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Understanding and improving safety in artisanal fishing: A safety-II approach in raft fishing

Maria Christine Werba Saldanha[a], Ricardo José Matos de Carvalho[b], Rodrigo Arcuri[c], Ana Gabriella Amorim[d], Mario Cesar Rodriguez Vidal[c], Paulo Victor Rodrigues de Carvalho[d,*]

[a] Programa de Pós-Graduação em Engenharia de Produção da Universidade Federal da Paraiba (UFPB), PB, Brazil
[b] Programa de Pós-Graduação em Engenharia de Produção da Universidade Federal do Rio Grande do Norte (PEP/UFRN), RN, Brazil
[c] Programa de Pós Graduação em Engenharia de Produção da Universidade Federal do Rio de Janeiro (PEP/COPPE/UFRJ), RJ, Brazil
[d] Comissão Nacional de Energia Nuclear, Instituto de Engenharia Nuclear, Cidade Universitária, Ilha do Fundão, Rio de Janeiro CEP 21941-906, RJ, Brazil

ABSTRACT

Artisanal fishing with rafts is responsible for most of the Brazilian Northeastern region fishing production. Fishing is done in open sea, with very small boats in the unpredictable and often hostile maritime environment. Safety is achieved through the fishermen's expertise to adjust their performance to cope with the demands and disturbances. Under this environment, safety should be improved by constraining the way people do things, based on traditional safety management principles or Safety I. This research describes a Safety II approach to improve raft fishing safety in a typical Brazilian beach community. Safety II main focus is on fishermen activities and strategies to construct safety during their fishing expeditions. The methods, following the action research iterative procedure, are workplace empirical studies to uncover knowledge, expertise, and artifacts that inform fishermen sensemaking and the Functional Resonance Analysis Method FRAM to model the fishing capture expeditions. Results indicated that the fishermen's safety related trade-offs during fishing expeditions depends on their sensemaking, and to improve safety there is a need of a broader, systemic and continuous approach, involving not only objective measures and devices to inform and to support sensemaking for safer decisions, but also ways improve survival conditions of fishermen.

1. Introduction

The artisanal fishing system studied in this paper – raft fishing in Brazilian Northeast coastline – has no formal safety system (no external safety-inspections, instructions, or any other formal safety instructions) as in the traditional industry sectors. This is an activity primarily based on personal knowledge (on fishing, raft navigation, and safety), consisting of a replicable, orally transmitted set of specialized skills, and culturally shared practices and beliefs that have stood the test of time (Diegues, 2002). Therefore, the levels and kinds of risks to health and safety depend on the environmental, social, economic, and cultural context. Interactions among these factors can contribute to increasing or diminishing risk perception (e.g. leading fishermen to abort fishing due to weather or sea conditions), which in such a loosely-controlled work space is very important for workers' safety. Under such characteristics, the Safety-II perspective appears to be the more adequate way to analyze and improve safety.

Morel et al. (2008) investigating decision-making of professional sea-fishing skippers concluded that traditional safety measures improve safety is done in "detriment of self-managed safety" (Morel et al., 2008, p-14). They also envisioned the need of new safety methods that cope with "the two types of safety, constrained on one hand, and self-managed on the other" (Morel et al. 2008, p-14). Nowadays, it is becoming clear that the Safety II (Hollnagel, 2014; Sujan et al., 2017) framework has the concepts and methods under such a holistic vision of safety could be created. Safety-II can be viewed as system and/or people abilities that keep the system functioning under varying conditions, in order to have the higher possible number of intended and acceptable outcomes (Hollnagel, 2014). From a Safety-II perspective, the purpose of the safety management in artisanal fishing systems, like the one described in this research, is to facilitate as much as possible the ways in which things can go right, in the sense that fishermen have safe fish capture expeditions.

Therefore Safety II issues on raft fishing are related to the navigation abilities with very small boats (the rafts) in the ever-changing maritime environment. Fishermen navigate along the coast (3–10 km) in expeditions of around 8 h with sail and/or small motor propulsion, and there is a risk to be adrift (when propulsion fails), to turn the raft, and occupational injuries due heavy load and physical demands of the activity. Safety in this situation involves complex processes, especially in decisions to abort or continue navigation due to weather, sea, or raft conditions. The major part of understanding whether safe conditions still exist relies upon the sensemaking (Klein et al., 2007; Klein et al., 2006), or common sense (Thorvaldsen, 2013) of fishermen. In this work

* Corresponding author.
E-mail addresses: agaap@ien.gov.br (A.G. Amorim), paulov@ien.gov.br (P.V.R.d. Carvalho).

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environment, the Safety-II perspective providing conditions for fishermen to succeed under expected and unexpected conditions, according to their actual work conditions, appears to be the most adequate way to improve safety in artisanal fishing settings.

The main research question that drove this study was:

How a Safety-II perspective can improve the understanding of safety in artisanal fishing, enabling the development of useful, practical and applied safety measures?

Other research questions needed to answer the first one are:

- What is the current context, practices, and functions involved in the safety of fishing expeditions?
- What are the existing sensemaking behaviors that inform decision-making during fishing expeditions?
- How can workers' safety actually be improved considering the environment in which artisanal fishing is situated?

2. Background and literature review

2.1. Artisanal fishing with rafts at Ponta Negra beach

Brazil fishes at sea about 580 thousand tons per year (Castello, 2010). The fishing communities represent a population of approximately 800,000 artisanal fishermen, involving 2 million people who produce about 55% of the national fishery production (Callou, 2010). In 2007, 28.8% of the national fish production occurred in the Northeast coast (Fig. 1) and artisanal fishing was responsible for 96.3% of this production (Castello, 2010). An important part of artisanal fishermen uses the "jangada" (raft), a secular sail-vessel with dimensions ranging from 3 up to 8 m that is suitable for the type of sea, wind and sandy coast found in the area (Diegues, 2002).

This study was done in the Ponta Negra beach located in the Rio Grande do Norte (RN) State. Rio Grande do Norte, in its 410 km of coastline, has 25 coastal municipalities, 97 fishing communities and about 13,000 fishermen who carry out the activity for subsistence and commercial purposes. Of the RN registered fishing fleet, 28.5% (1071) are rafts, which in 2007 have caught 2175t of fish (IBAMA, 2007). Of the 381 vessels registered in the Colonia Z-04 Fisheries and Aquaculture of Natal, where Ponta Negra is located, 22.8% (87) are rafts.

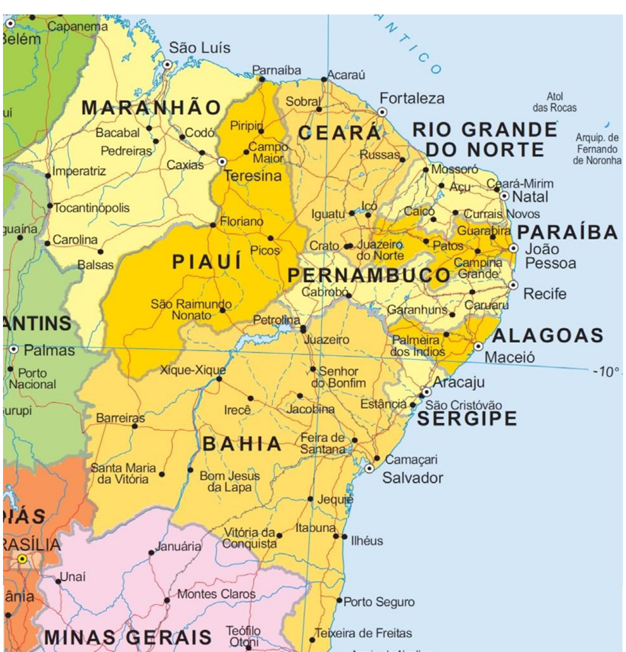

Fig. 1. Map of Brazilian Northeast region.

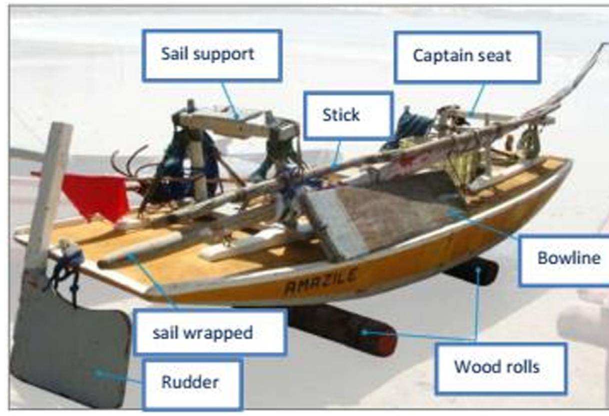

Fig. 2. The raft used for fishing at Ponta Negra. .
Source: Jaeschke, 2010

The Ponta Negra fishing community was chosen for this study because it is one of the main raft fishing communities of Natal, capital of Rio Grande do Norte State, the city where is located the university and the research group who developed this research. This community lies and has its fishing based at the most famous tourist beach of the state, the Praia de Ponta Negra. Artisanal fishing still represents an important participation in the production and commercialization of the fish in Natal city, whose main consumers are the restaurants and hotels of the city. It is a traditional community, similar to many others existing in Brazilian Northeast coast, where raft fishing occurs. Ponta Negra was initially populated by artisanal fishers, very small farmers, and currently by artisanal fishermen, workers, street vendors, and public employees. Another important issue for the choice of Ponta Negra concerns the demands on the safety and health of fishermen that appeared after a screening on Natal poor communities (Saldanha et al., 2012). Fig. 2 shows the raft used for fishing at Ponta Negra measuring from 3.6 to 5.14 m in length and 1.4 to 1.7 m in width, weighing around 642 kg, accommodating 2 crewmembers: the captain or master and a helper or bowmen that carries out different functions.

Rafts were originally designed to be propelled by sail, but the use of a small fuel engine for propulsion began in 2005. Currently, rafts design was adapted to use engine propulsion (ways to attach the engine to the Captain seat and a shaft added to the propeller) and most of the fishermen prefer to use the engine. It reduces the dependence of wind conditions and navigation time, thus reducing working time and improving the quality of the fish caught. The use of the engine decreases physical workload (required for sail navigation) and reduces the shipwreck events. When the engine is used, the master (captain) drives the vessel almost by himself, reducing the need for help from the bowman. However, with the engine, the costs of the shipment were increased. Fuel consumption varies from 4 to 6 L per shipment.

The fishing expeditions occur from Tuesdays to Saturdays. The weather and sea conditions during the summer (December-March) are more favorable than during the winter season (June-September) – characterized by intensive period of rains – resulting in more productivity on summer season. A 2010 study on fishing production with 11 rafts in January and 12 rafts in June showed that in January the 11 rafts completed 81 expeditions capturing 2854.5 kg of catch, averaging 35.24 kg per expedition. In June, the 12 rafts completed 106 expeditions, capturing 1211 kg of catch, averaging 11.42 kg per expedition (Celestino et al., 2012).

Fig. 3 shows the steps of the fishing expeditions. The raftsmen depart to the sea either in the small hours (2:00 a.m.), returning in the morning (between 8:00 a.m. and 9:00 a.m.), or in the afternoon (2:00 p.m.), returning after dusk (between 8:00 and 9:00 p.m.). The duration of the expedition varies from 3.5 to 9 h, depending on propulsion type (motor or sail), meteorological conditions (wind speed and direction),