Abstract
The present paper reports a study composed of three research activities exploring the economics of ergonomics in a shipping context. First, a literature study aimed to review previous studies on the economics of ergonomics in general and within the maritime domain in particular; and moreover, to ascertain the key ergonomic factors addressed in contemporary maritime ergonomic research. Second, the concept of ergonomics was probed from a stakeholder perspective through nine semi-structured qualitative interviews. Third, structured interviews were held with representatives of ten Swedish shipping companies to investigate if the shipowners are aware of and calculate the economic effects of ergonomics.

The results show that several models and methods have been developed to estimate costs and benefits of ergonomics in other industries, but no studies were found from the shipping industry. Whether these methods can be readily adapted to the shipping industry has to be investigated further. While contemporary maritime ergonomic literature showed a focus on physical ergonomic and health and safety issues, the results of the stakeholder interviews indicated a focus on organizational ergonomics. The Swedish shipowners calculate the costs of sick-leave, but do not estimate the economic effects of ergonomics on a regular basis.

Key words: Maritime Ergonomics, Human Factors, Work Environment, Economics, Shipping Industry.

1 Introduction
Ergonomics is a science of designing for human use, with the purpose to fit systems, tools, machines, and environments to the physical and mental abilities and limitations of people (Chapanis 1996). In addition to the ergonomic challenges of any industry, a ship at sea is subjected to some domain specific difficulties. Despite changes in work tasks onboard, towards more monitoring and administrative work, shipping
still suffer from a high level of occupational accidents (Bloor, Thomas and Lane 2000; Hansen, Nielsen and Frydenberg 2002). The maritime work environment has a high incidence of physiological and psychological stressors (Comperatore, Rivera and Kingsley 2005). The constantly moving surface and whole-body vibrations induced by sea and machinery can cause accidents, musculoskeletal disorders (Törner et al. 1994) and fatigue (Lützhöft et al. 2007). Moreover, the ship is a social and intercultural environment where crew of mixed nationalities and cultures besides work, also live, eat, and socialize together. Life onboard have been characterized by high demand and low control (Carter 2005), a combination well known to cause stress (Cooper and Marshall 1976; Karasek and Theorell 1990).

It is always costly for a ship operator when a ship has to be taken out of service due to accidents, pending investigations, detentions, or repairs. Besides the direct costs involved, it can lead to increased insurance premiums, lost business opportunities and loss of goodwill. Nevertheless, ergonomic deficiencies are not always recognized as production problems with a potential influence on the company’s bottom line. Rather, ergonomics tends to be regarded as a field where money is spent with little or no return on investment, a cost rather than an investment.

However, many ergonomists trust that what is good for the work environment is also good for business, and several studies support this opinion. Research on workplaces ashore show a strong relationship between a number of ergonomic issues and performance by way of increased production, higher quality, less cassation and less personnel turnover (Abrahamsson 2000; Axelsson 2000; Eklund et al. 2006; Goggins, Spielholz and Nothstein 2008).

The present paper reports an ongoing research project examining the economics of ergonomics within the shipping industry. The objective of this paper is to address the following questions:

- Are there any previous studies reported on the costs and benefits of ergonomic work in the shipping industry? If not, can models and methods developed within other domains be applied in shipping?
- Which key ergonomic factors are addressed in previous maritime ergonomics research?
- Which ergonomic factors do the shipping industry consider most important to address?
- Do Swedish shipowners calculate the economic effects of the work environment?

The paper is limited to comprise merchant ships of 500 Gross Tonnage and above, covered by the mandatory ISM Code (IMO 2002). Naval ships, fishing vessels, training ships and so called traditional ships are not included.