"Automation shift in the maritime sector of the offshore oil and gas industry: assessing risk and safety, protecting labor." (ASMOG).

O. Relevance to the call of proposals

ASMOG's research is highly innovative, relevant and reflects current problematics, i.e. the **automation shift in the maritime sector**. ASMOG satisfies the thematic priorities of OCEANS/MAROFF by investigating new developments in digital and automatic tools for maritime operations, such as the meanings and uses of Electronic Chart Display and Information System (ECDIS) and Dynamic Positioning (DP), and digitalization and automatization of autonomous- and remote-controlled vessels. These transformative developments of the maritime industry have enormous consequences for safety and efficiency at sea. To address these social and industrial impacts, ASMOG brings together partners from different sectors, including **Simsea, Knutsen OAS,** the **Norwegian Maritime Authority (NMA)**, the **Municipality of Haugesund, AVO Consulting** and researchers from the **University of Bergen** and **NTNU**.

ASMOG is highly relevant for **OCEANS** for several reasons. Firstly, the project prioritizes research in the maritime sector in cooperation with industries, governmental and national institutions. Secondly, it builds on the knowledge base and competitiveness of Norwegian maritime industries and the objectives specified by the **MAROFF**-program of the Norwegian Government's 2015 *Maritime Strategy, Maritime Opportunities –Blue Growth for a Green Future.* Thirdly, ASMOG helps to implement the recommendations of *Maritim21: An integrated maritime strategy for research, development and innovation* (2016) by **improving the interactivity and knowledge transfer between the R&D community, industry and governmental institutions**. As a collaborative project, ASMOG provides knowledge, strategies to **overcome challenges and improve and maintain safety of navigation and use of automated or semi-automated vessels**. This is a critical, but unaddressed area of investigation as the impact and multifaceted meanings of automation for seafarers, maritime industry, public institutions and society at large, remains largely unknown.

1. Excellence

1.1 State of the art, knowledge needs and project objectives

Continuously expanding into new domains, automation technology is high on the agenda of industrial players and public-sector decision-makers. Automation of offshore and maritime operations is a complex, expensive and far-reaching initiative, as it attempts to reconcile the destructive effects of the Anthropocene with the global demands of energy, goods and services in an accelerated and "overheated" capitalistic world system (Steffen et al., 2007:614; Eriksen, 2016). However, there is skepticism towards loss of employment as result of automation in some sectors and recent studies suggest that seafarers experience a loss of autonomy caused by the close interaction with mainland operation management through digital interconnection (Sampson, Turgo, Acejo, Ellis and Tang, 2019). The project is interested in studying **how the autonomation shift both changes as well as generates new frames for interaction between technology, seafarers and managers**. Some have argued for **the necessity of an automation shift to facilitate the next energy transition** and the maritime sector is central in this shift (Bergsma, Pruyn and van de Kaa, 2021)**.** When embedded in the quest for energy transition, automation is often referred to as "cleantech" (Hoffman and Loeber, 2016; Sjøtun, 2020). Indeed, the automation shift is interconnected to the energy transition through their simultaneous development, and both being encapsuled by the continual demand for safer, cleaner and efficient operations in accordance with the standards of the international community.

Anthropology has seen **a surge of interest in the field of human-computer interactions** in the last decade, a development that tracks the **ubiquitous role attained by computing**, in all human affairs. In maritime industries, this intellectual development is primarily expressed through experimental '**human factors'** research, which has long been dominated by individualistic perspectives drawn from organizational psychology. This tradition has developed valuable constructs for understanding cognitive dimensions of the human-machine interface, such as "situational awareness" (Endsley, 1995, 2015). The industry emphasizes "human factors" with the aim of reducing risk in marine operations (OCIMF 2020). ASMOG complements and challenges this analytical lens by adopting a resolutely *anthropological* approach to the subject matter. This approach is premised on the naturalistic study of automation practices 'in the wild'. It offers fresh empirical insights by situating **how different stakeholders perform automation in a broader social and cultural ecology**, emphasizing the interpersonal and interactive aspects of such novel technologies. Beyond policy briefs and reports, there are **currently major knowledge gaps** in research on the social impacts of the automation shift in the maritime sector. **ASMOG fills this gap by identifying paradigmatic challenges and possibilities in close collaboration with relevant industries and institutions.**

Social scientists have attempted to theorize technological developments across multiple levels and units of analysis. Some efforts have probed the nature of sociotechnical systems, focusing on interactions between technical infrastructure and the workplace (Pasmore, Francis, Haldeman, & Shani, 1982). Others have

explored the human enchantment with technology, by focusing on the development of a new class of so-called "hyperobjects" (Morton, 2013) and "technologies of imaginations" (Bear 2016). These are entities that seemingly outlast and out-scale not just individuals, but even entire generations, and man-made institutions. These studies echo classical accounts of *Homo faber* (Alvares, 1980), the magic of technology (Gell, 1988), and inquire into our penchant for technological fetishism (Pfaffenberger, 1988), often aiming to reveal the societal illusions created by human fascination with machines and the blind spots that the modernist narrative of technological wonder produces, including the societal implications of such narratives. This sort of study often looks at *engineers' practices* which have always been central to the definition of a socio-technical regime (Sjøtun, 2020; Kemp et al.,2001). Many of these studies revive the **legacy of political economy and Marxist theory** and relate the study of technology to **processes of globalization**, power relations, social inequalities and **neoliberalism** (Ong, 2007; Harvey, 2007). Another large body of studies focuses instead on the new "**assemblages**" (De Landa, 2016) created by the interaction of man and machine, or human/non-human interaction (Lowrie, 2018). This is part of the larger **Science and Technology Studies,** (Haraway, 1994) and the so-called "**ontological turn**" in anthropology (Holdbraad and Pedersen, 2017). These studies argue for the necessity of taking into account the agency of non-human actors in social analyses, because human social actions and practices are inescapably interlinked with the "objects" and instruments that our species create and use. These perspectives on human/non-human assemblages, socio-natures and the cyborg (Haraway, 1994) argue that **the boundary between humans, nature and machines is an artificial one**. We are "natural born cyborgs" (Clark, 2003). In this view non-human things and entities should not be conceptualized as merely passive objects, but as **co-producers of human knowledge and practice** (Latour, 1991).

Despite this wide-spanning interest in technology and technology developments in the social sciences, few studies address the expansive technological changes sweeping the maritime sector, including maritime transport and offshore oil and gas industry. **ASMOG does not only contribute with new knowledge by identifying and analyzing challenges and possibilities related to the automation shift but is also methodologically and theoretically innovative.** It will explore these developments through **simulation training**, experiments and through mutual exchange of knowledge and observation with industries and public institutions.

ASMOG's objectives are:

1) To identify key technological innovations, challenges and possibilities in the automation shift.
2) To build knowledge and create concrete methods and solutions to overcome challenges related to the automation shift.
3) To set the theoretical and methodological ground for collaborative and experimental research with the industries.
4) To bridge the knowledge and communication gaps between the industry, the seafarers and the public spheres.
5) To investigate the impact and deep meaning of automation in the labor market for various stakeholders.
6) To conceptualize the automation shift as a complex machine-society-nature system.

Research levels of this collaborative project will include: a) initiatives by the industry and responses by seafarers; b) their perceptions and experiences, or questions about top-down/bottom-up dimensions in implementation of various automation systems; c) role of seafarers, engineers and managers, and overarching interaction with the NMA and with the public.

The project takes as specific case the **nexus of automation and labor in the offshore oil and gas industry** and the social dynamics at different levels situated and illustrated in the exemplary case of the maritime city of Haugesund. The project takes this maritime cluster as point of departure in researching the automation shift related to oil and gas industry as the maritime sector interconnects both in terms of the service, shipping and supply to the oil and gas industry. The activities related to the oil and gas industry offshore are: tanking, oil and gas transport, subsea operations and rig operations. "Automation shift" is the paradigm against which the study will take place. Placed at the center of this study are different dynamics in which technological advancement (namely automation), risk assessment, labor rights and safe relationship with the ocean are being evaluated, discussed and theorized. The research team will develop concrete solutions to dampen risk and increment security in maritime operations and it will develop a way to communicate to the public about the automation shift's societal impact.

Project partners and contextual factors

Norway has in the last couple of years worked on many projects related to the automation shift such as Yara Birkeland. Different institutions, including the **Municipality of Haugesund** are on the avant-garde on this front, as they are actively involved in promoting and facilitating automation projects. For instance, they have recently applied for the permission to establish a national test centre for autonomous vessels in Killingøy.

The **NMA**, also located in Haugesund, is the administrative and supervisory authority in matters related to vessels with Norwegian flag and foreign ships in Norwegian waters. The NMA aims at being a world-leading and attractive collaborating partner with a focus on high level of safety and cleaner environment. Together with the Norwegian maritime cluster at large, the NMA plays a significant role in the automation shift in the international maritime organization. Maritime offshore operations are among the most expensive and most dangerous activities that can exist. To operate petroleum and LNG tanker ships can cost about 37000 dollars per day for the largest ships. To make a mistake is extremely expensive, not only economically but it can cost lives and the environment. The automation of the service vessels (ships) involved in oil and gas activities is a huge enterprise and according to the NMA this is the fastest automated field in the maritime sector (faster than passenger and cargo shipping, for instance). Among the NMA the perception is that all service ships will most likely be digitalized and remotely automated in the next ten years (David Svein Medhaug, personal communication). Norway is in the forefront of this shift and carries a great responsibility to secure safer, environmentally friendly, and efficient operations at seas.

Norway has a large maritime cluster and many shipping companies operating world-wide. **Knutsen OAS**, a Haugesund-founded shipping company, is the second largest shuttle tanker operator in the world and second in size in buoy loaders. They own a fleet specialized in transport of LNG with office in Spain which is managed by the head office in Haugesund. Over the next few years, they will hire several hundred new seafarers as they have built many new vessels, most of which will be operating with advanced digital solutions. Knutsen OAS is known for their own newly developed and approved ballast system. Even the traditional shipping such as the shuttle tanker operators represent a large and important part of today's project for energy transition with complex technology, both digital and automatic aimed at reducing emissions and again human and environmental risk during maritime operations. Knutsen OAS is exemplary of how Norwegian maritime industry is absolutely positioned to be a leader in this field due to the size of the company, the investment/technology willingness and expensive labor.

Automation has tended to improve safety and reliability in operations (hence reducing risk both for humans and environment) and removed tedious/repetitive tasks and thus improving the well-being of the workers. AVO Consulting is a Norwegian based company whose teams are specialists in technology helping companies perform more efficiently through smart use of technology. AVO Consulting's maritime team harnesses data from the maritime sector and provide new digitalization and automated technology to solve challenges with various operations. Working hand-in-hand with other shipping companies, AVO provides insight on how automation, digitalization and innovation change, how business models operate and the effect they have on people, culture and organization.

Finally, important to our research is the latest IMO 2020 regulations decree which demands a drastic cutting of Sulphur dioxide (SO_2) emissions by ships to 0,50% m/m from the previously allowed limit of 3,50% m/m. In addition, in the IMO strategic plan (2018-2023) the second key Strategic Direction (SD2) is to "integrate new and advancing technologies" whereas advancing technology is synonym for automation. In the same plan, the third strategic point (SD3) is "respond to climate change" (IMO, 2018:6). To conduct research on this huge transition is important and timely (ILO, 2019). This is both because of the need to improve safety for workers and the environment, and because ongoing innovations within automation in the maritime sector require research and collaboration with the social sciences in order to anticipate challenges, facilitate solutions as well as uncover societal and cultural dimensions of the shift. Innovation in offshore operations is key to improve safety and efficiency in the offshore oil and gas industry – and provides the basis for a transition to "green energy" solutions and technology due to the transfer value. One of the most important goals of the automation shift is to improve efficiency and safety for the workers, the environment and the machines.

1.2 Research questions and hypotheses, theoretical approach and methodology

Our hypothesis is as follows: **"Automation entails new safety considerations and learning methods in maritime operations, and generates new frames for interaction between technology, seafarers and shipping companies"**. To test this hypothesis, ASMOG is organized under different work packages (WPs). The WPs are a way of structuring the project's thematic areas and responsibilities; the collaboration with different project participants; and of organizing our dissemination of the result. The WPs will intersect and cross-fertilize each other. **The WPs are structured around the following research questions**, which have been formulated in collaboration with the partners:

1. **Automation, simulation and man-machine interaction:**
   - 1.1 How are different stakeholders working to address challenges brought about by the automation shift in the maritime offshore industry? What are the most effective human solutions to overcome these challenges?

1.2 How can humans in some specific cases, like during simulations, learn from interaction with machines and how can machines be "trained" by human factors?

1.3 What kind of knowledge about man-machine interaction or fully automated new vessels (in tandem with digitalization of traditional industry) can this research create?

2. Labor, industry and society:

2.1 How do the partners on this project - academia, industries and the public institutions -discuss and analyze the complexity of risk, safety and labor? How do they come to implement solutions to overcome challenges related for instance to skepticism, the fear factor, ethical questions and lack of knowledge related to the automation shift?

2.2 How do seafarers respond to automation initiatives, and how do they conceptualize labor safety and risk?

2.3 What is the significance of relational, socio-cultural and hierarchical dimensions of advanced technological operations?

3. Green technology:

3.1 Can this new type of collaboration and the theoretical and practical outcomes that will derive be used to develop guidelines and precedents which will be key inspiration models to other similar contexts?

3.2 Can we learn more about energy transition by carefully analyzing the paradox of greentech being developed in the largest energy industry in the world namely that of oil and gas?

3.3 In what ways are developments and learning methods within the automation shift made relevant for green energy initiatives and solutions?

4. Conceptualizing the automation shift:

4.1 In what ways does the automation shift actualize different values and understandings, conceptual and ethical frameworks related to labor and risk?

4.2 Is the theorization of labor and risk in this particular context (automation in the maritime industry) useful for the creation and implementation of practical ways to tackle challenges and uncertainty in the different sectors?

4.3 Is the theorization of labor and risk in this particular context useful to safeguard and strengthen workers' rights in a fast-changing industry? What are the consequences of the automation shift for legal and ethical norms guiding the industries?

The **theoretical approach** of ASMOG is **explorative** and grounded in anthropological theories. We pay particular attention to how **technologies are part of, and produce, a social universe of meaning, hierarchies and power** (Pfaffenberger 1988). At the core of the automation shift are reconfigurations of risk assessments and labor relations. We approach risk as a multi-dimensional concern; in terms of physical risk for the seafarers; operational and financial risk for the industries; and environmental risk. Drawing on anthropological studies of labor (Harris 2007, Harvey & Krohn-Hansen 2018) we explore changing labor relations and risk management at the interface between new technologies, increased labor specialization and precarious labor. We propose that notions of labor are both negotiated, contested and re-invented at this interface.

In our innovative focus on learning processes in automation and simulation trainings, ASMOG draws on the anthropology of the senses, phenomenology, and embodied learning (Bourdieu 1996, Ingold 1993, Muller 1996). Humans learn not only through language and vision, but by and through the body and the senses. These dimensions are important also for the use of highly advanced technologies – and especially the simulation trainings will enable us to make important observations in this regard. The simulation trainings facilitate a close-up and hands-on study not only of learning processes but also of the knowledges produced through human-machine relations (Latour 1991, Haraway 1994); i.e., how knowledge is produced, acquired, communicated and shared, and not least how the machines "learn" from humans. Rather than seeing man-machine interaction as an individualized phenomenon, we pay attention to relational, socio-cultural and hierarchical dimensions of technological operations and learning processes. Important to explore is for instance how hierarchies play out in automation and simulation trainings, i.e., given the highly internationalized working environment of the Norwegian maritime industry and considering its historically gender-specific character. ASMOG's emphasis on sociality in man-machine interaction facilitates our study of safety and risk assessments as socially embedded processes (Das 2018). This is vital for the understanding of safety and risk considerations as they are actualized at the complex interfaces between virtual and offshore operation management.

We analyze automation initiatives as a complex machine-society-nature system that generates **new frames for interaction between technology, seafarers and managers; between sea and mainland operations and relations**. Focusing especially on navigation at sea, we explore navigation not only as technological tool but as a complex relationship producing particular social relations, embodiments and envisionings of both virtual

and material landscapes. With automation, offshore operations take place at increasingly complex crossroads between sea and mainland, real-life and the virtual. This raises new questions about communication between automated vessels and mainland headquarters. ASMOG draws here on anthropological perspectives on technology's role in the production of space, i.e., by seeing space as produced through social – and technological – practices (Lefebvre 1991). We are hence concerned with understanding man-machine interaction not as an isolated phenomenon, but as part of the production of virtual and "real" space, spatial boundaries, and interconnections, both discursively (Brosius 1999) and materially (West et al. 2006). In this manner, ASMOG explores the production of spatial boundaries and interconnections at the crossroads between the virtual and material landscapes of offshore operations. We are interested in how these virtual and material landscapes may produce also particular mainland relations and identities. In studying these interconnections, we propose that Morton's hyperobjects can be considered as extended global infrastructures of technology-energy-transport relations, and that maritime hubs like Haugesund can be studied as a node in such a globalized system.

1.4 Novelty and ambition

ASMOG is an ambitious and unprecedented project. Pushing the research frontier forward, this anthropological project examines the various dynamics unfolding with the automation shift in the maritime sector. With UoB as project owner, the project unites the expertise, both theoretical and practical, of a world-known leading shipping company (Knutsen OAS); a seafarers training and simulation training provider (Simsea); a specialized team on the use of technology (AVO Consulting); the NMA and the Municipality of Haugesund. The project proposes **a novel theoretical and methodological approach** to investigate the relationship between humans and automation processes in the maritime sector, by using simulation training for seafarers as a site for data collection and a tool for sharing and developing new knowledge.

1.5 Methodology

Long-term ethnographic fieldwork will be the key method deployed by ASMOG's research team. Our ethnographic and multi-sited fieldwork will be conducted in the two industries (Simsea and Knutsen OAS); in the industrial port and the urban area of Haugesund; at vessels and in simulation trainings, and will involve a three-way approach: a) **participant observation** (i.e. immersion, observation and participation in the field) among seafarers and groups working or affected by the automation shift in the maritime sector; b) **semi-structured interviews** (with individual stakeholders, but also focus group interviews with the industry partners and other relevant groups); c) **secondary source review** (the collection and analysis of documents related to the automation shift also among other relevant archives like those of International Maritime Organization (IMO), industries working in technological innovation like Simsea and Knutsen, and other simulation suppliers and schools like Simwave and the Maritime Institute Willem Barentz in the Netherlands).

ASMOG builds on our experiences with well-established methods of participant observation in social anthropology, which involves immersion into the everyday experiences of the interlocutors and on-site observation of interaction, communication, and relations. **Participant observation is particularly apt** for exploring our research questions related to automation, as it involves engagement with interlocutors over long periods of time and can, through in-depth and on-site participation, identify important as well as subtle dimensions, challenges and possibilities related to the automation shift. In this regard, **social anthropology provides the fieldwork experience and hands-on method necessary** for this form of collaboration between social science and the industries – and to make use of on-site observations during operations as well as to make sense of social interaction and communication. While hence relying on well-established methods of participant observation, ASMOG is also highly **methodologically innovative** especially in that it will experiment with simulation trainings – and will be using these encounters as field data, as described below. Through participant observation we will produce ethnographic descriptions and analysis through community involvement and direct observation. ASMOG's participant observation will also involve working together with people employed in the industry, e.g., by participating in, holding and/or co-holding a simulation training to seafarers at Simsea; by joining Knutsen OAS seafarers on the vessel during a maritime operation; by assisting the NMA or the Municipality of Haugesund in their activities and network involved with maritime issues; and by working with the specialized team in maritime digitalization in AVO Consulting. In so doing, the project will increase understanding on how automation, digitalization and innovation changes how business models operate and the effect it has on people, culture and organization. **Central sites for ASMOG's empirical research are:**

Haugesund: The town has been a hub for the maritime industries since the 1800s, and currently hosts maritime industries related to the shipbuilding industry and shipping. 70% of Haugesund's industrial activities takes place in the maritime sector. This, together with the location of Knutsen OAS, Simsea and NMA makes Haugesund an important site for ASMOG in the study of initiatives, challenges and possibilities related to the

automation shift. Our partner the **Municipality of Haugesund** facilitates access to important arenas, interlocutors and documents, and contributes to identifying central questions for research and analysis.

Simulation: A simulator consists of different components: a system for audio and visual environment; mathematical models combined with a set of initial conditions for prediction, visualization and control; control systems as rudders for the instructors. These systems generate physical, behavioural and operational realism and a system for monitoring evaluation and training. The layout of a simulator consists of a server, an instructor and a trainee station. In maritime training there are four central elements in simulator training: the simulator, the program, the participant and the instructor. We will conduct and make observations during simulation trainings for seafarers, and these trainings will represent a key case for research. Our partner **Simsea** will provide the simulations and the "field" to conduct participant observation during simulation training, as well as the NMA's testing of automation at Killingøy where observations will also take place. These are technology-supported simulations of real, complex maritime operations. The simulation training is of multiple interest to the project as the use of simulation in training includes man-machine interaction and serves as an arena of insight in automation used in operations and the seafarer's interaction with operational technology. The simulator simultaneously carries the possibility to test new automation technology. Drawing on existing psychological models like that of Blooms taxonomy model, defining competence as knowledge, skills and attitudes, we will pay particular attention to learning processes and explore the application, advantages and limitations of these models. Does this psychological model lack a social and cultural aspect? Our exploration of simulation as competency-based training entails an emphasis on holism in seafarers' use of knowledge, i.e., understanding knowledge not in a limited sense, but emphasizing the ability to use knowledge, and the importance of attitudes and experiences that participants bring into the operational field.

Vessels: Seafaring vessels are another site of research, more specifically the vessels of our partner **Knutsen OAS**, where we as researchers will be on board with the seafarers; observing, participating to parts of the navigation and interviewing the crew in relation to actual technology, work forms and relations, navigation and ballast techniques, with a particular focus on the use, management, experience and understanding of these technologies. Our presence at the vessels will vary in time and depend on the company's convenience, and preferably we will be able to observe in practice the use of non-automated (as well as automated) technology, implying that we will observe the management of sea operations both at vessels - and from the mainland. In addition, we will pay particular attention to questions related to the transport of oil and gas and LNG – which is central to both Knutsen OAS's operations and under the NMA and IMO jurisdiction. In fact, IMO has in the last five years more than tripled the publication of reports/issues on automation. **Automation systems:** There are **numerous advanced operations** where sophisticated and innovative digital aids and technology are used in connection to transport of oil, such as in ship-to-ship operations and subsea explorations. The more specific selection of particular automation systems will be dependent on the need of the industries and will be decided in the first year of research. There are several automation processes which could be relevant to ASMOG. On the bridge of vessels, ECDIS, on deck, lifting and docking systems, in the engine room ballast and scrubber systems and externally to the vessel, mooring systems, work of DP and remotely operated subsea operations. These are examples of automation systems which are becoming extremely relevant in the offshore maritime sector and involving new kinds of interaction between the vessel crew and sophisticated automated systems; among the vessel crew; and not least with unpredictable nature and conditions at sea. All these scenarios make manifold and rich areas of study which have been under-investigated in the social sciences. For instance, ECDIS, a new sophisticated navigation system, is extremely accurate, but comes with new risks, as people tend to over-trust the system at the expense of other navigation systems. This and similar phenomena, will be investigated through ASMOG under the rubrics of "safety barriers" and "redundancies".

1.6 Data collection analysis and timeframe

ASMOG is a four years project (see GANTT chart and list of activities): **Phase 1, Initiation (first year):** Identify and anticipate the challenges and needs arising with the automation shift through meetings with the partners and researchers; Identify and adjust research questions and methods; Prepare the ground for our collaborative efforts; Literature surveys and refinement of theoretical tools; Opening workshop in Bergen with partners and members of the advisory board; Begin observations of simulation trainings and plan first publications. **Phase 2, Fieldwork and simulations (second year):** Build new knowledge around the challenges and needs identified in the WPs for instance around the man-machine interaction, the unpredictability of machines, around fear factors, risk assessment, and between machines-nature interactions. As a method to build this new knowledge base, the anthropologists will be on site observing simulation trainings and conducting interviews, following the process of a selected automation project; Organize follow-up meetings with the partners from the industry in order to share updates on recent findings, questions and challenges. **Phase 3, Fieldwork and simulation feedback (third year):** Consolidate the

knowledge base and disseminate knowledge by organizing further events for simulation trainings, followed up by interviews with participants in the simulations as well as meetings with project partners. This phase will take the form of experimental and innovative methods by the use of simulation. This will provide opportunities both for disseminating findings and making further observations, hence creating important feedback mechanisms for researchers and partners. Simulations will thus be central to the project's collaboration with the industrial partners; Produce various reports of relevance to the industries and public institutions. **Phase 4, Completion (fourth year):** Further dissemination of findings, both in the form of reports and academic publications; Identify points of further improvement, development, and possibilities within the industries; Organize an official closing symposium with the partners and the Advisory Board members

Ethical issues, gender, risk: The project's on-site observations of seafarers' involvement in simulated as well as real-life operations may give rise to ethical issues and dilemmas, i.e., in cases where mistakes are made – or more generally that the presence of researchers may be experienced as intrusive. We will therefore inform participants that the purpose of our research is to learn, not make assessments, and that observations will be used to improve the trainings and develop guidelines. Worth noting is also that the collaborating industries already have routines for ensuring ethical conduct with the presence of observers, and that observation is in fact part of the training itself. However, in order not to expose interlocutors to risk or harm, the team will rigorously apply the ethical standards and guidelines of the Norwegian National Committee on Research Ethics for the Social Sciences and the Humanities (NESH), and we will apply for ethical clearance with the NSD. Sensitivity will also be ensured considering how gender/class/ethnicity are defining factors that structure different degrees of vulnerability at the workplace. Here it is worth mentioning that this is a female-headed project conducted in a male-dominated industry, which may bring along certain gender issues and sensitivities. We will deal with this by respecting the dignity and integrity of all categories of participants. Finally, we are aware of the complexity of this collaboration and of the obstacles that can arise especially considering the pandemic restrictions. We will therefore make sure to secure good communication by regular updates and continual dialogue, but also digital alternatives for communication when needed.

2. Impact

2.1Potential for academic impact of the proposed research

On an academic level, this project will create new directions for collaborative knowledge production in terms of theory and methods for understanding the automation shift. This kind of project and approach is not yet represented in the anthropological nor in the political ecology literature. ASMOG thus has a potential to create a new collaborative research model and theoretical framework for future research on automation and maritime operations. Our innovative use of simulation trainings is likely also to inspire other similar studies in other fields. ASMOG will develop the research agenda on automation and work, risk and safety, providing a better understanding of man-machine interaction, public(users)/machine interaction and shading light on inter-communication among the different parties. We will do this by developing important ethnographic knowledge and perspectives on the automation shift, as well as new understandings of interpersonal dimensions of simulation and man-machine interaction, providing an important basis for further studies in the field.

2.3 Potential for industrial impact of the research project

ASMOG's results can be used to the training of seafarers that can further develop the important and fast arising field of automation. This will also benefit industries like Simsea and Knutsen OAS and public institutions like the NMA and the Municipality of Haugesund by contributing to key insights into the automation shift, and its meaning for society and the labor market. Further, ASMOG will reach out to IMO with proposals and guidelines for how seafarers can be trained in the future. Being placed at the intersection between science, industry and public institutions, ASMOG will develop important knowledge of interaction and communication between different groups dealing with automation. It will provide knowledge about coping and resilient mechanisms in overcoming challenges and minimizing risk, human and cultural factors affecting decision-making and the development/implementation of automation, dynamics of power relations and hierarchies at play, conflicts and resolutions. Further, on the basis of our close and innovative collaboration with the industries and public institutions, ASMOG will develop new forms and methods of collaboration of use also for similar projects in the future. Finally, much of the created knowledge and methodology will set a precedent to future projects aiming to facilitate the energy transition, like for instance in the fast-growing offshore wind farm project (Havvind).

2.4 Potential for societal impact and relevance for the UNSDG

The insights created through the project are envisioned to further inform the wider society about ongoing processes, challenges and possibilities related to the automation shift in the maritime sector. By wider society we mean the users of automation and the public in general. In addition, ASMOG will increase the knowledge about how to develop future strategies by providing concrete guidelines on how to make maritime operations

impacted by the automation shift safer both for workers and for the environment. The competence developed through ASMOG and the planned project outputs will provide the basis for value creation in Norwegian businesses and development of the public sector. The project addresses the UN Sustainable Development Goals as automation in the maritime sector is of benefit to at least 7 of 17 SDGs. (SDG3; SDG7; SDG8; SDG9; SDG12; SDG13; SDG14). This being a complex relationship, it needs the study and understanding from a social scientific point of view, especially considering that improvements to O&G production efficiency are often perceived as inimical to energy transition. Central for our rationale and motivation behind this project is that **such improvements in many cases can directly transfer to** the fast-growing maritime sector more generally.

2.5 Measures for communication and exploitation

A detailed description of dissemination plans can be found in the electronic application form and summed up in the GANTT chart. Researchers in the project will publish in peer-reviewed academic journals and recognized academic publishing houses. Academic publication outputs include: 2 special issues, based on findings and exchanges during workshops and including contributions from Advisory Board members, and 1 PhD-dissertation. In addition to academic publications, ASMOG will provide analyses for the industries and institutions which will appear in reports, webpages, on webinar and podcasts. In fact, the partners will be actively involved in the dissemination and utilization of the project results by publishing the reports and by implementing the designed simulation trainings among their costumers and staff. In the last year of the project a documentary about automation will be realized with the support of the Municipality of Haugesund and will be shown at the Haugesund Annual Film Festival.

3. Implementation (see also activities and milestones in the application)

All ASMOG's partners will be participating in planning and following the project. In meetings we shall set milestones. We shall report and brief periodically. Even though the research work will fall on the research institutions, the partners will be able to participate at every stage and suggest adjustments to the needs and milestones accordingly. The partners will contribute with their expertise (technical and legislative); and the academic researchers will contribute with their knowledge and experiences. This combination of factors makes the project very original and scientifically and methodologically creative.

3.1Project manager and project group

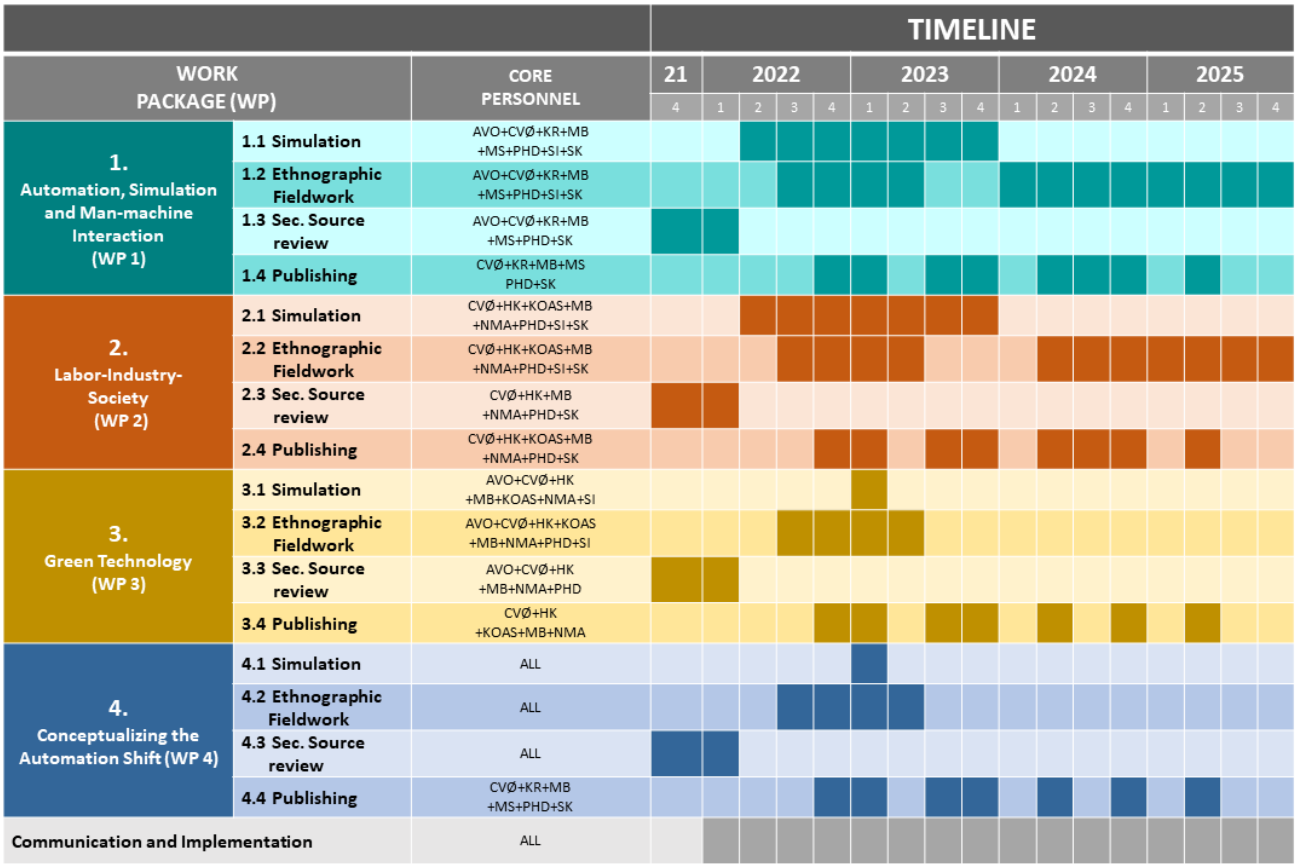
Researcher	*Main Task (with work package)*	*Relevant Knowledge*
Cecilie Vindal Ødegaard (PM), UiB	Overall project leadership and a particular responsibility for WPs 2, 3 and 4, wherein Ødegaard will also conduct research and fieldwork. Take leadership in the publication of results. Carry responsibility for main supervision of PhD candidate and mentoring for Post Doc.	Ødegaard has relevant expertise and experience in the extraction/energy sector in Peru; the energy transition in Svalbard as well as in labor-related research and has demonstrated ability to perform high-quality research. She has proven excellent abilities in mentoring and supervising more junior scholars in research and by leading several joint publications.
Ståle Knudsen (researcher), UoB	Co-supervision of PhD candidate. Collaborate to WP1, 2 and4.	Knudsen has extensive experience in the anthropology of knowledge and technology and has more recently researched interaction between Norwegian corporations and society. Extensive research management experience from project leadership and from being head of department.
Mads Solberg (Prof. II), NTNU	Will co-lead WP 1 and collaborate to WP4. Will contribute with expertise and knowledge about human-machine interactions, simulation-based methods, and the interface between cognitive science and anthropology. Analysis and writing.	Solberg has worked on human-machine interactions in healthcare and the molecular life-sciences. Having managed projects on simulation-based training in healthcare, he is now co-leader on WP1 "Professional epistemology" for the NRC-funded project PROSIM: Professional education and simulation-based training (2021-2024).
Marianna Betti (Post Doc 1)	Will co-lead research design across WPs with particular responsibility for WP1 and 3. Will conduct fieldwork among Knutsen OAS, simulation training at Simsea and have AVO Consulting as second	Betti has extensive knowledge about energy and the anthropology of oil and gas and has conducted extensive fieldwork research in Kenya where she has been following an upstream extractive project.

	field site. She will support publication and dissemination.	
Kjetil Rommetveit (researcher)	Collaborate to WP1 and 4.	Rommetveit has important research interests and expertise precisely in the area of human-machine interaction, in the role of technology in society and in autonomous robotics.
(PhD)	Will work on topics related to WP1 and 2. Will participate to WP4. Fieldwork research at the NMA and Simsea with simulation training.	Anthropologist or other social scientist with experience and knowledge of maritime training and/or seafarers in different operational contexts and/or digital/machine tools especially but not necessarily used in maritime operations.
Knutsen OAS (partner 1)	Will collaborate to WPs 2, 3 and 4 Will provide information about challenges related to ongoing technological projects being carried out in maritime sector. Will provide access to automation processes which will constitute some of the strongest contextual cases of the project. Primary fieldsite for Post Doc.	Long-term world-leading operational knowledge on shipping, bunkering, tankering, LNG transport and other initiatives for greener maritime operations. Leading activities on a number of innovative, digitalized projects in the maritime and offshore operations.
Simsea (partner 2)	Simsea will be the entity providing guidance and knowledge about simulations and training in the maritime sector across WPs. Facilitator and co-leader of WP1. As a center for maritime simulator training, Simsea provides access to the coaching sessions for seafarers and possibility for testing and training for the WPs participants.	Leading operational knowledge on simulators and simulation trainings. Simsea is a training arena for advanced maritime operations which aim to improve the operational competence of maritime personnel, improve their ability to interact and be innovative on board their vessels. Simsea embodies specialized knowledge of simulator technology in maritime training.
AVO Consulting (partner 3)	Will collaborate to WP 1 and 3. Will be providing guidance and knowledge about simulation technology and interaction with costumers. Will be the secondary fieldsite for PhD, Post Doc and other researchers	Leading knowledge organization in the Nordics on how automation, digitalization and innovation change how business models operate and the effect it has on people, culture and organization.
Svein David Medhaug, senior surveyor vessels and seafarers, Norwegian Maritime Authority (partner 4)	Will collaborate on WP 2 and 3. Will mentor the PhD as the PhD will conduct half the fieldwork at the NMA.	NMA has the knowledge of maritime regulations and approval process. Control room restrictions and HMI and limitations are topics NMA has knowledge about.
Arne-Christian Mohn, Major of the Municipality of Haugesund (partner 5)	Will collaborate to WP 2 and WP 3. Will carry out the interests of Haugesund which reflects those of the Norwegian maritime society at large, being Haugesund the largest maritime city in Norway.	Practical knowledge about the social and industrial needs and possibilities in the area. Work with projects, for instance on development of autonomy, maritime policy. Network and contacts.
Advisory Board: An international advisory board will be actively involved throughout the project. Members will monitor the progress of the research via project reports submitted to them by the PM, peer review, they will be invited to give lectures and to take part in the final symposium in year 4. Members are Hannah Appel, Antonio De Lauri, Mette High, Thomas Hylland-Eriksen, Eric Monteiro, Timothy Morton, Anders Røyrøy and Elisabeth Schober.		

3.2 Project organization and management

The core research group (**PM, researchers, Prof. II, PhD and Post Doc**) will collaborate, publish together, guide and cross-fertilize each other's research. In addition to fieldwork (and participation in international conferences), the PhD and Post Doc will visit Universities abroad as guest researchers. The PM will assist the PhD and Post Doc in applying for such funding from the RCN or UoB. ASMOG will unite the intellectual work of the core research group with the input of scholars who come with specific thematic expertise and who

make up the project's **multi-disciplinary advisory board**. **Appel** for her expertise on larger issues of energy, extraction, offshore infrastructures and capitalism. **De Lauri** for his broad theoretical and empirical knowledge on contemporary geopolitical dynamics and global entanglements. **High** for her expertise on work and oil and gas operations and for her leadership to the Energy Ethics project at University of St. Andrews. **Hylland Eriksen** for his world-known scholarship on the complexity of energy, capitalism and acceleration**. Monteiro** for his research on digitalization especially on large-scale infrastructural projects. **Morton** for his excellent philosophical scholarship on the intersection of machines and nature. **Røyrøy** for his expansive knowledge about automation and robotics for remote operation and finally **Schober** for her outstanding research on international cargo shipping and cargo ports and for her leadership to the ERC funded PORTS project at University of Oslo.



List of abbreviations: AVO (AVO Consulting); CVØ (Cecilie Vindal Ødegaard); HK (Municipality of Haugesund); KOAS (Knutsen OAS); KR (Kjetil Rommetveit); MB (Marianna Betti); MS (Mads Solberg); NMA (Norwegian Maritime Authority); PhD; SI (Simsea); SK (Ståle Knudsen)

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