

# Maritime Digitisation and Its Impact on Seafarers' Employment from a Career Perspective

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## ABSTRACT

This paper discusses the potential implications of maritime digitisation and automation on seafarers' careers. While Industry 4.0 implies the modernisation of work in general, it is anticipated that Industry 4.0 will have an impact on seafarers' employment on board contemporary ships. Previous analyses of seafarers' work seem to focus on merely the 'present – future' scenario and overlook seafarers and their career trajectories. Based on an extensive literature review on careers in the global labour market as well as on Industry 4.0, the paper discusses how current career prospects among seafarers may be affected and what alternatives for employment they might have after graduating from maritime education and training (MET) institutions. The paper presents preliminary remarks on career opportunities for seafarers and possible socio-economic implications on future maritime careers in the context of Industry 4.0. It concludes with a set of agendas to support individuals and MET institutions in this transition.

## 1. INTRODUCTION

Ships have been the main means of delivering goods around the world for hundreds of years [1], and nowadays over 73 per cent of global trade (by volume) is done by sea [2]. Despite the endurance of this industry, roles and skills at sea have changed over the centuries [3, 4]; roles like radio officer and carpenter no longer exist, and roles like administrative officer and electrical technician that did not exist in the past exist now. In the era of digitisation with cyber physical systems, so-called "Industry 4.0", seafarers are increasingly expected to adjust and advance their skills to be more digitally inclined [5].

Industry 4.0 is spreading at a much faster pace in the wider supply chains [6]. In shipping, testing autonomous or unmanned vessels has been driven by the industry, which is creating controversy among various maritime stakeholders; the International Maritime Organization (IMO) is currently undertaking a scoping exercise of 'Maritime Autonomous Surface Ships (MASS)' [7]. If autonomous or unmanned ships are introduced, one of the most affected stakeholders would be seafarers who are responsible for operating ships on board [5]. Current debates tend to focus on the advancement of technologies, which has the potential to replace humans with machines through automation [8]. However, the majority of management practices tend to focus on the effects of organisations on the physical environment while neglecting the human and social environment for sustainability [9]. This paper argues that the human element, and more specifically seafarers and their career prospects, would help a socio-economic sustainability of maritime industries by planning how to cultivate and utilise

maritime talents.

To address these issues, the paper presents a literature review of Industry 4.0 in shipping as a background. The review is followed by a discussion of careers, addressing changes to the nature of careers over the past four decades. Finally, the paper examines the implications of increasing automation and digitisation of processes and roles in the shipping industry and possible implications for maritime education and training (MET).

## 2. INDUSTRY 4.0 IN SHIPPING

Humans have experienced several industrial revolutions since the late 18th century when water- and steam-powered machineries accelerated manufacturing of goods [10]. Shipping has benefitted directly from such technological developments in terms of improved ship design technology and increased trade across the oceans, followed by mass production during Industry 2.0 in the 19th century. In the 20th century when Industry 3.0 introduced the first computers and automation [10], shipping has significantly increased its volume of cargos and the opportunities of maritime careers, including sea- and shore-based jobs [11].

In every industrial revolution (see Fig. 1), some jobs are created and others lost; in this context, technology and employment often bring controversy in public debates. In the UK, Industry 1.0 resulted in the use of machines abolishing people's jobs in the textile industry. Similarly, the previous industrial revolutions largely affected a single sector; for example, farmers were replaced by agricultural mechanisation. This is no longer the case with Industry 4.0, which has been moving rapidly across different sectors and at different skill levels. There are already signs of employment polarisation between low- and high-skilled non-routine jobs while jobs at medium skill levels have declined [2].

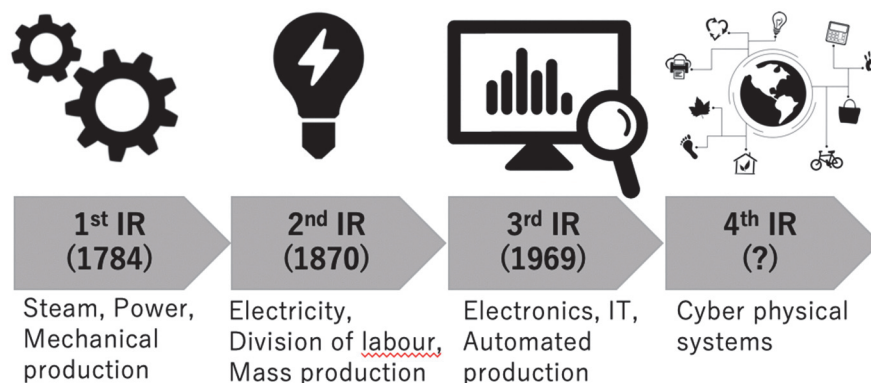


Fig. 1 A glance of Industrial Revolutions (Source: Authors)

Future maritime jobs and skills are becoming a major concern when it comes to implications of Industry 4.0 [5], such as cyber security, absence of regulations, and people's lack of trust in technology [12, 13]. A recent WMU report identified gaps in new and emerging technology readiness between developed and developing countries as well as the need for training for seafarers to adapt and equip them with the new required skills, such as operations monitoring and system management [5]. Industry 4.0 will bring a paradigm shift whereby seafarers increasingly interact with machines and shore-based personnel. This highlights the importance of leadership and communication skills in the context of ship operations in Industry 4.0 to facilitate human-machine and human-human coordination [14].

While this technology-driven trend ruling employment is one approach in the adaptation

process to digitisation, there may be other ways to support digital transformation with a higher emphasis on humans than technologies. Technology-centred approaches are limited because of the lack of awareness of human potential to understand a whole system of work as well as the limited understanding of individuals' career perspectives/trajectories [15]. Kulikov argues that humans' cognitive skills humans are not merely there to reach abstract thinking but also to reach a deeper understanding of meaning [16]. Such human-centred approaches can be considered as an alternative to the currently dominant technology-centred approaches which attempt to replace humans with machines through automation.

### **3. CHANGING NOTIONS OF CAREERS**

Within the framework of human-centred approaches, this paper focuses on how seafarers' future employment can be supported by career development perspectives. Seafarers' career prospects have changed over time [17] and this needs to be contextualised in wider employment practices across the industries. We begin with a review of the literature relating to careers from a historical perspective. Based on the examination of classical and modern notions of careers, the paper then provides a discussion on seafaring career trajectories and potential implications of digitisation on maritime jobs.

#### **3.1. CLASSICAL THEORIES ON CAREERS**

The notion of 'career' is based on the concept of bureaucratisation in organisations, dating back to the 19th century and developments in the industrial revolution [18]. For the purpose of this paper, 'bureaucratic' organisations are those deploying traditional employment practices, where workers retain an uninterrupted career in the same organisation for the duration of their working lives. A 'bureaucratic career' [19], often referred to as 'organisational' [20, 21], or as a 'traditional' [18, 22] career, involves a succession of positions in a strictly defined hierarchy [23], characterised by the logic of linear advancement, usually within a single organisation. Clarke notes how the concept of the bureaucratic career was implicitly present in Max Weber's theory of 'The Ideal Bureaucracy', featuring references to 'promotion based on technical competence' [21]. Additionally, in his book 'The Organisation Man', Whyte notes how workers with bureaucratic careers are not solely employed in a particular organisation but also belong to it [24]. In addition to the above characteristics, Merton indicates how bureaucratic occupations have a 'life-long tenure' and how they maximise 'vocational security' for individuals [25].

Individuals planning a 'career' are likely to make longstanding choices when it comes to the development of their knowledge and skills. Investment in training and skill development can be linked to the idea of the 'bureaucratic career', especially when it comes to an individual's career management. Most decisions relating to the management of bureaucratic careers are generally made by the employer [24], where the 'assignment of roles occurs on the basis of technical qualifications which are ascertained through formalised, impersonal procedures' [21]. In this case, employees would generally follow a mostly hierarchical route for advancement and would receive organisational support in their career development [25].

#### **3.2. CAREERS AND SKILLS IN MODERN ORGANISATIONS**

Changes to the classic model of careers started in the 1980s, when worldwide economic

factors led to uncertainty and increased competition among international companies [17]. These changes occurred due to different factors, e.g. mass layoffs and the flattening of traditional hierarchies [19, 21, 26] which put pressure on organisations worldwide to ‘push for greater profits and be more flexible in contracting their employees’ [27]. These changes facilitated a greater flexibility in employment [27] and contributed to the rise of a new career model, often referred to as a ‘flexible’ [19, 21], ‘boundaryless’ [28, 29, 30, 31] or ‘portfolio’ [32] career. Unlike the bureaucratic career that is ‘conceived to unfold in a single employment setting’ [33], flexible careers break traditional assumptions about hierarchy and career advancement [34]. Flexible careers emerged as a retort by individuals to the diminishing availability of bureaucratic careers within organisations and to the breakdown of organisational support. Consequently, employees were faced with a ‘new era’ of employment, where they were inescapably responsible for their own fate, and where they could no longer rely on organisational support in the development of their skills and the provision of life-long employment.

It is evident that modern employment practices affected the notions of shore-based careers in terms of bureaucracy and flexibility; however, how can we understand the careers for seafarers? Based on the review of classical and modern notions of “career”, the next section addresses seafarers’ careers in this context.

#### **4. UNDERSTANDING CAREERS FOR SEAFARERS**

Seafarers are the main workers in shipping, and there are approximately 1.5 million seafarers operating the world’s fleet [35]. Before presenting the implications of Industry 4.0, we describe some of the changes in the shipping industry that had impacts on the nature of careers in shipping.

##### **4.1. CHANGES TO EMPLOYMENT IN THE SHIPPING INDUSTRY**

Several global processes influenced the shipping industry over the years which facilitated the shift to a more flexible work environment. Open registry of vessels is one important process which has impacted different aspects of employment within shipping; e.g. a growing search for economic labour to crew internationally flagged vessels by ship owners [36], an increasing use of third-party manning agencies to recruit seafarers [4], and an upsurge in the number of temporary contracts issued to seafarers [37, 38].

An additional cost-cutting practice that has become commonly used among ship owners is reduced investment in seafarers’ vocational training compared to the past [39]. In the past, training was provided to seafarers by their employers [40, 41, 42]; however, nowadays, most of the costs associated with training are borne by seafarers and their families [4, 39]. In line with the changes described, seafaring careers have become increasingly flexible and casualised, while at the same time maintaining some of the bureaucratic characteristics of employment.

##### **4.2 A CAREER IN SHIPPING – COMBINING BUREAUCRACY AND FLEXIBILITY**

Seafaring as an occupation combines some features of bureaucratic employment with those of flexible employment [17]. Whilst hierarchical advancement is a major component of a seagoing career, presenting the option of a continuous career for some seafarers [43],

seafarers are becoming increasingly mobile due to the aforementioned employment practices. Seafarers shift from company to company, vessel to vessel, and voyage to voyage in order to advance their careers [4, 39]. In this respect, seafarers might develop long-term careers at sea based on sporadic, temporary employment contracts as part of a ‘continuous’ employment trajectory.

#### **4.3. AUTOMATION AND DIGITISATION IN SEAFARING CAREERS**

We are seeing just the beginning of the effect of Industry 4.0 in the maritime sector. The extreme end of digitisation in shipping is often discussed through the narrative of autonomous ships or unmanned vessels which are slowly entering our lives. The world’s first all-electric container feeder from Norway, YARA Birkeland, will be fully autonomous by the end of 2020 [44]. The Mayflower Autonomous Ship Project is another attempt to cross the Atlantic Ocean by 2020 [45]. While these projects are eye-catching, the majority of existing vessels are still a long way from fully automated operations. Thus, it would seem that the human involvement in shipping is still required in order to operate the world’s fleet; however, seafarers’ skills and qualifications are likely to change in the foreseeable future.

Changing roles and skills required for seafarers in modern shipping are considered to affect seafarers’ career prospects. After a number of years of working at sea, seafarers often shift ashore to take shore-based jobs in areas such as ship survey, port management, maritime lecturing, maritime administrations, ship repair and marine equipment, marine insurance, ship broking and finance, ship classification, maritime law, and offshore work [46]. Faststreams surveyed over 2,000 maritime industry professionals, including 823 serving seafarers, regarding the differences between perception and reality about seafarers’ careers at sea and ashore. The report highlights the challenges experienced by seafarers when shifting to shore-based careers, not only due to the salary drop compared to their earnings at sea, but also abandoning the respect gained from a hierarchical ship work environment and assimilating to a completely different organisation of work from the beginning, and even possibly moving to cities with their families [47].

In addition to these challenges associated with seafarers’ career transition to shore, digitisation is expected to create an increased connectivity between ship and shore and an increased number of shore-based ship operations may become the mainstream [48]. Digital connectivity also opened up the emergence of new business models in maritime operations, for example, in Norway [14]. While new industry players participate in maritime operations, seafarers’ career trajectories may inevitably expand outside the traditional maritime industrial spheres to include work in other industries.

#### **5. CHALLENGES IN MET INSTITUTIONS TO SUPPORT SEAFARERS’ CAREERS**

The minimum standards for seafarers’ certifications are internationally regulated under the international convention on Standards of Training, Certification, and Watchkeeping (STCW) [37, 39]. If the industry demands a new set of skills, this is likely to raise questions in MET with respect to training based on the minimum standards sufficient to guarantee seafarers’ employability. Such anticipation by MET institutions is inevitable; however, as long as the STCW convention remains the same, maritime administrations will not have adequate justification to advise MET institutions to change their curricula. Additionally, even if future

maritime skill sets were possible to predict, it would be challenging for educators to ensure their students are appropriately equipped for their maritime careers at sea and ashore.

Furthermore, MET continues to upgrade seafarers' knowledge and renew their certificates regularly while on shore leave. As the costs for maritime education are generally borne by seafarers [4, 17], the general flexibilisation of labour among seafarers working in the global labour market, MET's role in supporting seafarers' careers in Industry 4.0 remains in question.

## **6. CONCLUSION**

The paper reviewed the literature on digitisation and automation within and beyond the maritime industry and identified the limitations of a technology-centred approach, thus suggesting the inclusion of a human-centred approach, including the consideration of seafarers' careers.

While emerging maritime job opportunities require digital skills linked to operations monitoring and system management, there seems to be a gap between the minimum standards of STCW and the advanced digital skills to ensure seafarers' employability. This would pose a new challenge for MET institutions globally. In addition, due to the bureaucratic and flexible careers practised in shipping, the responsibility for career development tends to be carried by individual seafarers. This problem also relates to MET in terms of how MET institutions can support seafarers' career development as life-long learning providers. The paper argues that the responsibility for adaptation to Industry 4.0 should not be placed solely on seafarers but on other stakeholders, including shipowners and other industry players, governments, and MET institutions, in order to strategically design future maritime career opportunities to build capacity for the sustainable maritime industry.

The discussions presented in this paper are limited to literature review only. Future studies can be empirically developed to investigate seafarers' possible career trajectories as well as MET funding issues to support seafarers' career development in the era of Industry 4.0.

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