Maritime University Curriculum and Technology Planning for the 21st Century

Part II: Strategic Education Technology Planning

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ABSTRACT

The Maritime University administrator is faced with enormous challenges at the dawning of the 21st century. New simulators and laboratory equipment, obtained at high initial costs and requiring specialized maintenance and upkeep, become obsolete in only five years. Certification agencies "raise the bar", the standards for curriculum content and outcomes, seemingly every year. Students often come to the school with computer technology skills more advanced than that of their instructors. The most important, and arguably difficult, responsibility of the Maritime University administrator is to understand this environment and develop a comprehensive strategic education technology planning.

The timing and level of sophistication of new education technology is critical to assure the preparedness of students entering the maritime workplace. With every area of the global economy undergoing continuous technological innovation, increasing amounts of time must be devoted to tracking and trending a host of technology changes that might impact curriculum content.

Other emerging technologies promise advantages for the academy. Distance learning facilities increase the reach of isolated schools. On-line, interactive curriculum support systems increase student/faculty interaction and encourage idea exchange and team learning. Increasingly sophisticated simulator systems replace high-maintenance-cost hands on equipment.

This paper, Part II in a series, presents a new and unique solution in the form of a simple analytical tool, for Maritime University leaders to identify, assess, and then implement *only the most appropriate* technological opportunities.

1.0. Introduction

This paper describes an executive decision making tool developed and applied by the author in high-technology private industry. It has been adapted for the educational organization and herein is detailed its use for the maritime university or academy. The tool has shown excellent success helping leaders identify and select strategic initiatives for their organizations. The tool, a centerpiece for effective strategic education technology planning will help the maritime university officer sort through the often overwhelming number of technical and organization opportunities, or even threats, at hand, to achieve more consistent results and minimize over or under-investment in critical education resources.

2.0. Strategic Education Technology Planning

2.1. Technology Forecasting and Strategic Education Technology Planning

Strategic decisions involve forecasts. The better the forecast, the better chance of success of the strategic plan. Since coming into favor in American industries in the 1960's, strategic planning has focused mainly on financial scenarios and marketplace predictions. Over the last several decades, in response to and to stay ahead of the rapid change in technology across society, leading businesses and organizations have made strategic *technology* planning a cornerstone of their overall strategic planning effort. Leading educational institutions joined in the practice of drawing up strategic technology plans as computing, communication, and other technologies began to have a major impact, and portend drastic change, in education delivery and learning methodologies. Technology will be the principal driver of education change in the future.

The maritime university has had to keep up with technology change occurring throughout the maritime industry, from ship propulsion and operation technology to cargo handling facilities on to the logistic deployment of resources and transportation of goods. Now the academy must also keep up with technology change throughout the education "industry", from distance learning to on-line, interactive curriculum support systems on to increasingly sophisticated simulator systems. The "keeping up" promises to become more and more challenging with the current acceleration of industry and education technology change. New planning tools are required.

The drift and flow of technology change is a current to be reckoned with on the ocean of change on which the maritime university sails. The academy officer or executive must be able to forecast technological change and make sound decisions regarding the future course of the academy. Quantitative technology forecasting has been proven to be an excellent predictor of future technology performance and adoption times (Walk 2001). Technology forecasting thus is a critical part of strategic education technology planning and decision making for the maritime officer, and is a critical component of the decision tool presented in this paper.

2.2. Quantitative Technology Forecasting – An Introduction

Quantitative technology forecasting has been applied successfully across a broad range of technologies including communications, energy, medicine, transportation, and many other areas. A quantitative technology forecast will include the study of historic data to identify one of or a combination of several recognized universal technology diffusion or substitution trends. Rates of new technology adoption and rates of change of technology performance characteristics take on common patterns. The discovery of such a pattern indicates that a fundamental trajectory or envelope curve has been found and that reliable forecasts then can be made. These quantitative methods have proven accurate in predicting technology change in thousands of applications across technologies as diverse as carbon-based primary fuels to consumer electronics, on time scales spanning centuries or only months. Technology diffusion patterns and the driving social needs can be identified through study of historic, time-referenced data, from which the projection in time of new technology adoption can be determined reliably and accurately.

Several of the many techniques in quantitative technology forecasting are ideally suitable for projecting technological change in maritime education and training, and are introduced in more detail and illustrated in Part I of this paper series (Walk 2001).

2.3. Sample Impacts of Technology Forecasts in Strategic Education Technology Planning

The following are illustrative of the benefits and advantages of technology forecasting as an integrated part of strategic education technology planning.

2.3.1. Simulators

Simulators, the pride of many technical schools as icons of relevance in curricula, also signal the predictable end of a technology, arriving at schools late in the technology life stages. In a time of rapid technology substitution, simulators might not provide effective student career preparation as in the past.

2.3.2. Industry versus Curriculum Adoption Lag Times

The lag of the curriculum content adoption curve for a new technology is likely fixed soon after the up-tick of the logistic curve of a diffusing technology in industry. Measures of the lag-time of curriculum adoption following industry adoption might include counts of chapters in textbooks, market share or percent of curricula hours, etc.

2.3.3. Downward Diffusion of Laboratory Technology

There should be evidence of smooth downward diffusion of laboratory technology through the tiers of education – research university, second-tier universities, technical schools, high schools, etc. Such a forecast will help establish adoption times, and thus investment times, at the maritime university.

2.3.4. Substitution of Textbook Technology Subjects

Targeting and timing text and course content to a projection of technology performance level or adoption might help increase adoption rates of new technology in industry. Students would enter the workplace ready to manage the latest technology and be immediately productive, rather than being prepared only to operate declining or obsolete technology, and requiring unproductive on-the-job training to perform with new technology.

2.3.5. Invariants in Education Technology

The history of the adoption, and also the rejection, of new technologies in the classroom and in the field is evidence of anthropological invariants in what is commonly or collectively called education. What technology we require, or tolerate, in a classroom can be told by reading the tealeaves of accepted and rejected historic learning technology, helping us to avoid blunders such as huge investments in ineffective digital technology.

3.0. The Opportunity Wheel Decision Tool

3.1. Origins of the Tool

The author once served as Product Manager, a junior executive position responsible for a major product division of a leading international manufacturer of electronic instruments. The duties of the position included strategic planning for new products and services. Reporting directly to the position were development and design engineering staff, salespeople, and marketing managers. Indirect reports included manufacturing staff. The position held profit-loss responsibility and included serving on plant operating committees and the corporation strategic planning committee.

The product manager was at the center of new product technology initiatives and the person whom to contact if you had a new idea on an existing or new product. The author was besieged, and often under considerable pressure, to accept the ideas for product changes from all corners of the company. Sales people invoked the promise of extravagant revenues if only their idea was chosen. Marketers warned of competitive moves and championed their concepts of product morphology. Engineers had their pet exotic technologies they wanted to see integrated into the product line. Manufacturing was always conservative in regards to what, when, and how much they could and could not produce. And finance wanted guarantees of profit and high rapid return on investment or no money would be authorized for development.

Deciding on which new product or product improvement to follow posed significant challenges. Individually, each idea usually stood on its own merits, at least within the experience and world-view of the person suggesting the idea. The problems came when new ideas in one department conflicted with or simply did not fit within another department's outlook or realities. Sales wanted to sell something manufacturing couldn't make. Engineers wanted to design something marketing could not promote. And finance held out veto authority based on financial projections others either did not understand or did not believe. And so on.

This author had seen executives make poor decisions that wasted resources, talent, and capital pursuing "lop-sided" product technology opportunities that led to disasters. Lop-sided, that is, because though a product and its technology were outstanding in some aspects, they could be a disruptive or impossible task to the company in other aspects. Products went to market late; specifications changed time and time again; profits did not materialize. The sales department was driving engineering; marketing was driving production; finance was putting pressure on product management. Sometimes the new product or technology pitfalls were overlooked, other times the pitfalls were ignored, either way at serious peril to the company. It was often as if a ship's captain set sail solely because of strong winds at sea but ignored or overlooked the safety of the crew and the preservation of the cargo. The author saw executive ignorance, arrogance, and obfuscance in new product and technology development that wreaked havoc in the operation of previously well-managed companies.

To avoid the problems other executives had made and were making, the author developed a tool to evaluate new proposals and opportunities in a balanced fashion. Balanced, that is, across all the many constraints and capabilities of the company. The author led his reports in a process where new opportunities were scored on likely impact in eight major areas of the company. A new product would have to show promise of successful implementation everywhere in the company to be accepted for investment and development. People from different departments had to listen to each other's concerns, collaborate and achieve consensus on the benefit or advantage of a new technology. The politics of currying favor with the product manager to win approval of one's idea ended. Intimidation and rivalries at the planning meetings ceased when everyone had to understand everyone else's problems and solutions for a new opportunity to be accepted.

3.2. Using the Opportunity Wheel

The decision process is shown in Figure 1. The Opportunity Wheel is an arrangement of spokes about a hub. The spokes represent the major areas of the company involved in new product offerings; the hub is the new idea or opportunity. The major impact areas to be evaluated are Customers, Sales Channels, Technology Strategy (from technology forecasts), Competition, Profit, Product Portfolio, Skills/Resource Plan, and Production. Figure 2 lists the evaluation criteria used by the planning group to select or reject the opportunity.

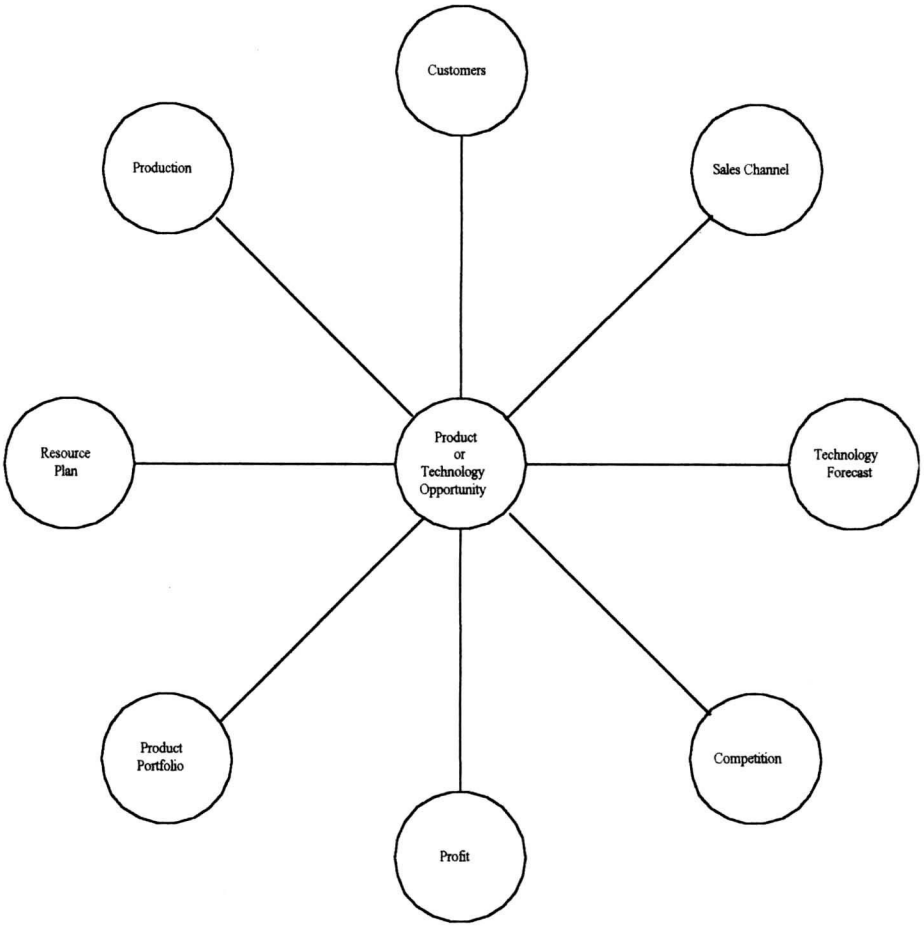


Figure 1. Technology Opportunity Wheel

The decision-making process procedure is as follows.

1. A new opportunity is written in the middle circle.
2. The evaluation team assigns a point value at each spoke based on criteria specific to that area
3. The scores are tallied for an overall score for the idea or opportunity
4. A passing score means a product development plan begins.
5. A failing score means the idea is rejected.
6. A marginal score means that low-value areas are reconsidered to see what changes can be made to increase the overall score of the idea.

The criteria are scored on a simple, three-value (0, 5, 10) point scale. Usually, "10's" and "0's" are quickly identified and consensus easily achieved. If the group is divided on a score, a compromise "5" is assigned and discussions quickly move on to the next impact area.

A high overall score, or O-score, in itself is not sufficient to "pass" the test. A new product or technology could score high in many areas and fail in several others. To select a "lop-sided" idea could spell disaster for the company as the zero-score areas face serious disruptions and fail to meet objectives. To avoid such problems, a new idea is rejected if it has two or more "0" scores. Also, the new idea must have at least 2 "10" scores to pass. It is no use pursuing mediocre (too few "10's") or risky (too many "0's") products or technologies.

3.3. Sample Application of the Opportunity Wheel

A high-tech company serving in the electric power industry was considering expanding their product offering to include on-line measurement systems replacing standard hand-held devices. It seemed to be the trend

in other industries and so made some strategic sense. The product manager, marketing manager, and technical specialists used the Wheel to evaluate the new product technology. The exercise resulted in the following:

Customers: (10) (Same customer base)
Sales Channel: (0) (Sales team technically inadequate)
Technology Forecast: (5) (Within forecasts)
Competition: (5) (Equal to the competition's recent initiatives)
Profit: (5) (Nominal profit expected)
Product Portfolio: (0) (All new concept)
Resource Plan: (0) (No proficient design engineers on staff)
Production: (5) (Require some modification of production facilities and supply chain)

Overall Score (30), with 1 "10" and 3 "0's"

The new product concept was rejected on account of a low O-score. With three "0's", it was decided that raising the overall score would involve considerable time and expense.

3.4. Advantages of Using the Opportunity Wheel in Strategic Planning

The list of advantages of using the Opportunity Wheel tool in strategic planning is long. To mention a few: The old politics of influence peddling, intrigue, and favoritism are replaced with an objective, consensus-based process, optimizing company investment and resources in future activities. Strategic planning documents are no longer filled with visionary language and wishful thinking, but contain valuable, realistic, doable plans. All new ideas are given full attention and evaluated using consistent criteria assuring all individuals that their ideas will receive equal due process in evaluations. After some experience with the Wheel, incomplete or otherwise poorly considered ideas don't even make it to the group for consideration. Everyone involved in the process learns to respect the expertise, experience, and opinions of others, to see other departments not as barriers to overcome but partners with whom to work together for success.

4.0. The Opportunity Wheel in Strategic Education Planning

4.1. Analogous Impact Areas for the Maritime University

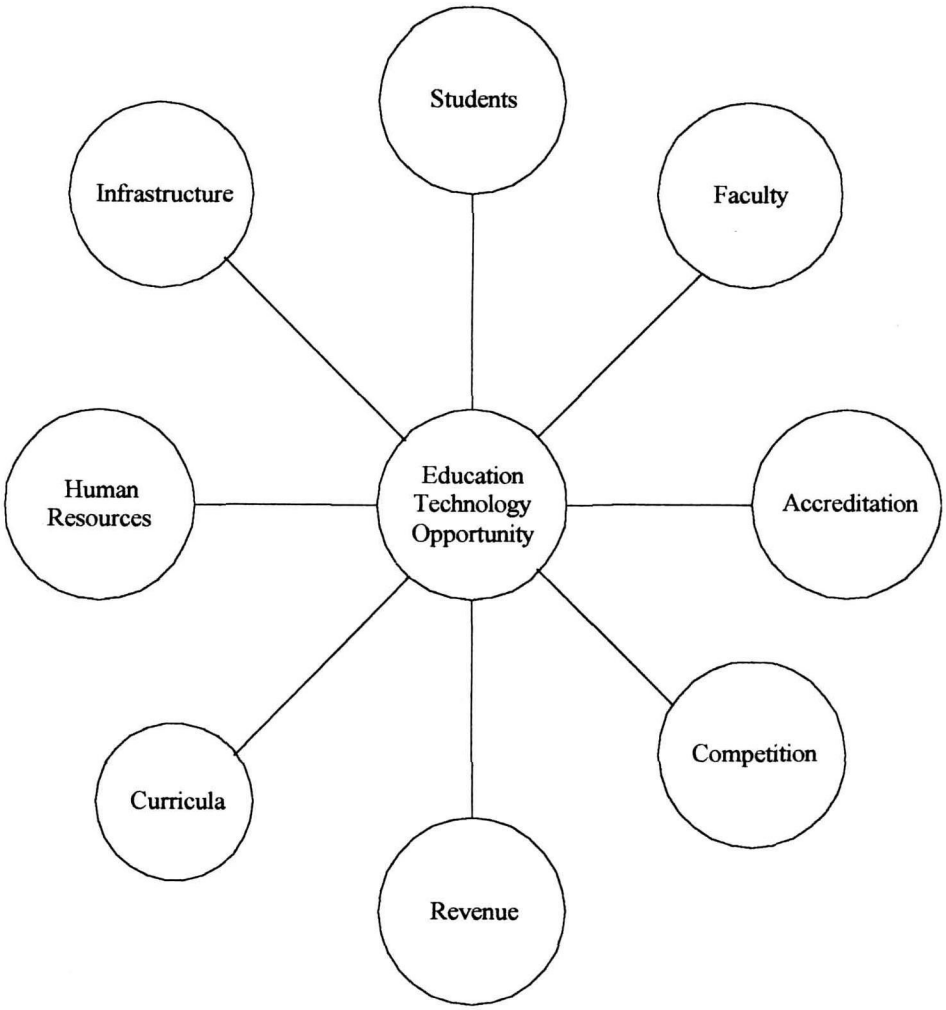
The Opportunity Wheel was adapted for the maritime university executive or officer and planning groups. See Figure 2. Appropriate impact areas are assigned to spokes that are closely analogous to business model impact areas. New evaluation criteria are adapted for the new scoring process, shown in Figure 3. The evaluation procedure and scoring remain the same (See Section 3.2.).

4.2. Using the Opportunity Wheel in Strategic Education Planning

The opportunity evaluation and decision-making are the same for the maritime application as described for the business or corporation. The maritime executive can bring his planning group or heads of departments together and perform an objective and thorough evaluation of new opportunities. The new ideas can be as simple as development of a campus on-line bulleting board to the consideration of a new curriculum targeting technology change in industry. The Wheel scales to all levels of decision making.

4.3. Sample Application from Maine Maritime Academy

In 2000, Maine Maritime Academy established the Center for Technology Forecasting, a research, teaching, and service center dedicated to furthering the science of quantitative technology forecasting, with a focus on the maritime industry and across the full spectrum of technological development. The program has been a success, meeting early goals of attracting students, working with other education institutions, providing consultation to local industries, and providing services to government planning agencies. How would the opportunity scored if the Opportunity Wheel had been available at the time the concept of a new center was being considered? Here is what might have been the result:



Impact Area	Comment
Students	Future recruits and possibly returning graduates
Faculty	To be directly and indirectly involved in new program or technology
Accreditation	Academic associations, standards boards, government agencies
Competition	Other maritime universities, other institutions, private companies
Revenue	Net annual or planning period income
Curricula and Education Technology	Courses, subjects, lab equipment, etc., and all learning technologies
Human Resources	Support personnel of all kinds
Infrastructure	Physical plant, education support resources, other assets

Figure 2. The Opportunity Wheel and Impact Areas for Strategic Education Technology Planning

1. Students
    a. Student opportunity not identified
    b. Significant advantage for many students
    c. All students advantaged
2. Faculty
    a. Little or no faculty interest, experience, or relevant teaching skills
    b. Of interest to some faculty willing to peruse the opportunity
    c. Of interest to nearly all faculty
3. Accreditation and Academic Mission
    a. Low probability of or negative impact on accreditation or licensing status
    b. No effect on academic standards requirements
    c. Enhances accreditation or licensing status
4. Competition
    a. No new significant edge over competing institutions
    b. Significant advantage over some competing institutions
    c. Significant advantage over competing institutions
5. Revenue
    a. No changes in revenue in the foreseeable future
    b. Some acceptable loss or a certain small gain in revenue in the short term
    c. Major probability of positive revenue change
6. Curricula and Education Technology
    a. Outside current curricula plans or education technology forecasts
    b. Adds to curricula plans or education technology forecasts
    c. Fits curricula plans or education technology forecasts
7. Human Resources
    a. Major new resources must be identified, acquired, and trained
    b. Increases workload of some resources, or train or add some new resources
    c. Present faculty, staff, and administrative resources are sufficient
8. Infrastructure
    a. Demands major infrastructure improvement
    b. Some infrastructure improvement required
    c. Infrastructure can accommodate change with minor impacts

Scoring: a = 0 points, b = 5 Points, c = 10 Points
Overall Score < 40 Points: Not an opportunity.
Overall Score = 40 Points: Possible opportunity. Consider ways to improve scores.
Overall Score > 40, with at least 2 10's and no more than 2 0's: Begin Strategic Plan.

Figure 3. Impact Area Evaluation Criteria and Scoring

Students (5)
Faculty (5)
Accreditation (5)
Competition (5)
Revenue (10)
Curricula and Education Technology (10)
Human Resources (10)
Infrastructure (10)

Overall Score (60), with 4 "10's" and no "0's"

This exercise indicates that use of the Wheel would have supported the decision to found the Center program, and would have served as a good indicator for the program's success. A score of 60 is not necessarily low. Experience has shown it to be rare that scores obtain above 60 in a new technology opportunity.

5.0. Advantages for the Maritime University Executive

The rapid changes taking place in the maritime industry organization, operations, and technology places demands on the leadership of the maritime universities to continuously track and update technologies and curricula of their schools. Whole departments or degree programs can begin and end in only several years. The maritime university executive ultimately is responsible for student outcomes, the measure of success of the maritime university's programs, measured largely by the value added in the application of new technology for the graduates' employers or in service in public organizations.

Private industry has found that the executive influence on the outcome of new product initiatives is highest at the beginning of the program. This concept is adapted for the maritime executive and illustrated in Figure 4. The ability to influence student outcomes is maximized at the earliest stages of new curriculum and education technology adoption. The rapid change of technology forces the maritime leaders to make the right choices up front of the new program process. There is little room for error in decision-making and little or no time available to redesign new education opportunities in today's rapid pace of technological change and in the competition to provide the highest quality students to the world's maritime labor markets.

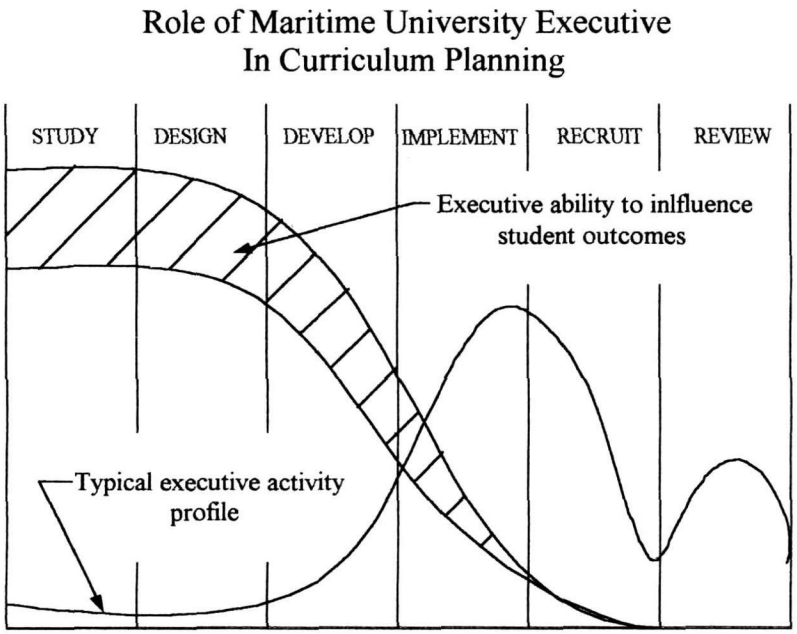


Figure 4. Students Outcomes and the Influence of the Maritime Executive (Adapted from Roussel, et al, 1991)

6.0 Conclusion

Technology will be the main driver of education change in the future. New tools are required to evaluate and select new technology in maritime education and training. The Opportunity Wheel is simple to use, encourages collaboration and cooperation across departments and divisions of the school, and brings new technology and other program ideas to full light and scrutiny by all those who would be impacted by their implementation. The tool can help reduce the risk of failure and help assure success of adopting new education technology or program changes. This new decision making tool will engage maritime university leadership at the very beginning of the strategic education technology planning process, at the optimal point of executive influence on student outcomes.

References

(1) Roussel, Philip A., et al (1991): *Third Generation R&D*, Harvard Business School Press.

(2) Walk, Steven R. (2001): Maritime University Curriculum and Technology Planning for the 21st Century, Part I: Projecting Maritime Education and Training Technology Needs Using Quantitative Technology Forecasting, 2nd General Assembly of IAMU, Hyogo, Japan.