

## Article

# Maritime Risk Research and Its Uptake in Policymaking: A Case Study of the Baltic Sea Region

Jens-Uwe Schröder-Hinrichs, Anish Arvind Hebbar \* and Anas S. Alamoush 

World Maritime University, SE 201 24 Malmö, Sweden; jus@wmu.se (J.-U.S.-H.); asa@wmu.se (A.S.A.)

\* Correspondence: ah@wmu.se; Tel.: +46-40-356-310

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**Abstract:** The literature on maritime risk management is rich and the findings are pertinent to maritime authorities in the Baltic Sea region; however, little is known regarding how much of the available research is actually utilized. This paper aims to evaluate the uptake of maritime risk research by maritime authorities in the Baltic Sea region and to propose recommendations for its improvement. An existing model to evaluate research uptake was adopted. The factors that could improve research uptake were identified and built into a framework of research institutions' push of research and its pull by the maritime authorities and industry. The level of research uptake and the utilization of push and pull factors were examined using an online survey questionnaire and in addition, policymakers and researchers were engaged in a workshop to identify the best practices and opportunities for research uptake in the Baltic Sea region. The results show that the overall research uptake level is reasonably good, although factors that increase research utilization are not wholly taken up. Policy recommendations are provided to improve research uptake and science communication. The emergent framework of improvement factors and best practices should serve as a guide to policymakers and researchers to optimize the uptake of research, regardless of discipline.

**Keywords:** research uptake; policy; policymaking; policy process; knowledge utilization; risk

## 1. Introduction to Maritime Risk Research and Its Role in Policymaking

Maritime transportation is the lifeblood of the global economy but burgeoning shipping traffic [1] exposes coastal states, including those in the Baltic Sea region (BSR), to the associated risks of collision, grounding, and oil spills [2], entailing potential risks to society, impacting the economy [3], environmental safety, and ecosystems [4], besides exerting pressure on its sensitive marine environment [5].

Numerous factors influence shipping accidents such as the traffic type [6], operational problems [7], weather conditions [8], and regulatory issues [9]. An increase in shipping traffic leads to an increase in accidents [10], and there is no visible decrease in this trend [11], particularly in confined sea areas with dense traffic such as the BSR with attendant environmental concerns [12]. Maritime risk research has tried to keep pace and progressed in two interconnected approaches, safety of navigation or prevention of shipping accidents, and preparedness and response to incidents [13].

Maritime risk research for prevention includes analysis of ship collisions and accidents [14], waterways risk assessment [15], risk of ships grounding [16], probability of collisions [17], analysis of the risk of ship collision based on Automatic Identification System (AIS) [18], etc. AIS data are particularly explored as a surrogate indicator of accidents to develop the rate of traffic conflict [19], near miss [20], near-collision [21], collision candidate [22], and critical encounters [23].

Research products for ships related to accident prevention decision support systems (DSS) include real-time collision avoidance [24], computation of hull loads and damage [25], ice navigation planning [26], handling Not-Under-Command ship [27], cargo handling and stability [28], and voyage

optimization in different weather conditions [29]. Within the domain of maritime risk response research is the OpenRisk Toolbox [13] developed by HELCOM through a project involving research collaboration among universities in the BSR. The toolbox is a collection of methods and tools for performing a risk assessment of oil spills at sea with guidance on procedures to implement it in organizational processes and stimulate regional cooperation.

Oil spill response DSS research for use by maritime authorities comprises Bayesian Networks to assess oil spills [30], SmartResponse Web which simulates the atmospheric forces that drive the oil spills [31], the Next Generation SmartResponse Web for winter maritime transport [32], and Seatrack Web, the HELCOM drift model for forecasting [33]. Typically, states act through their maritime authorities to assess the identified risks, implement preventive actions to offset the risks, and prepare a response to minimize the consequences dependent on common sense, institutional memory, practical knowledge of experts, standards, and regulations [13].

The Convention on the Law of the Sea 1982, the Convention on the Safety of Life at Sea, the Convention on the Prevention of pollution by ships 1973/1978, and the Oil Pollution Preparedness, Response, and Cooperation Convention 1990 are examples of treaty instruments by states to ensure the safety of maritime shipping and protection of the marine environment at a global level.

Examples of the states in the Baltic Sea region (BSR) acting through the International Maritime Organization for regulatory response to risk, supported by relevant research, include the designation of the Baltic Sea as a Particularly Sensitive Sea Area, providing enhanced environmental standards for ships transiting the BSR [34], and the establishment of the Mandatory Ship Reporting System in the Gulf of Finland [35] to enhance maritime safety.

Thus, it may be said that maritime transportation, maritime risk research, and policy addressing maritime risk follow each other, so to say, in a ceaseless cycle.

To address the maritime risks, academic research has comprehensively developed approaches, frameworks, risk management tools and methods, models, and simulations that aim to identify, evaluate, and propose solutions, ultimately presenting evidence which could serve as a guide for policymakers and the industry.

However, utilization of knowledge in policymaking is determined by the structure and characteristics of policymaking, and research is only one among its many components of information and beliefs [36]. It is, therefore, vital to link policymakers with pertinent research. Knowledge from research not only enlightens policymakers but also challenges their underlying assumptions and methodical ideas that constitute policy decisions and infiltrates the policy process in ways that would change decision-makers' perception of concurrent issues [37]. Knowledge from research improves decision-making and increases policymakers' confidence to select what works and what does not under different circumstances [38]. Knowledge stemming from research evidence provides decision-makers with ample background ideas, concepts, and information that widens their understanding of the policy domain [39,40].

However, a perception prevailing for quite some time is that policymakers may not be utilizing academic research [39,41,42]. Huberman [43] argued that research is not used as often as a can opener is used, and Daviter [44] suggested that the role of knowledge in the policy process remains a central theoretical puzzle with an ever-increasing volume of policy-relevant evidence being produced and disseminated, while research knowledge rarely enters the decision-making realm.

Scientific evidence and knowledge are imperative for maritime policy. Apparently, there is an enormous reservoir of research results; however, the uptake of research is a matter of concern. Therefore, we argue that while policy-relevant knowledge exists, the question is to what extent maritime administrations utilize maritime risk research to fill policy gaps, solve problems, or choose among alternatives.

To assess the uptake of maritime risk research, this paper aims to answer the following three questions:

- (a) What is the level of uptake of maritime risk research in the BSR maritime authorities?

- (b) What are the factors, in the literature, that improve research uptake and science communication?
- (c) What is the extent to which the identified factors govern research uptake and science communication in the BSR? What are the best practices of research uptake in the BSR?

The remainder of the paper is organized as follows. In Section 2, we introduce the theoretical background of research uptake and the improvement factors framework. Section 3 describes the materials and methods. Section 4 discusses the results of the questionnaire and the workshop, and in the final section, Section 5, we present conclusions and recommendations.

## 2. Literature Review on Assessment of Research Uptake

The theoretical understanding of research uptake is essential to any discussion on its assessment. Our review of the literature yielded several viewpoints of research uptake—as utilization of scientific and technical knowledge by decision-makers and those in professional practices [42]; an iterative rolling procedure that calls for active participation of both the researcher and end-users of the research [45]; and a process connecting and transferring research to policy, and getting research into policy and practice [46]. Broadly viewed as a process rather than as a discrete event that happens at a specific time [47], research uptake is believed to occur over the long-term with the accumulated result exerting influence on policymaking [38].

While several studies have attempted an explanation of the research utilization process, studies, e.g., [42,43,48–50], conceptualized four possible models for the utilization of social science in the policy sphere—the knowledge-driven model, where research findings drive policies; the problem-solving model, where research result can sort out users' problems; the interactive model, where policy dynamics are interconnected with the researcher (research to policy); and the political model, where interests predetermine policymakers' stance toward research. Nutley et al. [51] identified two distinct processes of research utilization—research into practice and research in practice.

### 2.1. Assessment of Knowledge Utilization

One of the key elements in this research is to identify the level of uptake of maritime risk management research by maritime authorities in the BSR. A key question in this context is whether the literature provides guidance on assessment of research utilization and if so, what are the suggested approaches to assessment. Our review revealed that various scales and indices have been proposed to measure the utilization of knowledge, such as Hall's scales [52,53], the Johnson scale [54], and the Pelz and Horsley research utilization index [55]. Rich and Oh [47] recommend multiple dimensions and multiple measures for knowledge utilization.

The Knott and Wildavsky [38] model stands out because of its relative simplicity and goes beyond the mere conceptual or instrumental focus of the other approaches. Besides, the model was frequently cited and utilized in different studies, e.g., [56–58], including the utilization of social science research in Canada [59] and the utilization of university research in governmental agencies [60].

The Knott and Wildavsky scale envisages six stages, beginning with reception through cognition, discussion, reference, and effort until the last stage, influence, where the research influences the policymaking process (Table 1). The scale is cumulative in the sense that cognition builds on reception, discussion on cognition, and so on. It has also been argued that the model not only captures the degree of utilization of research but also its influence on policy [57] and in capturing the current utilization of research behavior in six different stages, the model eliminates the bias that comes from respondents memory, as they may not be able to single out a study which impacted their practice of knowledge utilization, and also because of the fact that any given policy will not necessarily be based on one single study [60]. It was, therefore, apt to choose to utilize the Knott and Wildavsky model in our research.

**Table 1.** Stages of knowledge utilization.

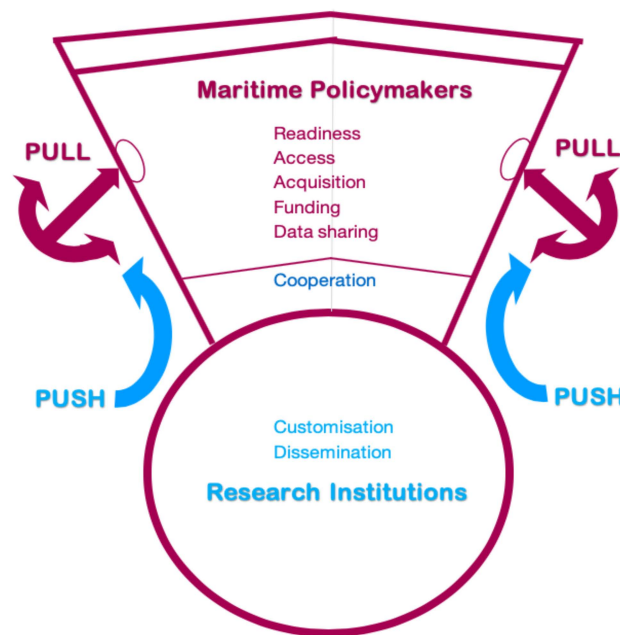
Number	Stage	Meaning
1	Reception	Relevant research is received by users such as policymakers, means that it arrives at the desk of the users
2	Cognition	Users read and understand the relevant research
3	Discussion	The recipient of research discusses the importance of research with peers
4	Reference	The research is preferred by users and, therefore, they cite it in their work reports or documents
5	Effort (adoption)	The users of research are influenced by the research information and, therefore, exert efforts to adopt it into their decisions or policies
6	Influence	The research results are input in policy processes in a way they would influence decisions

Source: Knott and Wildavsky [38].

## 2.2. Assessment of Research Uptake Influencing Factors

While the Knott and Wildavsky scale may be described as an effective indicator of the level of the uptake of research, the literature is replete with attempts to integrate and categorize the different factors which contribute to the improvement of uptake [42,61–63]. Using prior studies as a basis, Landry et al. [59] categorized factors that influence research utilization into science push variables, demand-pull variables, dissemination variables, and interaction variables. Hanney et al. [64] identified factors that affect the extent of research utilization in policymaking such as models of policymaking, categories of research, and the interface between research and policies. Lavis et al. [65] classified factors of utilization as instrumental, conceptual, and symbolic. Landry et al. [60] further categorized the factors into engineering (e.g., the study type), organizational (e.g., the relevance of the research), bipolar community (e.g., the interaction between the researchers and policymakers), linkage mechanisms (e.g., partnerships), and individual attributes (e.g., the educational level of research users).

Viewed broadly, these varied interpretations of improvement factors are suggestive of a two-way classification with the policymakers or end users on one side and researchers on the other. Based on a synthesis of the literature, we distil the research uptake influencing factors into two categories—the maritime authorities' pull factors and the research institutions' and researchers' push factors. Common to both push and pull is the key attribute, partnership and cooperation, between the authorities and research institutions. The two-way framework, as depicted in Figure 1, is highly interactive. Pull is an essential component because without efforts from maritime authorities to acquire research, uptake would be rare and no further knowledge would get across. Push, on the other hand, represents behavioral efforts of research institutions to communicate their results. A discussion on each of the categories and the improvement factors ensues.



**Figure 1.** Research uptake push and pull improvement factors.

### 2.2.1. The Push Factors of Research Uptake

The research institutions' push factors are discerned to include adaptation and customization of research, dissemination efforts, and partnership and cooperation between maritime authorities and industry.

Firstly, it has been suggested that research utilization increases when researchers focus their research on users' needs by making it pertinent to the objectives pursued by the industry and authorities [49,60,66,67]. Adaptation of research requires gaining knowledge about authorities and the industry's needs and objectives [68] by contacting and inquiring from authorities about issues and problems that require solutions [64]. Customization of research comprises of simple actions such as including policy recommendations in research findings [69–71], and summaries and priorities in a format that is easy to understand, showing relevance and applicability to policymakers and the industry [72,73].

Secondly, facilitation, sharing, and communication of research evidence and findings are vital in policy advocacy [72]. Research findings, if not disseminated enough, would make no impact on policymaking [74]. Hence, researchers should endeavor to extensively disseminate research results to potential users [59]. Examples of possible efforts for research dissemination include sending tailored, targeted messages to policymakers about new evidence from research in their domains, which might be useful in policy and program development [62,75] or one research institution, either individually or in cooperation with others in a research network, synthesizing the research findings in a particular field such as maritime risk and disseminating them on a periodic basis [76,77].

Thirdly, lack of interaction between researchers and their potential recipients has long been recognized as a cause for the underutilization of research [43,62,63]. It is suggested that the more sustained and intense the interaction between researchers and potential users is, the more likely it is utilization will occur. The interaction would be advantageous if it happens throughout different stages of knowledge production, dissemination, and utilization [60]. The ways available to research institutions to improve the linkages include conducting of seminars, conferences, or special events to interact and connect with maritime authorities and industry [78,79] and availing opportunities to appraise the stakeholders about relevant research, and in the process, building lasting relationships founded on trust [72] and, possibly, collaborative research partnerships [80].

### 2.2.2. The Pull Factors of Research Uptake

The maritime authority and industry pull of relevant research is discerned to comprise of six factors—authorities' readiness to receive research, access to research, acquisition efforts, partnership and cooperation with research institutions, funding of research, and sharing of data with researchers as discussed below.

Firstly, some organizational cultures inherently support the use of research [75]. Regardless, the different practices to improve the authorities readiness to receive and use research include training of staff and employees to value, read, interpret, and appraise research [73,81,82], providing incentives to employees who bring value from research to better implement policies [73], and employing staff that are experienced in both policymaking and research, as they would have a better understanding of policy-relevant research [83,84].

Secondly, provisioning and maintaining adequate access to research to keep staff and employees updated on current research could be achieved in several different ways. One possible way is to buy a subscription to digital libraries, databases, and research summaries to sustain access to research [79,85] or simply designate an expert employee to identify and collect research [86]. Alternately, the authorities could engage a research broker or intermediary who can widen the access and use of existing relevant research knowledge [71,72], besides helping in the formulation of the research question and passing them on to researchers, although this may require policymakers to ensure that the brokers are independent and there is no conflict of interest among stakeholders [86–88].

Thirdly, further to research access, the authorities' efforts to acquire research by various means is a vital step in research uptake. Acquisition efforts could involve the purchase of relevant journals and making them available to the concerned staff [89,90], so that they have visual and hands-on material in the relevant fields. Additionally, website download of free access research [90] has been cited as an easy way to make relevant research readily available to staff and employees.

Fourthly, keeping continuous and up-to-date relationships and partnerships with research institutions and researchers are vital pathways that lead to the engagement of authorities with researchers. Just as research institutions do, authorities could hold workshops, conferences, and special meetings with researchers to strengthen cooperation and partnerships, seek appraisal of recent research findings, share research needs, and promote contribution of researchers in policymaking [85,90,91]. Further, individual staff members could be encouraged to exert efforts to establish personal contact with researchers and research institutions [60,78] for organizational benefit.

Fifthly, funding-required research facilitates increase in research uptake [72]. It has been observed that researchers are more sensitive to the needs of funders outside the academic domain and that funded research projects stimulate researchers to answer specific questions and solve problems within the funder's area [42,59]. Moreover, the organization that contributes to the cost of research promotes the relationship with research institutions or researchers [92].

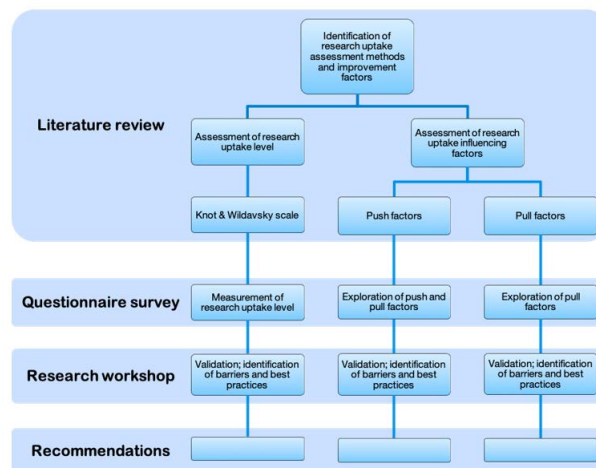
Lastly, when researchers and research institutions have the opportunity to use the local data of authorities and industries in their studies, the results are that much more relevant and of greater benefit to the authorities in policymaking [87,93].

## 3. Material and Methods

### 3.1. Data Collection

The conceptual framework for examining research uptake is presented in Figure 2. From the literature, we identified the Knott and Wildavsky method to be best suited for assessment of research uptake, and the improvement factors discerned were conceptualized into research institution push and maritime administration pull factors. The methodology for data collection comprised of a stakeholder workshop and a survey using an online questionnaire.





**Figure 2.** Research conceptual framework.

The survey questionnaire was administered via an email to 88 potential respondents. The survey population comprised policymakers, maritime authorities, and the shipping industry in the BSR. All the workshop participants from maritime administrations and industry were administered the questionnaire. Additional participants were approached by consulting websites of maritime authorities and industry, and researchers' experience in the field. A cover letter appraised the respondents of the purpose of the survey, sought explicit consent, and assured anonymity of data and confidentiality of personal information. As such, this might have influenced the respondents' answer; however, in various questions, respondents were given closed and open-ended questions as 'other' or 'give an example to support your answer', to limit this possibility. Three weeks after the first email, a reminder was sent seeking a response to the questionnaire. Thirty quality responses were received, representing 34% turnover. We did not conduct non-response bias, since all the respondents answered after the email was sent. Although the sample size is limited, considering the diverse level of management, country of origin, and engagement of respondents in policymaking, the sample is considered consistent with other exploratory studies in the discipline.

The questionnaire contained 20 key questions in three sections—one section applied the six stages in the Knott and Wildavsky [38] model to examine the level of research uptake, questions in another section examined the research uptake pull factors related to maritime authorities, and the final section explored the research institutions' push factors to communicate science to authorities. It should be noted here that we examine if research institutions push research to authorities from the authorities and industry experience side only because we only sent the questionnaire to the maritime authorities and industry. All questions were based on a Likert scale which ranged from Do Not Need or Do Not Apply (0), to Never (1), Rarely (2), Sometimes (3), Often (4), and Always (5). Four questions which had multiple item questions were tested for internal reliability by calculation of Cronbach's alpha [94]. The results were reliable for all the four multiple-item questions i.e., the six-item questions of the Knott and Wildavsky scale (0.91), the scale having already been tested and resulting in internal reliability by [59,60]; the two-item questions on cooperation in pull factors (0.89); the three-item questions on access in pull factors (0.62); and the two-item questions on cooperation in push factors (0.80).

Further insights were gained from a one-day workshop entitled 'From research to practice' held at the World Maritime University (WMU) in Malmö, Sweden on 19 December 2019. Researchers from research institutions and policy makers from maritime administrations and regional organizations were key participants of the workshop, besides representatives of the industry and international non-governmental organizations. The focus of the workshop was to identify the best practices for the uptake of maritime risk research by maritime authorities in the BSR, industry and research institutions, and barriers and opportunities to improve research uptake. The qualitative data gleaned from the workshop are linked within the results and discussions of questionnaire.

### 3.2. Descriptive Statistics

In the questionnaire survey, we received a total of 30 responses. Respondents represented six of the eight BSR countries, i.e., Denmark 13%, Estonia 7%, Finland 17%, Latvia 23%, Poland 17%, and Sweden 13%, besides 10% from international non-governmental organizations, such as BIMCO and the International Council for the Exploration of the Sea. Overall, maritime authorities made up 63.3% and the industry respondents, mainly from shipping and intergovernmental organizations, accounted for the remaining 36.7%. As regards the respondents' managerial level, top management comprised 30%, middle management 23.3%, and operational level 46.7%. In terms of length of experience in the maritime sector, 20% of the respondents had more than 21 years of experience, 33.3% had 11–20 years, 23.3% had 6–10 years, and 23.3% had 1–5 years. This fusion of management levels and varied experience resulted in forming a largely well-rounded view on the varied perceptions of research uptake.

In the stakeholder workshop, we had a total of 25 participants. On the push side, we had 14 researchers from eight research institutions in the BSR—Aalto, Helsinki, Tartu, Hochschule Wismar, Gdynia Maritime University, the Nautical Institute, Chalmers University of Technology, and WMU. The pull side was represented by 11 policymakers from BSR maritime authorities and industry namely, Swedish, Danish, Latvian, and Finnish maritime authorities, HELCOM (via video message), the Swedish Shipowners Association, the International Chamber of Shipping (ICS), the International Council for the Exploration of the Sea (ICES), BIMCO, and the Maritime Safety Unit in the Directorate General MOVE of the European Commission.

## 4. Results and Discussions

### 4.1. The Push Factors of Research Uptake

We examined the research uptake push factors relating to research institutions and researchers in terms of adaptation and customization of research (adaptation), dissemination efforts (dissemination), and partnership and cooperation (cooperation). Table 2 presents the questionnaire results and the frequency distribution of push by research institutions to communicate research.

**Table 2.** Frequency distribution of push factors.

Pull Factors	Don't Apply Don't Need (0)	Never (1)	Rarely (2)	Sometimes (3)	Usually (4)	Always (5)
Adaptation	20%	30%	30%	17%	3%	0
Dissemination	20%	33%	38%	3%	3%	0
Cooperation	15%	11%	28%	36%	10%	0

From the frequency of responses in Table 2, it is observed that the push from research institutions towards maritime authorities and industry is rather low. However, good cooperation prevails between research institutions and the authorities. Forty-six percent of the respondents confirmed cooperative engagement through mutual participation in maritime risk seminars, workshops, and conferences on a usual or occasional basis. Cooperation in policy-relevant research is not well practiced. Fifty percent of the survey respondents had never or rarely engaged in policy research, a fact validated and highlighted as a barrier by policymakers attending the workshop. Among the key concerns were non-inclusion of policy makers in the research making process of research institutions, insufficient efforts for transfer of knowledge from maritime research institutions to authorities and industries, and researchers' focus on producing research regardless of the level of uptake, all of which were believed to be leading to a weak implementation of the theoretical knowledge produced, despite its excellent potential. Researchers at the workshop, on the other hand, observed that they were lacking the required feedback on the extent to which authorities and industry value and utilize the research.



Regardless, it emerged from the workshop that cooperation, as the best practice, is manifested by HELCOM and Gdynia Maritime University (GMU). The university is represented as a member in committees and subcommittees at the International Maritime Organization (IMO) and is a member in government committees and boards in Poland. GMU cooperates with the Polish Maritime Administration and, for example, conducted navigational analysis for Polish ports. GMU has also established cooperation with the Polish Register of Shipping (PRS), a classification society, so that students can apply the academic results of the software developed at the university. The HELCOM project platform policy workshop at the Second Shipping and environment Conference in Gothenburg, Sweden in 2019 was cited as another example. The workshop further identified topics such as discharge of scrubber wash water, onshore power supply, and antifouling paint issues as requiring urgent research to support clean shipping and policy making in the BSR.

From Table 2, secondly, we observe that research is not quite adapted to respondents' needs, given the fact that 60% never or rarely received research adapted to their needs and only 17% stated that research is sometimes adapted to the work they pursue. Thirdly, dissemination efforts are inadequate since 68% of respondents never or rarely receive research summaries, news briefs, or relevant information about current maritime research results. We classify both adaptation and dissemination as barriers to research uptake. Overall, the research institutions' efforts to communicate research to authorities and industries by customizing and adapting research to their objectives and practicing dissemination tools are insubstantial.

In the workshop, policymakers elaborated on the adaptation and dissemination barriers. In their opinion, research results do not always meet the expectations of authorities and the industry. Research is not customized to policymakers' needs and the variety of scientific tools, models, and results could be overwhelming. Furthermore, policymakers often require solutions in shorter times, while research typically takes longer. Research usually gives solutions but hardly ever on how to implement. Often, the ideas and solutions are required to be dealt with by new research. Researchers do not always conclude the final bit of work, whereas stakeholders always require a conspicuous final solution.

Notwithstanding the low dissemination, the workshop identified the best practices at GMU, BIMCO, and HELCOM. GMU conducts peer-to-peer meetings, local workshops, and conferences to communicate science, e.g., Transnav: The International Conference on Marine Navigation and Safety of Sea Transportation. Although not an academic institution, BIMCO as a front runner in the shipping industry translates some of their projects' outcomes into other languages. Part of the work under the efficienSea2 project is translated into Chinese and shared with shipbuilders. Further, BIMCO has shared both Smartship and Sea Traffic Management project results with other stakeholders. HELCOM has created 'project platforms' to better disseminate science from projects to stakeholders effectively using policy papers for the purpose. One specific example is the CSHIPP project (clean shipping platform), which synthesizes results and brings science into policymaking.

#### *4.2. The Pull Factors of Research Uptake*

The maritime authorities' efforts to utilize research were explored in terms of their readiness to receive and use research (readiness), access to research (access), acquisition efforts (acquisition), partnership and cooperation (cooperation), funding or co-funding research projects (funding), and sharing of local data with researchers (sharing data). Table 3 presents the results of the questionnaire survey of the pull efforts by policymakers.

Overall, the pull efforts exerted by the maritime authorities and industry are very modest. Low values of pull were recorded across all factors in the "always" and "usually" categories and at the same time, significantly high values were recorded in the "never" and rarely" categories in the key pull factors.

To investigate readiness to receive research, we examined provision of training courses to authorities on research appreciation and 73% stated that they never or rarely received training. For policymakers to access research, their work should provide subscriptions to databases and libraries,

or a person designated to appraise maritime risk research unless knowledge brokers are appointed to increase access to research. Only 21% of authorities and industry have requisite access to relevant maritime risk research. The subscription does not include databases but is limited to monthly magazines and, consequently, downloading is limited to open-access articles, notably from Elsevier and Google Scholar. FleetMon and Marine Insight are popular websites for referral, and LinkedIn as social media.

**Table 3.** Frequency distribution of pull efforts.

<b>Pull Factors</b>	<b>Don't Apply Don't Need (0)</b>	<b>Never (1)</b>	<b>Rarely (2)</b>	<b>Sometimes (3)</b>	<b>Usually (4)</b>	<b>Always (5)</b>
Readiness	10%	43%	30%	17%	0	0
Access	23%	38%	18%	9%	6%	6%
Acquisition	13%	20%	36%	14%	14%	3%
Cooperation	11%	15%	22%	32%	17%	3%
Funding	23%	10%	7%	43%	10%	7%
Sharing data	13%	3%	10%	53%	21%	0

Inadequacy of readiness and access to research were identified as barriers in the workshop too. Policymakers suggested a lack of capacity in terms of resources, tools, time, and knowledge to read scientific papers and participate in scientific seminars. Furthermore, staff lacked awareness and experience about current research and maritime administrations required funding to address such issues. Evidently, government priorities preceded research uptake issues.

Acquisition efforts to own research results by different means, such as purchase of relevant maritime risk research articles, are limited, with only 31% of the surveyed authorities indicating that they procure maritime risk articles at least sometimes, or more often. The workshop revealed two examples of the best practices of acquisition efforts. The Danish Maritime Authority (DMA) frequently acquires research from the University of Lund and employs maritime risk prevention research through training to ship surveyors and regulations developed for passenger ships. The Swedish Shipowners Association engages with research in four areas, namely, ships digitalization and automation, design and technology, behavioral improvement, and competence in shipping industry.

The questionnaire survey revealed that 17% of authorities and industries usually, and 32% sometimes, cooperate with research institutions through mutual participation in conferences, which reportedly opens a window for discussions about relevant research in addition to promoting contact with relevant researchers. The workshop identified the two best practices of cooperation. First, the Finnish Transport and Communications Agency (TRAFICOM)'s collaboration with research institutions, including Aalto University, Helsinki University, Turku University, Technical University of Tampere, Finnish Meteorological Institute, and Technical University of Tampere. Second, the Swedish Shipowners Association's newly founded collaboration between the Finnish and Swedish maritime clusters to take steps toward green, safe, and smart shipping in line, with which conferences were held to communicate knowledge and best practices and strengthen collaboration among politicians, industry, academia, and authorities.

Funding of research appeared to be an established practice for authorities with 53% of survey participants funding research, at least sometimes, to mitigate problems in their field. However, these projects are often not linked to scientific issues and, therefore, do not result in an associated research paper. The workshop identified several best practices. TRAFICOM subcontracts required research for timely solutions. The Swedish Maritime Authority participates in funding and has been involved in research projects such as the Automatic Identification Systems, polar research, STM BALT SAFE, MONA LIZA, and FAMOS. DMA subcontracted research on emerging issues in autonomous shipping to the Technical University of Denmark, CORE law firm, and FORCE Technology Institute. In addition, DMA is frequently a partner in research projects e.g., the ShippingLab innovation project,

which aims to build Denmark's first autonomous ship, and the accidents-at-sea issues project with the Centre of Maritime Health and Society at the University of Southern Denmark.

Finally, as per the survey, sharing of data with researchers for academic research depended on the type of data requested, i.e., whether they are standard public data or confidential, and 21% usually and 53% sometimes provided the requested data. At the workshop, academic researchers reported hardships in acquiring primary and secondary data from the industry and authorities and, consequently, it is hard to validate and confirm research results. Further, researchers stated that the industry and authorities remote themselves from academia when it comes to sharing data and that it is difficult to approach experts in the field and obtain the required data and relevant information.

#### 4.3. Assessment of Research Uptake Level

Participant experience and engagement with maritime risk research was measured over six stages of research utilization as per the Knott and Wildavsky [38] scale modified by Landry et al. [60], as shown in Table 4, emphasizing in the questionnaire that research includes scientific journals, articles, technical magazines, governmental studies, and books. Table 5 presents the findings of the assessment of research uptake. The results of the individual stages are described below. As expected, no respondent indicated the option "always" in any stage of research uptake.

**Table 4.** Research uptake assessment stages and questions.

Uptake Stages	Question
Reception	I receive the maritime risk research relevant to my field
Cognition	I read and understand the relevant maritime risk research
Discussion	I discuss research findings with my peers
Reference	I cite the maritime risk research as references in my own professional reports
Efforts	I make efforts to adopt the maritime risk research results in my work decisions
Influence	The research on maritime risk influenced the policies in my administration

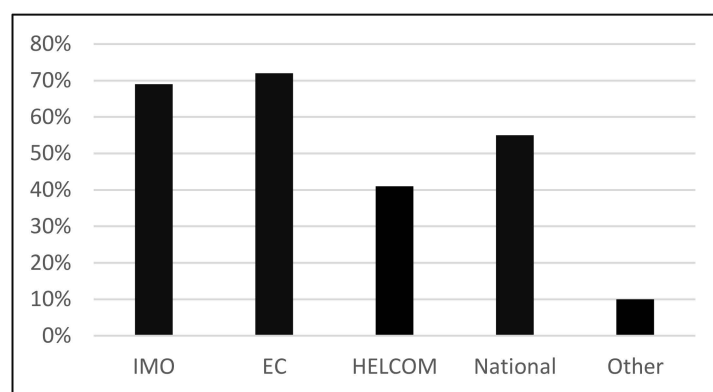
**Table 5.** Frequency distribution of stages and level of the uptake.

Uptake Stages	Don't Apply Don't Need (0)	Never (1)	Rarely (2)	Sometimes (3)	Usually (4)	Always (5)	Index Mean
Reception	0	3%	24%	60%	13%	0	2.6
Cognition	10%	7%	17%	43%	23%	0	5.1
Discussion	7%	10%	23%	43%	17%	0	6.0
Reference	17%	17%	27%	30%	10%	0	9.5
Efforts	10%	13%	23%	37%	17%	0	11.3
Influence	10%	10%	30%	43%	7%	0	9.20
Uptake level							41.6%

Reception of research appeared to be high, as 73% of respondents receive at least some form of maritime risk research. Conversely, 27% of respondents never and rarely receive research. Participants who replied in the affirmative were further required to indicate if the source was the International Maritime Organization (IMO), European Commission (EC) such as EMSA, Helsinki Commission (HELCOM), or national resources, and give examples if national or any other sources of research were utilized. Figure 3 indicates a high reception of research by survey participants from both EC and IMO, around 70%, and a relatively lower 40% from HELCOM. National sources, for 65% of participants, include government reports, transport administration research project results, and research by national maritime universities, e.g., Maritime University in Gdynia and Maritime Academy in Szczecin in Poland, Aalto University, the University of Helsinki and the University of Turku in Finland, and Danish Universities. We observed here that policy received from IMO, EC, and national agencies prevails over university maritime risk research, indicating that academic maritime risk research is not highly received, especially from international universities which found no mention. This result ties in with

the finding of low dissemination efforts from research institution to authorities, and the relatively low acquisition efforts from the maritime authorities.

Cognition is key to research uptake. Only 23% of the survey participants usually understood the research they read, whereas 43% sometimes understood and 22% never or rarely understood the research they received, particularly when it is complicated with math and equations. We observed that challenges in understanding research and the requirement for research is closely related to the participants' experience and managerial level, with respondents bearing short experience of 1–5 years in the maritime sector or serving in a lower level of management not understanding the research received or stating that they do not need it. We could further link low cognition with the low customization and adaptation efforts from research institutions as suggested by policymakers in the workshop, and the low readiness of maritime authorities due to insufficient training in interpretation and understanding of research, among other things.



**Figure 3.** Sources of research received.

In the advanced stages of research uptake—discussion, reference, efforts, and influence—we observed a progressive increase in the percentage of maritime research that is never or rarely used, and at the same time, decrease in the use of maritime research. Apparently, one in every six respondents usually discussed research with peers. Forty percent at least sometimes refer to research in their professional reports. Seventeen percent usually make efforts to adopt maritime risk research results in work decisions. Maritime risk research is ultimately expected to influence decisions by policymakers, which appeared to be the usual case for 7%, and only sometimes for 43% of the respondents. On the whole, the results suggest that a significant proportion of the respondents in maritime authorities receive and understand maritime risk research. However, academic research marginally influences outcome decisions.

Determination of the overall research uptake level in terms of a numerical value is a novel and significant result of this research. Because the stages are cumulative, building on each other, and each following stage is more important than the previous, we created an index out of the six stages, and allocated a score to each stage, with increasing order of weights to each higher stage using weighting scores from other similar studies [38,56,59,60]. Based on the respondents' answers on the Likert scale, i.e., Do Not Need or Do Not Apply (0), Never (1), Rarely (2), Sometimes (3), Often (4), Always (5), we multiply each response by a score that presents the stage weight in terms of relative importance, i.e., stage one by one, stage two by two, stage three by three, and so on. The values in respect of each respondent are summed into an index that should give a result from 0 to 115. The mean of each response is obtained, and the average of all means of all responses represents the value of research uptake. The uptake level of maritime risk research in the BSR thus obtained is 41.6%. Overall, this result indicates that maritime risk research matters to maritime authorities and industries in the BSR. However, we could not investigate further the level of research uptake across the two domains of maritime authorities and industry due to the limited number of responses.

## 5. Conclusions

The level of research uptake in Baltic Sea maritime authorities is relatively good, although we only investigated maritime risk research. Whereas utilization of research is reasonably good, policy decisions are only marginally influenced by research. By measuring the uptake in six stages, we shed light on the process of maritime research uptake, and thereby observed that policymakers at different managerial levels usually read research, and to a modest extent, understand and discuss research with peers. According to the framework of improvement factors that we created, we examined the utilization of push and pull factors. The barrier between research institutions and authorities is still high as push efforts from research institutions through adaptation, customization, and dissemination of research are not yet optimal. As regards the pull efforts by maritime authorities, their readiness to receive, interpret, and value the research is low, and so is the case with access and acquisition effort to own research results. We could link the low utilization of the pull factors with the modest uptake of maritime research. Funding research is a norm; however, the focus appears to be on the research project rather than search for an answer to a scientific problem, which may be already established in academic research. The results showed that researchers could source data to a certain extent; however, researchers require much more data and validation. Cooperation between maritime authorities, industry, and research institutions is very good, in terms of attending each other's seminars and conferences, but this is not the case with mutual engagement in policy research and there is still scope for improvement. Thus, there is scope to improve policymakers' readiness to receive research as well as access to and acquisition of research.

The survey findings of the push and pull improvement factors and assessment of research uptake level together with the workshop takeaways on opportunities to further improve the uptake of maritime risk research are summarized as policy recommendations at Appendix A.

Future research on the subject should take into consideration other determinants of research uptake, including the improvement factors that we introduced in this paper, and involve a bigger population sample. The other possible determinants are the type of research, either quantitative or qualitative, the number of employees in the organization, the educational background of the employees, [60], in addition to the capacity of the authorities, country policy, regional policies, and international policies. Such determinants are hard to measure in a small population of maritime authorities and industries as in this research.

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## Appendix A. Policy Recommendations for Enhancing Research Uptake

**Training.** The readiness of maritime authorities to receive and interpret research is inherently low and, therefore, training should be considered for staff, particularly those with shorter experience and in lower management levels, on the value of research and refining skills to interpret research.

**Focus.** Policymakers recommend research focus on new and emerging maritime challenges and risks, e.g., digitalization, autonomous shipping, and cyber risk. Further, it is important to ensure that sustainability is a key objective in all research. Direct and timely solutions to problems are imperative. It is frustrating for policymakers when research hints at new and further research without completely sorting the outstanding problem. Research should consider implementation aspects vis-à-vis administrations' financial and other resources and consider the end users' needs. Uptake should be a consideration prior and post publishing.

Researchers are typically inclined to create scholarly knowledge and, therefore, may not focus on policy issues. Nonetheless, there is a need for policy-driven research, in national, regional, and international contexts. Research yields important findings for local authorities when it addresses their national policies. It is recommended that maritime research institutions and researchers follow international negotiations at the EU and IMO level and keep track of maritime policy issues. Researchers require training on policy research and on the objectives of BSR maritime authorities and industry. On the other hand, engaging the relevant authorities in policy research is a step forward in dissemination, which would lead to long-lasting partnerships.

**Data.** Availability of local data to researchers in their empirical studies is an important catalyst toward production of customized research. Local data create relevant, considerable, and evident results that are of great benefit for the authorities and industries. It is recommended that maritime authorities and industry dedicate time to provide required data, and allow the researcher to conduct experiments, interviews, and surveys, so that the results produced are more relevant.

**Communication.** The research institutions' communication of research to authorities is often complex and iterated. It would be more beneficial if research institutions sent tailored research results or a synthesis of research findings and scientific guidance to experts and policymakers. Besides, extensive networking of research partners among universities and integration with relevant research forums will enable communication of research with peers as well as maritime authorities and industries. Research communication is not an academic issue per se, and maritime authorities and industry would do better in sharing research projects results nationally, regionally, and internationally. There may be value in sharing relevant research project outcomes with other states or regions, or IMO.

**Funding.** The efforts, which we suggest research institutions undertake, require capacities, impose costs, and yet, provide no incentives. Hence, providing dedicated funding for communication of research and incentivizing research communication are opportunities to overcome the issue. Yet another suggestion is that industry and maritime authorities provide fellowships for PhD programs and post-doctoral research as incentives to premature researchers and address stakeholders' research requirements.

**Cooperation.** Cooperation is a reliable platform to improve uptake and although cooperation is increasing, maritime authorities could communicate with maritime research institutions and show their willingness to attend and participate in academic conferences and seminars. On the other hand, there are calls for research institutions to establish contact with authorities and collaborate and engage in networking events and programs to gain knowledge about authorities and industries' objectives, challenges, and priorities. Consequently, non-scientists would be involved in research making and linkages between research institutions, authorities, and industries would be strengthened and maintained. Collaboration stimulates research and breaks down funding barriers.

**Acquisition.** Acquisition effort to own research results is not largely practiced; thus, the purchase of relevant academic peer-reviewed articles is suggested. Further, research institutions, industry, and maritime authorities would need to look at past projects' results, since it is useful to know issues that have already been researched. For example, at the EU level, information on past and ongoing projects can be found in the Transport Research and Innovation Monitoring and Information System, or TRIMIS (<https://trimis.ec.europa.eu/>). Answers to policy issues may lie within the products of completed projects, thereby increasing the acquisition of maritime research based on science, ultimately saving time and efforts.



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