

# Foresight Future Skills in Digitalisation Era: The Role of Participatory Design in Simulation-based Maritime Education

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**Abstract** – A few studies in the maritime domain utilize participatory design (PD) in ship design workshops, however, none of them addresses a full picture of how PD can make changes in simulation-based maritime education. In this reflection paper, we answer how PD can help to foresight future skills in the maritime domain, especially on how to use simulators to support increasing competence of seafarers and in turn to redesign simulators to support maritime education. In this paper, we aim to uplift the experimental skills of current debate from normal science to a socially embedded marine technology, addressing collaborative and innovative research activities, to enable all participants (seafarers, trainers, technicians, authorities etc.) to share their experiences so a joint recognition of needed future skills can be reached. Along with the exchange of experiences, we assert that the supported simulations and simulator techniques could be designed to achieve sustainable growth for all participants as well as the upcoming digitalisation era in the maritime domain.

## Keywords

Participatory design, simulation-based maritime education, future competence.

## INTRODUCTION

A Norwegian television program, Lykkeland<sup>1</sup>, reveals the interesting history of how Norway became a world-leading maritime nation. From the program, viewers learn how the Gulf Stream brings Norway immense fishing opportunities but it also indirectly shapes the country's socioeconomic structure from its maritime technologies and worldwide operations to its vivid maritime history and culture. As a result of improvements in information technology and infrastructure, marine technologies and operations have dramatically evolved from traditional automatic, mechanical, mechatronic-based technologies to digitalisation<sup>2</sup> -

based intelligence, human-centred, and information and communication technologies (ICT) supported smart operations. Such changes subvert the traditional evaluation of the competence of individual labours. As such, it is worthy to question whether Norway is ready for the pluralization of the high-tech revolution and is able to lead the future maritime domain. Can Norway still produce high competence individual labours and maritime organizations that will lead the maritime world in adopting those high-tech solutions?

To answer these questions, we should review the Norwegian maritime education and training system in current digitalisation process of marine technologies and maritime organisations. Currently, Norwegian maritime education consists of three main venues: vocational education (fagskole), technical colleges (høgskolen), and comprehensive universities. Along with several training companies across the country, these three educational systems contribute to disequilibrium. For example, vocational education and technical colleges primarily focus on utilizing simulators to train seafarers from the novice to the proficient level. After that, course certificates are awarded to students who later achieve some experience at sea then get certificates from the maritime authority of Norway. Certificates are primarily only paper that describes a position in the maritime industries. Alternatively training companies also offer training programs to seafarers and offer diplomas or certificates if the companies are approved by the Norwegian Maritime Authority (Sjøfartsdirektoratet, 2019). On the other hand, comprehensive universities instruct technicians in how to design maritime simulations. There is no overlap between seafarers and technicians. In addition, technicians have less experience working at sea, while the seafarers have less knowledge of the simulators' capabilities and limitations. Altogether, the relationship between competences of individual labours and the above-mentioned missing links among organizations create a gap in which unavoidable fundamental questions are raised over the long term: Who has competence, who defines it, who evaluates it, and which relevant simulators are equivalent to in-situ knowledge and skills of which people in the work setting? Simply put it, the usefulness of scenarios created by simulators is

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uncertain and unstable. This leads to an interesting research question: *How participatory design as a research method contributes to the design of marine technologies, creating scenarios via simulators for example, in turn, to help designing simulation-based maritime education?*

### **COMPETENCE AND MARITIME OPERATIONS**

In line with the research question, another important issue develops—why do we argue over whether utilizing simulators is the only way to train seafarers from a novice to a proficient level, but not to the expert level? The Ministry of Education and Research of Norway, which prioritizes non-cognitive skills and experience-based expertise (Utredninger, 2018), provides a definition: Competence is consistence of skills, knowledge, understanding, and attitude (Sjøfartsdirektoratet, 2019). This means that if an individual wants to gain high competence in his or her field, simply knowing a lot of facts and rules, such as training procedures, provides only a basic understanding of the necessary skills. The person must also know how to find his own way around the knowledge needed in his profession (Dreyfus & Dreyfus, 1988).

Hence, it is noticeable that current simulator-based maritime education in Norway may not be able to offer a platform for seafarers to gain the highest level of competence if there is no suitable methodology. The reason for this is simple; land-based simulators are connected through a machine network to engage seafarers in the training process. Because technicians restrict this network to a predefined class of appropriate responses (cognitive skills of marine operators), the network incorporates the intelligence that was built into the machines by the technicians for that particular context. These skills reflect the competence of the technicians, not the competence of the seafarers. In addition, seafarers must follow the work procedures in their training programme. However, that is not true regarding seafarers' in-situ work practices at sea (Pan, 2018). If that is an issue, should we draw an equal sign between the technicians, seafarers, and trainers in vocational and technical schools towards their contributions in the maritime training? Are the competences of technicians the same as those of maritime authorities and managers? Are the competences of technicians the same as those of maritime trainers at different schools? These are questionable. Can we expect technicians to produce a product that will increase the competences of trainers, authorities, managers, and seafarers? Again, we doubt it. Competence cannot be transferred from one individual labour group to another simply through a fixed simulator. No one can duplicate the working experiences of others to produce the same success stories. However, only one

thing can be learned from others: apply the lessons you learn to your daily work practice and obtain experiences to achieve competence.

As Dreyfus and Dreyfus (1988) argue:

*... [Stuart] he saw that no matter how much more work was done in computer simulation and operation research, and no matter how sophisticated the rules and procedures become, [the] analytic abstractions would never allow the computer to attain expertise.*

In this vein, whether the networks succeed or fail, and whether the final training produces seafarer competence, it remains true that human experts, after years of experience, are able to respond intuitively to situations in a way that defies logic and surprises even the experts and trainers. Thus, if a simulator is not able to function competently, why do we expect the formal training procedures that similar with 'formal mathematical or analytical rationality' (Flyvberg, 2001) of the simulator to help seafarers gain a deep understanding of the competencies that build upon vast successful and non-duplicable experiences? Moreover, why do we only use the results from experimental work to misrepresent experience, another form of competence? Is it fruitful to help designing marine technologies with better and better scenarios? If knowledge bridges among different participants in the simulation-based maritime education is not built yet, then can we foresight future skills in digitalisation era? We would say, no.

Gaining a high level of competence and future skills in an unstructured area like maritime operations seems to require considerable concrete experiences with some type of structure. An individual person will be both an expert in certain types of methods in his or her own area of skill and less skilled in other areas. Being an expert, or being at any particular stage of skill acquisition, does not necessarily mean performing as well as everyone else who exhibits the same type of thought processes. Everyone function in at least one of five stages of skill level: novice, advanced beginner, competent, proficient, and expert (Dreyfus & Dreyfus, 1988). A good proficient performer, such as a technician setting up a fixed simulator, while intuitively organizing and understanding his task, will still find himself thinking analytically about what to do. The same applies to investigators of future skills.

If we accept that we can misunderstand that human skills are not abstract and rule-guided, then it is a time for us to understand that human learning is more intelligence than calculative rationality. Human competence is contrary to logic and reasoning. For example, human behaviour does not always follow rational goals but a vast rationality of "combining

component parts to obtain a whole” (Sjøfartsdirektoratet, 2019) or arational<sup>3</sup> behaviour. If such understanding matters, then competent performance is rational, proficiency performance is transitional, and expert action is *arational*.

How do we apply this understanding of the human learning process to the technology environment? How can we bring contributions from all participants to redesign technology (i.e., creating scenarios) and foresight future? We must have a holistic understanding of the competence of seafarers, trainers, technicians, authorities, and managers and their simulator-supported interactive relationships toward decision-making. It is important to bear in mind, as scientists, that your users are not stupid (Maceli, 2011) and that only the designed mechanism of training is, in most cases, the fault of scientists. Thus, participatory design as a research approach respects all users of simulators and can facilitate a design process for the maritime education. Probably it is not the only approach, but in our view, it is the best way to answer the question of who will evaluate whose competence through which joint agreement of what simulator competence.

#### **WHY HUMAN LEARNING MATTERS IN FORESIGHT FUTURE SKILLS**

Looking at the maritime domain, vocational education and technical colleges do train seafarers in gaining cognitive skills<sup>4</sup>. However, cognitive skills are not full competence (Sjøfartsdirektoratet, 2019) and are rule-guided, expressed as “knowing that.” If working situation is changed and thus requires new skills, a seafarer might not be able to handle it due to a lack of experience, expressed as “knowing how.” This “knowing how” requires us to be broader participants to both build knowledge and exchange experiences. Together, we can build up an ecosystem to help develop competence and value for foresight future skills, including redesigning simulators to better support regulations and organizational restructuring.

What causes the knowledge gap of competence in the maritime domain? Three factors contribute to the gap:

1. Vocational education, technical colleges, and training companies primarily focus on cognitive skills of maritime operations (Dragomir, 2006).
2. Comprehensive universities overlook technology use and its relation to human learning and competence, leading to a mismatch between technology design and technology use (Pan, 2018)
3. Maritime industries have ambiguous rules and regulations that complicate recognition of a seafarer who possesses high competence (Pan, Oksavik, & Hildre, 2019). Although seafarers participate in most

education and research activities in the above two types of institutions, they take all results as granted and perhaps with less cognitive justice (van der Velden, 2009).

It is noticeable that the distribution of maritime education is not the only thing that contributes to the gap. The International Convention on Standards of Training, Certification and Watch-keeping (STCW) for Seafarers (International Maritime Organization, 2010) is also accountable. Notably, we do not admit that STCW has done something wrong. Instead, we illustrate that STCW has nothing to do with increasing seafarers’ competence but only promises a procedure to train a novice seafarer and bring him or her to the proficient level. In addition, all these levels obey three principles (Flyvberg, 2001) that help describe how things work: the practical level, the component level, and the functional level. These three principles follow basic rules and laws of physics and mathematics. For example, the simulator divides a particular job at sea into different components, each with its own function, and puts them all together to produce a result. This way, mechanistic functions are combined to encompass the functioning of the whole. Such top-down, context-independent (Simon, 1996) analytical methods for cognitive skills (Pan, 2018; Sjøfartsdirektoratet, 2019) are adopted to analyse competences of seafarers along a wide range between novice and proficient (Pan, 2018). For example, using a survey, questionnaire, and tools, we can evaluate human performance in simulators repeatedly until we get a satisfactory result.

The point is that no one can prove how many evaluations are enough because controlled experiments are not able to predict which unpredictable phenomena will cause failures<sup>4</sup>. If we cannot manage what we choose to measure, we will not be able to control the cost of running experiments and will only create digital waste in most cases. All this will disable us from forecasting the usefulness of future skills for seafarers, trainers, technicians, authorities, and managers. As we are able to foresee and devise regulations for selecting future seafarers, it is important to address the transferring of competence through updated simulators. On one hand, we have to deal with participation, competence reuse, and competence transfer, while on the other hand, and decide how to combine these elements to shape simulator development. All these issues are important factors in foresight future skills in the maritime domain in the era of digitalization, artificial intelligence, and human-centred and ICT supported smart maritime operations.

## **PARTICIPATORY DESIGN**

Participatory design (PD), which is a bottom-up and context-dependent research methodology for conducting an action-based study in foresight future skills. This approach enables us to avoid a sole top-down (evaluation-oriented and exploratory-oriented, see table 1) approach so we can focus on how to support the transferring of competence through the supported simulators. We propose our use of participatory design consists of four methods: 1) literature and statistics review, 2) interview and focus groups, 3) scenario-based future workshops, simulation building, and after action review (AAR), and 4) simulation-reconfiguration and user innovation. Although PD is a systematic guideline for conducting design-relevant analysis for the maritime domain, the important matter is the interactive relationships among methods that shape and reshape the results of the study.

### **Literature and statistic review**

Once a topic is chosen and selected as a possible problem or question, it is time to explore what work has been done on this topic, problem, or question. When reviewing literature, you look up all relevant material that has ever been published on your topic. You then familiarize yourself with the literature and carefully recode the information so you can include it in your references. You will learn about the ongoing processes of new knowledge and discoveries that are taking place in your field. There are plenty of published maritime studies that report how seafaring skills are evaluated in simulators. These are importance resources for figuring out the inabilities of both seafarers and simulators. This is a process to investigate the cognitive skills of seafarers in current studies.

A purely literature and statistics review will not provide in-depth answers to how to foresee the future. You will only discover what is missing in a field. Your research will need to fill the gap in the existing field and existing studies or verify previous studies, using a better methodology that refutes, substantiates, or extends existing theory. In addition, the results of PD approach are still part of the cognitive procedure for both the studied seafarers and the people who conduct the study. This means that literature and statistical results can only promise a new round of experimental work in evaluating human performance in automatic, mechanical, and mechatronic-based technology. To foresee the future, one must shift to qualitative methods to understand phenomena in the field from a broader view of marine operations at sea and control and management on land.

### **Interview and focus groups**

Interviews and observation concentrate on the interviewees' personal situations and needs. In particular, the interviewer acts as a moderator and focus groups aim to capture group dynamics (Bergold & Thomas, 2012). The use of interviews and focus groups can help to confirm previous studies and identify the stakeholders who belong to the work settings or organizational context directly related to the simulation.

The personal experiences of seafarers will be brought to the table and be given the same priority when investigating their use of simulators during the training process. These experiences will be taken into account when trainers set up scenarios and guide seafarers to use the simulators. It also helps to investigate whether the trainers' experiences of setting up scenarios and "guidelines" for use with the simulators actually match with seafarers. This matching process is essential for companies to self-compare with their process of crafting rules and regulations for selecting seafarers for specific positions and if the certificates distributed are still valuable. The matching process also increases awareness of the authority to examine whether a certificate can guarantee a "knowing how" ability of the seafarer.

Through exchanging experiences in focus groups, it is possible to negotiate a common agreement of competence. Who owns it, who can evaluate it, how is it evaluated, and what technology is used in the simulator to evaluate it? Remember that future skills are not taken for granted in the era of digitalization and artificial intelligence. Everyone should be ready to review their abilities based on experiences of the past and present to foresee potential skills needed in the future and to shape technology development to support the foresight skills.

### **Scenario-based future workshops, simulation building, and after action review**

After conducting the interviews and focus groups, scenarios can be drawn from the various experiences of the different participants. In this manner, scenario-based future workshops can be arranged to study the various types of future knowledge and skills needed for the participants. This process can also help identify related tasks, needs, and solutions, and helps in the redesign of simulations that scope out future knowledge and skills from all participants.

Prototypes can be made to address concerns from participants. Technicians and participants can co-design the simulations. Next, we can immediately hold an after action review (AAR) that enables all participants to describe whether they are satisfied with the results at this stage. Could they still use their

experience to achieve a new competence in their field? If so, the use of AAR can help us develop collaboration and help in testing the practical technical integration of seafarers into the decision support process for dynamic resource allocation. This allocation of resources can be used in group meetings and workshops with other participants, such as those who are not able to participate in such a process.

#### **Simulator-reconfiguration and user innovation**

The above processes help us focus more broadly on developing collaboration more than we have anticipated. The reason is simple. Training seafarers in simulations and foreseeing their future skills are strongly based on simulator-based technology. Without reconfigured and updated technology, it is impossible to draw a line between past and future skills. We must also focus on collaboration between participants because future skills benefit from a joint agreement among different participants in simulator-based training. Thus, we should create a platform that treats all participants as equal as much as possible and encourage them to innovate together through the platform toward a joint agreement. It is definitely about designing and redesigning simulations, simulators, and the experiences of organizations.

Bear in mind that, though this is not the last stage of foreseeing future skills, it may be a new point of departure. Foresight future skills are not a static activity but a dynamic process. We should prepare an iteration process toward innovation with simulation and, most importantly, with the people who use and design the simulations. Innovation is not just about product innovation, it is a process of sustainable growth. Participants must better integrate product innovation with their research, business, and market models into the process and service innovations (Govindarajan & Desai, 2013).

#### **POSITIONING PD IN SIMULATION-BASED MARITIME EDUCATION**

##### **Identifying prerequisites for stakeholder participation**

If the joint work processes and the simulator support of the participants' engagement initiatives do not work together successfully, consequences in different areas, not the least of which in the maritime domain, can be devastating. Participant participation in design is crucial and must be able to handle substantial practical challenges. Since resource scarcity at different organizations lies behind the majority of the initiatives, limited time and organizational resources are usually set aside for participant participation. The issue is further complicated by the fact that seafarers and many other important participants do not operate in an organizational context. In our experience, both these circumstances were apparent in the difficulty to retain a coherent design group over time. The reason

is due to a misunderstanding of human learning and misuse of research methods and techniques from the natural sciences to the maritime domain. Let us interpret this idea further.

##### *Learning from the past to handle the future*

In light of societal development, the role of contemporary PD is not primarily protecting participants from alienation and ergonomic delicense of technology nor is driven by ideological values of workplace democracy. A pronounced defensive approach no longer makes sense. On the contrary, the simulator itself has become a tool for empowerment and increased transparency between educational institutions, training schools, authorities, and the shipping companies. In a wider perspective, the PD approach can be seen as a chance for researchers to bring political values to the forefront, as they not only encourage organizational efficiency and redundancy motives, but also clearly develop the skills and competences of the seafarers involved. The PD approach can be an important means to increase opportunities for seafarers, letting them interact and propose design solutions that in the long-run will benefit and increase the very same initiatives. This helps seafarers contribute to decision making and play a more emphasized role. For this development to take place, we need a discourse focusing on how the PD approach can be used to allow seafarers to build or re-configure systems that are more effective.

As described, we note how PD is not exclusively or primarily about simulation artefacts but is equally about improving collaborative settings and processes. Such practical solutions involve an initial broad organizational focus involving participant identification and involvement, defining and negotiating tasks and responsibilities, handling legal aspects, and introducing interdisciplinary perspectives and multifaceted development teams. It seems plausible that PD in similar institutional transformation maritime contexts will not only experience similar challenges but will also need to address them similarly. In addition, sufficient time and resources must be spent on organizational analysis and early design. Given the resource-constrained character of the environment, the major related PD challenge will likely persuade maritime authorities on long-term returns on investment in participant participation to enable them to provide the means for experience. Studies focusing on potential cost-benefits of applying PD is a way to address this challenge. Organizational analysis requires substantial time and effort to enable proper technology development. It has been suggested that PD should focus active participant participation where it is most needed (e.g., in needs analysis and iterative design).

In our experience, it is evident that the PD process is primarily about development of new collaborations, new tasks, and identifying basic equipment needs. We perceive simulator reconfiguration and development of participant innovation as rather straightforward once organizational and ethical issues have been addressed. It was thus possible to balance the more intensive and resource-demanding initial efforts with more concentrated work around simulator re-configuration and extension, once central issues of the collaboration have been addressed. The study of participant innovation in relation to maritime studies concluded that in order to properly foresee future skills, we must involve everyone who designs and uses simulators to make decisions during the process. The conditions for participant innovation were more favourable where PD gradually turned in this direction. With growing experience, participants can add functionality to the simulations as part of their first responder engagement. They also successively adapted functions to overcome legal obstacles and technological constraints. In other words, simulators and PD can be combined to enable participant empowerment, take active part in re-configuration, and propose their own design solutions. A necessary step in this direction is adopting guidelines for PD to develop situated applications and make them open to meta-design and re-configuration.

#### *Combing qualitative research methods in situated contexts*

In any design context, it is crucial to address identified challenges by targeting the approach and design techniques to the current situation or project. Over the decades, numerous methods for active user participation, techniques, and tools (e.g., organizational games, role-playing games, organizational toolkits, future workshops, storyboarding) have been applied, used, and evaluated in research. Also, qualitative ethnographic inspired methods, such as contextual inquiry and interpretation sessions, have been applied. However, in the current maritime context, many of the above methods and tools have not been practiced. Therefore, retaining a design group with active participant participation in a short period of time can be an option. For instance, when training seafarers in simulators, debriefing sessions can involve other participants to foresee future skills and discuss present experiences. As to qualitative methods, contextual inquiry is possible to accomplish when the common context is identified and clear to the participants and when ethnography in general presumes an organizational setting or existing situation to study.

A scenario-based future workshop and an exercise AAR can explore new possibilities for maritime

domain in foreseeing future skills. It may be argued that interviews and focus groups, even though the latter are similar to design groups, are data collection methods that enable user representation rather than active participation. In retrospect, we perceive that focus groups directly suggest many users' needs. They also provide the necessary baseline for a collaborative setting and expose how much was not set in the project's context in terms of tasks, responsibilities, legal matters, etc. This made it possible for us to plan the remainder of the study and extend our design team accordingly. Taking this together with our past experience, the PD perspective seems suitable for future work in the maritime domain, as a replacement or complement to the current design method for foresight skills and knowledge as well as the maritime education.

In addition, many basic needs and simulation requirements emerged first in the simulated "real" situation. It may be argued that real exercises are costly and resource consuming. On the other hand, we deem them as extremely valuable when the situated context is new to the participation. As for AARs, they are not part of traditional toolboxes but are explicitly used for participant feedback. We believe that the AAR elaborates and explains many of the things that have been observed during exercises from a group perspective in identifying and elaborating on the participants' needs.

#### **REFLECTION ON UTILISATION OF PD IN THE DIGITALISATION ERA**

Our experience is based on project examples taking place in the Norwegian maritime domain. The study should be viewed as a contribution to the ongoing debate on new methods, addressing how a planned approach can be successively and pragmatically modified and applied to foresight future skills in the maritime education, both for training seafarers and educating technicians, managers and trainers. Of course, any project will need to do its own modifications and every final combination of methods will depend on the specific project context. Of course, we do not claim to solve all potential challenges associated with our approach, but rather we provide some suggestions as to how they may be approached. In many respects, the related work in similar maritime settings points to similar challenges. It has been difficult practically to involve the participants over time using the traditional engineering design approach, the same difficulty applies to the PD approach too. Therefore, in the cross-sector setting involving semi-professionals in collaboration with the universities, we have to choose carefully who will be the participants and the possibility to be engaged to integrate the new

collaborations and include the development of simulations through the experience at sea.

However, there is a long way to go since a well-established research group is needed. Historical issues caused the gaps of maritime education in higher education and have already leading to unsystematic structure for research and development of maritime technology. Well, the most bogeyman problem is to unfruitfully picture an incomplete work practices of participants. For example, Mallam et al. (2017) designed an ‘ergonomic ship-evaluation tool’ for introducing participatory design as a method to design a ship. The tool can create an environment that will help naval architects, crews and ergonomists work together to develop human-centered design solutions for physical work environments. The tool grapes the crews demand rather than what their work practices are in reality.

While, the central concern with in PD is to deal with the relation between studying the work practices of the workers from whom new technologies are being developed and directly engaging workers in design (Jeanette Blomberg & Karati, 2013). Thus, it is too dangerous to only utilise a piece of PD and overlook another part. Furthermore, it is a challenge to conclude that there is a human-centered approach in the maritime studies (Costa, Lundh, & Mackinnon, 2018; de Vries, Hogström, Costa, & Mallam, 2017; Mallam, Lundh, & MacKinnon, 2017a) although a few researchers claim such concept elsewhere.

#### **The focus of PD in the digitalisation era**

If there is an advantage to utilise PD in the maritime studies, we should know what is PD about. According to Blomberg and Karasti (2013, p. 89):

*Participatory design has been defined by its insistence that worker’s knowledge is available to shape design directions by providing places and spaces for interaction between designers and practitioners that do not privilege one kind of knowledge over another.*

PD brings unique experiences and perspectives when people mutual learn from others’ domain of knowledge. Everyone who participates in the design process has a voice that can be heard and be considered during the design process. This is a vital point for controlling the quality of a research and development project.

Now, with the increased concerns of safety maritime operation, designers are pushed to seek most appropriate approach to deal with such interests. However, we have to warn that it might be good to make visible participants’ situated methods for creating the coherence of phenomena, such as applying the studied results from ergonomists

regarding the traditional engineering design work, however, we lose the opportunity to describe phenomena using participants’ categories and organising frameworks.

digitalisation as a concept but a term we use to describe the era of digitalising, autonomous, and many other promising words which are omnipresent used in the maritime sections, including shipyards, maritime consulting, maritime education, and crew management and so on. Due to non-existing systematic approach in the maritime domain, one could not find in-depth discussions regarding how technology can be and should be implemented in the maritime domain. PD can bring changes that is defined by the interests of workers, the requirements for their work, and the jointly negotiated path to change. Although researchers, developers, managers and others in the maritime domain might have different expertise and favourite in their own fields, they could find their ways to make the project more sustainable. As Bødker et al (Bødker, Kensing, & Simonsen, 2004, pp.140-141) remarked:

*Good IT design requires knowledge of work practices in order to determine which company traditions are fundamental and sustainable, and which are outdated. Put in a different way, only when a design team has fundamental knowledge of existing work practices can it arrive at what we call a ‘sustainable design’.*

In this case, in the digitalisation era, all participants are the actors to shape the future in the maritime education. Maritime education may no longer only about engineering, electrician, management, and training, it becomes complex and with less clear boundary with other courses. That means everyone becomes co-designer and must opportunities to see first-hand, participant in, the life of the user participants. This is essential for the maritime education for the future skills. What competence should one to have in the digital era?

#### **The change for the simulation-based maritime education**

In order to better prepare for the future, we need to include studying phenomena in a systematic way of participants in their everyday settings, taking a holistic view, providing a descriptive understanding, and taking a member’s perspective (Blomberg, Giacomini, Mosher, & Swenton-Wall, 1993). Therefore, there is no necessary to distinguish who is providing what types of maritime education but we can see them as a completely organisational system, including humans, technological artefacts, and institutional rules for organising humans and technologies together.



The starting point is always to find a way of providing socially enriched understanding of current work practices that is fruitful for designing simulation-based maritime education. It is firstly important to respect for the different knowledge that seafarers, engineers, technician, manager, and designers bring to PD project. In this manner, we could commitment to a members' perspective that focuses on gaining an insider's view and using terms relevant and meaningful to the people who use simulators. This is the best way to create opportunities for designers and workers to learn about each other's domain through direct interaction for co-creating situations where seafarers can experience the design possibilities and encounter first-hand experiences.

Secondly, it is also important to have a holistic view of how the outcome of the design that may affect the work practices of all participants. For example, changes in creating a scenario of maritime training that may request an impact on the engineering, design, teaching as well as management skills.

Thirdly, describing current situation is important to prescribing a change. This is because without better knowing current situation is a vial resource to anchor change in the past and present, and offering all participants a limit scheme for the future imagination. For example, in the early work of PD, researchers show that users with their own knowledge and experience can provide a perspective on their everyday work practices, often in the context of envisioning new artefacts and ways of working (Kyng, 1995).

Fourthly, since everyone is participating in designing scenarios-based maritime education, everyone is co-designer and must have opportunities to see first-hand, participate in, the life of the maritime education. The participatory designer, in this unique situation, can engage in a continuum of 'roles' with the ability to cycle between participation in the life of all simulator users and looking for new possibilities for changes.

#### Education providers as mediators

With our lengthy discussion of the contribution of PD, we recognise the importance of re-scrutinizing the role of educational providers in the maritime domain. We need to stress that educational providers are mediators between the workplace and the design intervention for simulation-based maritime education. In this manner, simulators are not only products one developed for others to use. Also, simulators are not one who can only use for teaching purposes. We must acknowledge that simulation is only a tool that is used to support humans cooperation, collaboration, and maybe competition. However, without mutual learning process, we

cannot confidently state that the non-transferable skills of different experts in their own fields can be grounded firmly via simulation-based maritime education. Thus, it will be a challenge for using simulator as a tool to promise educational goals, including training for the future.

In such consequence, education providers have to shift their positions from only providers' position to the positions of mediators. In tradition, educational providers only provide either educating people to design technology, or training people to use technology (see Figure 1). This single way of education cannot promise simulator-based maritime education will help seafarers to be professionals; neither can help other participants have a clear and complete direction of maritime development. This is understandable that maritime domain was and is following the development of normal science (Kuhn, 2012), following the cognitive processor (procedure learning) (Card, Moran, & Newell, 1986) rather taking humans learning into account, which might base on intimated knowledge of several thousand concrete cases in peoples own area of expertise (Flyvberg, 2001). PD has contributed to change and offered an approach to help linking back the knowledge of work practices to the design of technology (see Figure 2).

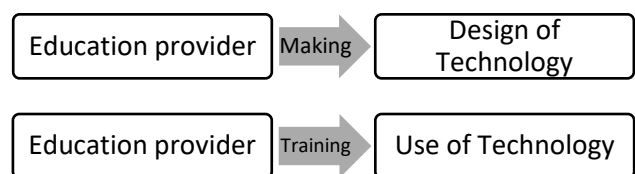


Figure 1: The role of education provider in the traditional maritime domain

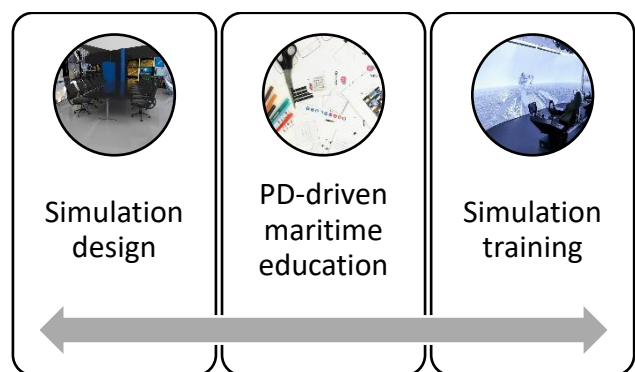


Figure 2: The role of education provider in PD-driven maritime domain

In this process, PD can help avoiding useless repetition of evaluation of training results, not to say its limitation of identifying ones true expertise. Instead, PD shifts our focus how to bring those expertise in the cycle to design. Winograd and Flores (Winograd & Flores, 1986, p. xi) add:



*We encounter the deep questions of design when we recognize that in designing tools we are designing ways of being.*

Design is, fundamentally for us, about designing futures for actual people. If people wish to encounter digitalisation, autonomous and other attractive activities in digitalisation era, we must agree that it is simulation-based maritime education is a system where PD can facilitate different techniques to make innovation for the maritime domain, especially focusing on the future skills and competence in the digital future.

Hence, in the end, we suggest three tips for the maritime domain for implementing PD-based maritime research and development.

- For education providers, a trained ethnographer can help to mediate simulation use and design. A trained ethnographer can co-realise (Forsythe, 1999) what observed in reality and design in simulation will best match the need of all participants.
- Case-based scenario making can help support of re-conceptualizing and restructuring how maritime training and engineering work (simulation design) should be undertaken. PD helps to filling the distance between the missing area of competence in the maritime domain. This activity builds up a life-cycle development of competence and value for foresight future skills.
- PD informs maritime studies as interdisciplinary research area. PD is valuable in making visible ‘multiple communities’ in the maritime studies and do not leave ‘distance area’ for unmeasurable expertise in the design process. Instead, PD allows creating a disciplinary division of labour, the differing expertise complementing one another. In this view, interdisciplinary is seen as a functional activity can be viewed as seeking its own ways of representing ‘methodological’ positions of different fields to work in a common place for making innovation.

Through the PD perspectives, we assume that rebuilding the knowledge base and practice in the maritime structure for shaping a healthy research and development platform is an advantage. The PD perspective could do this, and the maritime domain urgently needs it.

#### **CONCLUDING REMARKS**

Although this is a point of departure for discussing how participatory design can play a role to develop a methodology for foresight of future skills in the

maritime domain, we find there is huge potential to restructure maritime education and research as a basis to support foreseeing competence of maritime personnel. In the article we argue that using a bottom-to-top model to forecast human capability we can redesign key features of future skills, as well as processes of linking past and current skills and knowledge to future needs. Through the process of the PD approach, many participants from industry, research institutions, training companies, and authorities could cooperatively offer valuable insights into structuring the future. This collaborative approach is one characteristic of the foresight exercise that achieves consensus on shared visions and commitment to the results. The most required of us is to deploy this approach speciously into practice to improve simulation-based maritime education and training for the benefit of the future maritime labour force in Norway.

#### **ACKNOWLEDGMENTS**

The project is co-funded by the Erasmus+ programme of the European Union (No. 601186-EPP-1-2018-1-NL-EPPKA2-SSA-B) and Norwegian University of Science and Technology (No. 90406900). The European Commission support for the production of this publication does not constitute endorsement of the contents, which reflects the views only of the authors, and the Commission cannot be held responsible for any use, which may be made of the information contained therein.

#### **NOTES**

1. Lykkeland is a TV program lunched on NRK TV series from 2018. The TV program is about when Phillips has found the largest subsea oil basin in history, everything in Norway is about to change.
2. Digitalization means that business uses technology to engage with people to address precisely their particular needs. However, a phony of digitization is widely cited in industries, which, on the contrary, aims at increasing the efficiency of technology processes. Our understanding of digitalization follows the former definition.
3. *Arational* is an adjective term and means a behavior or action is not based on or governed by logical reasoning.
4. Cognitive skills come from the procedure learning. There are four stages of procedure learning. First, cognitive processor is ‘programmed’ with procedural knowledge acquired from learning. Second, at first procedures are declarative knowledge from problem solving (trial and error) and explicit instructions (through comprehend instructive material). Third, with practice, converted into procedural knowledge one can routinely executed to achieve goal to gain a routine skill. Forth, with extensive practice, a skill becomes automated – you can perform procedure automatically.

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