometrical shapes, like the surfaces of car bodies, and in the visualization techniques in CAD and virtual prototyping (Healy & Hoyles, 2001). Entertainment industry is one of the clients for mathematical software nowadays (Gouba, 2008). Visualization and animation are the basis of computer games and the vivid special effects in movies (Rappaz, 2003). These tricks are made possible by mathematical models (Rappaz, 2003). Design and Systems engineers have always been active users of mathematics in their profession (Heilio, 2004). The possibility to set up realistic large-scale system models and the development of modern control theory has made the computational platform a powerful tool with new dimensions.

Business analytics has become a new catchall phrase that includes well-established fields of applied mathematics such as operations research and management science (Stafford, 1979). At the same time, however, the term also has a flavour of something new, the application of the immense databases that are becoming more and more readily available to business executives. Mathematical approaches to logistics, warehousing, and facility location have been practiced, since the 1950s (Stafford, 1979). The new opportunity for businesses and students hoping to enter the industry lies in the development of algorithms and techniques to handle large amounts of structured and unstructured data at low cost (Nahmias, 2003). Corporations are adopting business intelligence (i.e., data) and analysis (that is, quantitative methods) across the enterprise, including marketing, human resources, finance, supply chain management, facility location, risk management, and product and process design.

One cannot escape the feeling that these mathematical formulas have an independent existence and an intelligence of their own, that they are wiser than we are, wiser even than their discoveries that we get more out of them than was originally put into them. The hypothesis is that with this insight, the use of mathematics will become even more effective (Kneebone, 1963). It will lead to a methodological approach towards the design of mathematical models more than available at present. SIAM (2016) reported that a study involving 203 mathematicians (102 master's and 101 doctoral graduates from 1998-1992) and 75 managers indicated that mathematics was a factor in many non-academic sector job recruitments. The study conducted by SIAM (2016) revealed that 28% of the Ph.D. Mathematics graduates were in government jobs, 19% in engineering research, computer services and software mathematics-related jobs. A total of 83% of Ph.D. Mathematics and 76% of the Master's holder respondents were in mathematics-related jobs respectively (BLS, 2015).

Heilio (2004) stated that Industrial Mathematics is a fast-growing field within the mathematical sciences. It is characterized by the origin of the problems in which it engages, they all come from industry - Research and Development, finances, and communications. The common feature running through this enterprise is the goal of gaining a better understanding of industrial models and processes through mathematical ideas and computations. There is an approach of presenting real industrial problems and their mathematical modeling as a

Journal of Research in Education and Society
Volume 13, Number 2, August 2022
ISSN(p): 2141-6753 ISSN(e): 2795-3033
Published By
International Centre for Integrated Development Research, Nigeria
In collaboration with
Copperstone University, Luanshya, Zambia

motivation for developing mathematical methods that are needed for solving the problems (Heilio, 2004).

5. MATHEMATICS AND JOB PROSPECTS

Mathematics has been called the language of science (Stecke, 2005). Mathematics solves many real-world problems in industry, the physical sciences, life sciences, economics, social and human sciences, engineering, and technology (Friedman & Littman, 1994). For example, Mathematics was used to build many of the ancient wonders of the world, such as the pyramids of Egypt, the Great Wall of China, and the hanging gardens of Babylon (Healy & Sutherland, 1990). Early mathematics (computations, statistics, and accounting) has been applied to operations problems in administration and managing technical activities by public administrators, engineers, and managers (Ross, 1985). The early project management techniques included project evaluation, review techniques, and the critical path method (Stecke, 2005). These are to help manage large projects. Mathematics (computations, statistics, and accounting) has been applied to operations problems, administration, and managing technical activities, by public administrators, engineers, and managers (Ramana, 2007).

Many planning problems, including aggregate planning problems, are solved using mathematics. According to Nahmias (2005), Aggregate planning problems involve making decisions on workforce and capacity over a long time, say over a year. These decisions assume a forecast of demand, and they provide constraints on the actual day-to-day operations. Many real, large, and aggregate production planning problems are solved using linear programming (Bronson, 1983). In automated manufacturing, solving planning problems becomes necessary before actual production can begin (Stafford, 1979). Integer programming are used for selecting a candidate set of pare types (Brownson, 1983). Simulation or queuing models or Petri nets are used for evaluating candidate solutions (sets of part types) according to the appropriate measures of performance (Brownson, 1983). Glover, Klingman, and Phillips (1992) provided many examples of network flow model applications. Some applications that they mentioned include electrical circuit board design, telecommunications, water management, the design of

Journal of Research in Education and Society
Volume 13, Number 2, August 2022
ISSN(p): 2141-6753 ISSN(e): 2795-3033
Published By
International Centre for Integrated Development Research, Nigeria
In collaboration with
Copperstone University, Luanshya, Zambia

transportation systems, metalworking, chemical processing, aircraft design, fluid dynamic analysis, computer job processing, production, marketing, distribution, financial planning, project selection, facility location, and accounting. They also provided other non-industrial applications of network flow analysis in the arts, sociology, and archaeology.

Science, engineering, and technology discoveries are intertwined with advances across the mathematical sciences. New mathematical tools disentangle the complex biotic and abiotic processes that drive the climate system. Mathematics illuminates the interaction of magnetic fields; and fluid flows in the hot plasmas within stars; and mathematical modeling plays a role in research on micro and optical devices (Rappaz, 2003). Innovative optimization methods form the core of computational algorithms that provide decision-making tools for internet-based business information systems (Bronson, 1983). Mathematicians and statisticians need to collaborate with engineers and scientists to extend the frontiers of discovery where science and mathematics meet, both in research and in educating a new generation for careers in academia, industry, and government.

Davis (1994) reported that recent graduates saw substantial new opportunities for mathematics in industry and government. Computing, electronics, and software engineering were listed by 32% of Ph.D. interviewed, 30% listed financial analysis, 28% said engineering, and said it is operations research. Only 11% of the Ph.D.'s and 6% of the master's graduates thought that opportunities for mathematics were limited. Davis (1994) reported again that 59% of managers agreed that there are opportunities in their organizations for increased contributions from mathematics. Only 17% of managers disagreed that there were definitely or probably no additional opportunities for mathematics in their organizations.

6. APPLICATIONS OF MATHEMATICS IN INDUSTRIES

Davis (1994) reported the associations between areas of mathematics and applications encountered as outlined below:

i. Algebra and number theory-Cryptography
ii. Computational fluid dynamics-Aircraft and automobile design
iii. Differential equations-Aerodynamics, porous media, finance

iv. Discrete mathematics-Communication and information security
v. Formal systems and logic-Computer security, verification
vi. Geometry-Computer-aided engineering and design
vii. Nonlinear control-Operation of mechanical and electrical systems
viii. Numerical analysis-Essentially all applications
ix. Optimization-Asset allocation, shape and system design
x. Parallel algorithms-Weather modeling and prediction, crash simulation
xi. Statistics-Design of experiments, analysis of large data sets
xii. Stochastic processes- Signal analysis

Common themes are the technical advantages and cost savings that accrue from clever modeling, analysis, and computation by mathematicians working with other professionals. The mathematician's logical, problem-solving approach is widely seen to provide a noticeable competitive edge.

7. MATHEMATICS AND MET CURRICULUM

In general, many mathematics courses in our colleges and universities are all direct lecture and sit-down face-to-face assessment based. Their delivery does not involve any field experience or field trip for industrial observation where students are confronted with industrial mathematical reality. When students go on attachment, their focuses are not on the problem identification and the role mathematics can play in the modeling and determination of their solutions. These mathematics courses have become isolated academic programs, which are studied only in the classroom, examinations taken and abandoned, not for life's challenges. The need for mathematics and its role in the maritime sector performance remains more relevant than before. The introduction of sophisticated equipment in the operations within the maritime industry lays credence to the assertion that the mathematics curriculum must be redesigned to meet these changing trends squarely, especially in the face of the rapid growth of/within the industry (Nahmias, 2005). Maritime Education and Training practitioners are expected to track this apparent relevance of mathematics in the marine industry and fashion out their training curricula (Heilio, 2004). As stated earlier, the modern computer/technology age has generated a need and a window of opportunity for a new kind of expertise in problem identification and solution within the maritime industry. This field could be called industrial mathematics, mathematical technology, or computational engineering. The development presents a challenge to the maritime educational programs and curriculum development. Some colleges and universities already offer specialized Microsoft (MS) programs oriented toward the professional use of mathematics (Healy & Sutherland, 1990). There are excellent programs to equip the students with the skills needed in mathematical projects and the Research and Development (R&D) sections in the maritime industry (Bronson, 1983). In general, there is still a lot of room for improvement. Pathetically, some mathematics departments have stayed too long in the pasture of isolated abstract mathematics and failed to face the challenge of the changing maritime world.

8. CONCLUSION AND RECOMMENDATIONS

A good maritime educational package would contain a selection of mathematics, computing skills, and basic knowledge of physics, engineering, or other professional input. The job title in the industry is seldom that of a mathematician; it can be a researcher, an engineer, a system specialist, and development manager. The reality is that the maritime industry is as teamwork as industrial mathematics. Success stories are borne when specialists join their expertise and visions in a synergic manner. Teamwork makes communication skills a necessary matter. It would be imperative to train oneself and others to work in a project team, where interpersonal communication is continuously present. To become a well-applied mathematician, you should be curious about other areas of interest and learn basic facts from a few neighbouring areas outside mathematics. To tackle the fascinating tasks and challenges of developing questions in modern industry, the student needs a solid and sufficiently broad theoretical education and operational skills in the methods of applied mathematics. The most important single skill experience is modeling projects. The lectures, books, and laboratory exercises are necessarily the actual process of nurturing into an expert. With knowledge of mathematics, all related problems encountered can be solved or reduced to the barest minimum.

To successfully transfer mathematical knowledge to maritime disciplines, mathematical modeling must be crucial to the current educational challenges. Many departments should introduce mathematical modeling courses in the curriculum. A course in modeling may contain a study of maritime cases and solving exercises. The challenges and fascination are the students' exposure to open problems and addressing the questions arising from real maritime context. The real-world questions may be from the student's fields of activity, hobbies, as well as the professions of their parents. Developing a mathematically curious eye may produce an idea for a modeling exercise. A mathematical modeling course should:

i. Contain a collection of maritime case studies which can stir students' curiosity
ii. Indicate the diversity of maritime industries' problems and how to model their solutions.
iii. Ensure the development of models from simple maritime issues to more sophisticated ones
iv. Stress the interdisciplinary nature, teamwork aspect, and communication skills involved in mathematics
v. Tell about the open nature of the maritime problems and the non-existence of the right solutions
vi. Bring home the understanding of practical benefits in the usage of the models
vii. Tie together mathematical ideas from different earlier maritime-related courses
viii. Develop and generate mathematical simulations in maritime challenges.

The modeling courses should be in different forms. A traditional lecture course with weekly exercise sessions is a possibility. It would be important to implement a group work model and PC-lab activities in a maritime mathematics course. The most rewarding form might be projects and weekly sessions where the students report and discuss their work and progress on the problems. A very successful form and educational innovation is a modeling week and intensive problem-solving workshop.

The supply of good classroom examples and maritime case studies from different application areas is a factor in the development of attractive and inspiring educational modules in both applied and industrial mathematics used in the maritime industry. In the courses on mathematical modeling, we should need a flow of fresh problems to maintain an intellectual urge. It should be important to have ongoing contacts with different maritime sectors, professions, and diverse pockets of innovative processes. A new mode of assessment should be devised for the evaluation of students who make provision from regular face-to-face examinations to virtual forms of assessment that allow the learners to take examinations. Students are encouraged to give serious attention to their future. The maritime industry is competitive and requires a tool for a competitive career in mathematics.

9. REFERENCES

Adesina, S (1977).Planning and Educational Development in Nigeria Academy Press, Lagos.

Akakpo, G.S & Ngankan, T.M. (2015). A Mathematical Model for Analysis on Ships Collision Avoidance.

Alderton, P. M (2004). Reeds Sea Transport: Operation and Economics (5th edition). Thomas Reed Publications,

Bronson, R. (1983). Schaum’s Outline of Theory and Problems of Operations Research, McGraw-Hill Inc., Singapore.

Bureau of Labour Statistics (BLS) (2015). Employment Projections: 2014-24 Summary. Bureau of Labour Statistics, United States Department of Labour.

Cipra, D. (2004). Transportation Research Board, Washington, Dc,2004. Enhancing state and MPO transportation planning using National Household Travel Survey.

Davis, P.W. (1994). Mathematics in Industry: The Job Market of the Future, 1994 SIAM Forum Final Report, Society for Industrial and Applied Mathematics, Philadelphia, Pennsylvania

Dula, J. (2014). Application of Trigonometry in orthodromic Navigation, Bachelor Thesis, Split: University of Split, Faculty of Maritime Studies,

Evans, C,W. (1992). Engineering Mathematics. A programmed Approach,2nd edition, Imperial College Press, London.

Journal of Research in Education and Society
Volume 13, Number 2, August 2022
ISSN(p): 2141-6753 ISSN(e): 2795-3033
Published By
International Centre for Integrated Development Research, Nigeria
In collaboration with
Copperstone University, Luanshya, Zambia

Friedman, A. & Littman, W. (1994). Industrial Mathematics: A Course in Solving Real-World Problems, Institute for Mathematics and its Applications, University of Minnesota.

Glover, F., Klingman, D., and Phillips, N. (1992). Network Models in Optimization and Their Applications in Practice. John Wiley & Sons, New York.

Gouba, L. (2008). The importance of Mathematics in everyday life. African Institute for Mathematical Sciences, South Africa.

Gupta, B.D.(2003). Mathematical Physics, 2nd edition, Vikas Publishing House PVT Ltd, New Delhi.

Healy, L. & Hoyles, C. (2001). Software tools for geometrical problems solving: potentials and pitfalls. International Journal of computers for mathematics learning.

Healy, L. & Sutherland, R. (1990). Exploring mathematics with spreadsheets, Hennel Hempstead, UK, Simon and Schuster.

Heilio, M. (2004). Mathematical technology transfer-Industrial applications and educational programmes in mathematics. Lappeenranta University of Technology. Lappeenranta, Finland.

Ilori, S.A. & Akinyele, O. (1991). Elementary Abstract and Linear Algebra, Ibadan University Press.

Kneebone, G.T.(1963).Mathematical logic and the foundations of mathematics, An introductory survey, 1st edition, Dove Books on mathematics.

Monfardini, E., Probst, L., Szenci, K., Cambier, B. & Friderers, L. (2012). Emerging industries: Report on the methodology for their classification and on the most active, significant and relevant new emerging industrial sectors.

Nahmias, S. (2005). Production and Operations Analysis.5th Edition, Irwin McGraw Hill, Homewood IL.

Omotoso, O.O., Dunya, T., Ogbu, V.A., (2011), Introduction to Mathematics for Higher Institutions, Scientific Prints, Owerri.

Omotoso, O.O., Dunya, T., Abioye, A.I., (2014), Calculus and Basic Transforms for Higher Institutions, DAISOK Prints publication, Lagos.

Page, M.G. (1970). Mathematics for Mechanical Technicians, Macmillan Publishing Co. Inc., New York.

Ramana, B.V. ((2007). Applied mathematics, Tata McGraw-Hill Education.

Rappaz, M. (2003). Numerical modeling in materials science and engineering, Germany Springer-Verlag Berlin Heidelberg.

Ross, C.T. (1985). Finite Elements method in Engineering science, Athens, Ellis Horwood Limited.

Journal of Research in Education and Society
Volume 13, Number 2, August 2022
ISSN(p): 2141-6753 ISSN(e): 2795-3033
Published By
International Centre for Integrated Development Research, Nigeria
In collaboration with
Copperstone University, Luanshya, Zambia

SIAM (2016). Society for Industrial and Applied Mathematics (SIAM) Report on Mathematics in Industry.

SIAM (2012). Society for Industrial and Applied Mathematics (SIAM) Report on Mathematics in Industry.

SIAM (1996). Society for Industrial and Applied Mathematics (SIAM) Report on Mathematics in Industry.

Stafford, L. W. (1979).Business Mathematics, The English Language Book Society and Macdonald amd Evans Ltd., Plymouth.

Stecke, K.E. (2005). Using Mathematics to Solve Some Problems in Industry. University of Texas at Dallas, School of Management.