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Determination of Parameters to Model Seafarers' Supply in Latvia

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ABSTRACT: Shortage of seafarers is important topic as maritime industry plays a key role for economy of the European Union. According to the latest assessment of economic value of shipping industry in 2012, the EU shipping industry is estimated to have directly contributed €56 billion to GDP, employed 590,000 people, and generated tax revenues of €6 billion. During recent years increasing attention is paid to the education and training of seafarers as the seafarers and their knowledge are essential to sustainable development of the maritime cluster, as indicated in the maritime strategy of European Union. Indicative estimates suggest there were almost 38,000 students/cadets in maritime academy – type training across the EU and Norway in 2012, a 11% increase from 2004. Understanding of current trends in the pool of seafarers is prerequisite for successful implementation of the strategy. Main obstacle for assessment of effectiveness is lack of possibilities to monitor contribution from maritime education institutions to current state of European seafarers' pool. The aim of this article is to show parameters which should be taken into account to model seafarers' supply in future. The parameters are discussed on the basis of information from the Seamen Registry of Maritime Administration of Latvia.

1 INTRODUCTION

Nowadays wide attention within maritime society is paid to the shortage of seafarers. The main reason is that the skills and experience of seafarers are vital to the smooth functioning of the shipping industry, and are also highly valued by enterprises in the wider maritime cluster and beyond (Oxford Economics, 2014).

The worldwide supply of seafarers in 2010 was estimated to be 624,000 officers and 747,000 ratings, while the current estimate of worldwide demand for seafarers (in 2010) is 637,000 officers and 747,000 ratings (BIMCO/ ISF 2010). As one of the response to shortage of seafarers the International Maritime Organization in 2008 launched campaign "Go to sea" to attract entrants to the shipping industry (IMO 2008).

However, it takes time to give results for such a campaign therefore it is difficult to assess the results if there is no available information about changes in number of entrants. The Task Force on Maritime Employment and Competitiveness in their report underlined the need for reliable data to assess the scope and scale of the problems regarding shortage of seafarers (EC, 2011a).

European Union (EU) policy papers also underlines the importance of shortage of the seafarers as the seafarers and their knowledge, skills and competences are perceived as important resource for the development of sustainable European maritime cluster. European Maritime Safety agency is

developing unified database collecting the information regarding the issued certificates of competency by EU member states. While this data system is not launched it is difficult to predict what will be the possibilities of such a system. The problem with the data is clearly stated in Study on EU seafarers' employment - it is clear that detailed data on maritime employment is scarce, sometimes outdated and often not reliable. Moreover, the great differences from a country to another are in data collection and presentation of results prevent all serious analysis on employment structure and evolution (EC, 2011b).

This article shows the experience of the Seamen Registry of Maritime Administration of Latvia (MAL) in analysis of parameters (number, age, qualification) and processes (inflow, outflow) of Latvian Seafarers' pool as the basic factors for modelling seafarers supply. The article discusses the pool of certified seafarers with regard to number, qualification, age group and shows the inflow and outflow parameters for deck and engine officers. As the general workers on board are represented by ratings, who are relatively unskilled and have less training than the officers, therefor trainee officers or cadets provide a necessary new input into the industry. (Glen, 2008)

2 DATABASE OF LATVIAN SEAMEN REGISTRY

Information is the basis of any analysis The Seamen Registry of Maritime Administration of Latvia uses information from the database of the Latvian Seamen Registry to analyse processes and parameters of pool of seafarers. The main aim of the database of the Latvian Seamen Registry is to serve for seafarers' certification purposes according to national and STCW requirements. The database contains information not only about the issued certificates but also about the employment, education, training and seamen discharge book. See table 1.

Table 1. Data areas, sources and main information fields of database of Latvian Seamen Registry (MAL 2014)

Data area	Main data provider	Main fields
Personal data	Seafarer	Birth date, place of living, nationality
Certificates of competence and other qualification documents	Issuing organization, seafarer	STCW reference, validity of endorsement
Education	Education institution	Name of programme, qualification, STCW reference, graduation year
Training	Training organization	Training course, STCW reference, validity of course, course date
Employment	National crewing agencies	Ship name, flag, employment, period, capacity on board

The database is based on the seafarer as data unit and related records of individual person. Each person in database has his/her own information blocks, where records regarding to his education, training, and employment certificates can be found. Main data providers are the Seamen Registry, seafarers, companies and training centres.

3 THEORETHICAL CONCEPT OF SEAFARERS' POOL MODELING

Concept of "shortage of seafarers" is linked with two estimated figures and means difference between figures of supply of seafarers and demand of seafarers. Number of ships, size, type and manning requirement on them serves as basis for calculation of demand figures. The information mostly is collected from various sources such as administrations, questionnaires or industry representatives for supply figures (Glen, 2008; Li & Wonham, 1999).

The supply /demand analysis is described by Waals and Veenstra in their article "A Forecast model and benchmarking of the supply and demand of maritime officers" (Waals, 2002). The methodology for modelling Latvian seafarers' supply in future is developed on the basis of Waals' and other researchers' works in this field.

The demand for Latvian seafarers is not analysed in this article as Latvia should be considered as seafarers' supplying country (EC, 2011a) and most of the Latvian seafarers are employed under foreign flags on ships owned by foreign shipowners. In 2013 only 6% of seafarers were employed on ships under Latvian flag according to data analysis from the database of the Latvian Seamen Registry. Therefore, national demand for seafarers is limited and demand is driven by international fleet development.

As any labour model, the seafarers' pool model is stock model where the present condition depends on inflow and outflow processes.

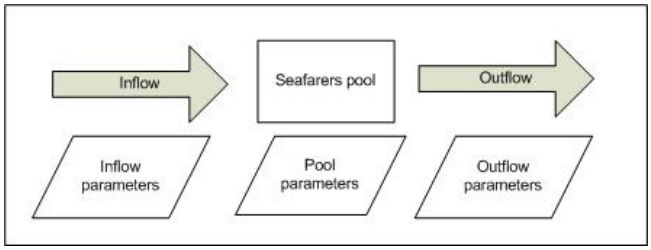

Figure 1.Simple concept of seafarers' pool (authors)

Although seafarer can be considered as any person working on board this article focuses on qualified seafarers – persons holding document of qualification issued by the Latvian Seamen Registry. STCW reference in this article is used to indicate qualified seafarer holding qualification document containing reference to STCW Convention. Therefore, active seafarers in context of this article are persons who hold valid documents of qualifications and are available for shipboard employment. It is not possible to use data from database to determine those who are not seeking to work on board ship or inactive seafarers (Glen, 2008) as the data reflects facts not decisions. Considering qualification as the basis of determination of number of active seafarers additional attention is paid to the officers' pool inflow

parameters looking to the maritime education and training system where graduates are obtaining qualifications.

4 SEAFARERS' POOL PARAMETERS AND PRESENT CONDITIONS

Number, qualifications and age can be considered as main seafarers' pool parameters. Ship's type, size and flag on which seafarers are employed can be considered as additional parameters for the employed seafarers. However, this article focuses on available pool; therefore, employment parameters are not discussed. The data about the employment cannot provide complete picture of the active number of Latvian seafarers as approximately 10% of seafarers are employed directly or through foreign crewing companies, which are not obliged to provide data about employment to the Latvian Seamen Registry. Also part of seafarers does not work on board ships regularly, therefore it is difficult to assess the accuracy level of the employment data.

The number of seafarers in Latvia is calculated every year with reference date – the 1st of January. The number of valid documents of competence or qualifications such as certificates of competency or certificates of qualification is taken as the basis of the number of seafarers. The validity period of endorsement or qualification document is five years, therefore it is assumed if the endorsement is not revalidated seafarers have left the pool of active seafarers. Similar approach is used in United Kingdom (UK) where the active number of officers is based on data on those seafarers who are holding Certificates of Competency (CoC) (Department of Transport 2013). The difference with the UK approach lies in determination of number of ratings as in UK these data comes from a membership survey conducted by the Chamber of Shipping but in Latvia the validity of qualification document is used.

The last valid certificates are taken as indicator in calculations, showing the qualification and its level as person can have two or more valid certificates at the same time.

The active or employed seafarer is person who holds a valid certificate and therefore can be employed on board. The published figures about the number of seafarers reflect the number of persons with valid certificates even if they are not employed on board in particular year. The size and structure of active seafarers' pool in Latvian is given in table 2.

Table 2. Size and structure of seafarers' pool (MAL 2014)

Total number of seafarers	13,015
1) Merchant fleet seafarers:	12,030
1.1) Deck department	5730
Officers	2600
Ratings	3130
1.2) Engine department:	4885
Officers	3045
Ratings	1840
1.3) Catering department (cooks, stewards)	1415
2) Inland fleet seafarers & personell of fishing vessels	985

92% of seafarers are the seafarers of merchant fleet. 47.6% of them are classified as deck department' seafarers, 40.6% are classified as engine department' seafarers, but 11.8% are classified as catering department' seafarers. As the shortage of seafarers is referenced to shortage of officers detailed structure of officers is shown in table 3. Only 10% of all officers or 16% of engine department officers are reefer engineers and electro technical officers therefore main focus in further analysis is paid to deck officers and engineers.

Table 3. Structure of officers according to the department (MAL 2014)

Deck officers		**46%**
Officers in charge of navigational watch (of deck officers)	A-II/1	30%
Masters on ships of 3000 GT or more (of deck officers)	A-II/2	39%
Chief officers on ships of 3000 GT or more (of deck officers)	A-II/2	24%
Engine officers		**54%**
Officers in charge of an engineering watch on ships with 750kW propulsion power or more (of engine officers)	A-III/1	20%
Chief Engineer Officers on ships with 3000 kW propulsion power or more (of engine officers)	A-III/2	33%
2nd Engineer Officers on-ships-with 3000kW propulsion power or more (of engine officers)	A-III/2	21%
Electro technical officers (of engine officers)	A-III/6	12%
Ref.engineers (of engine officers)		4%

Share of deck officers is 46% from all persons with valid officers' certificates. Main part of all officers both in engine (53%) and deck department (63%) has management level certificates which allow them to work on ships with 3000 GT/3000 kW propulsion power or more. The number of seafarers does not provide information about how many seafarers are close to retirement age or how many seafarers started their career recently. The figure 2 shows the average age structure of the seafarers of merchant fleet.

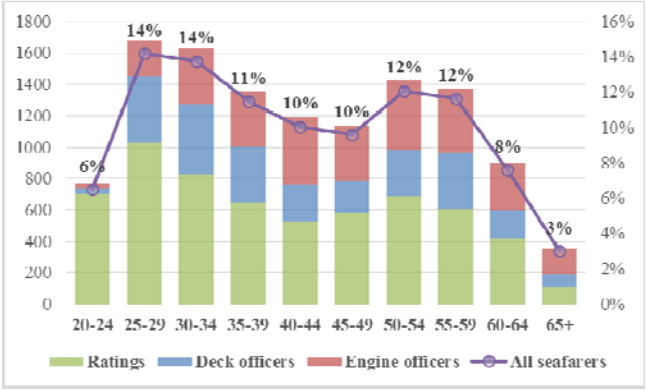

Figure 2. Age structure of the seafarers of merchant fleet (MAL 2014)

It can be seen that proportion of merchant fleet increases till age of 29 years and then gradually decreases. Sharp decrease of number of seafarers starts from age of 60. It can be assumed that active seafarers are in the age range from 20 to 65 years

(approximately 97% of seafarers are within this age range). Also it is clear that seafarers over the age of 65 are going to retire in the closest years. Additionally the seafarers with different qualifications from different departments can be analysed. The table 4 shows how many seafarers from all seafarers with particular qualification can be found in given age group.

Table 4. Age groups of seafarers in deck and engine departments (MAL 2014)

Age group	20-29	30-39	40-49	50-59	60<
Masters on ships > 3000 GT	0%	21%	21%	41%	17%
Chief officers on ships > 3000 GT	11%	48%	18%	18%	5%
Watch officers on ships > 500 GT	48%	32%	10%	8%	2%
Deck ratings	31%	25%	17%	19%	8%
Chief engineers on ships > 3000 kW	0%	17%	29%	37%	17%
2nd engineers on ships > 3000 kW	6%	38%	27%	23%	6%
Watch engineers on Ships > 750 kW	33%	38%	18%	10%	1%
Engine ratings	24%	21%	18%	24%	12%

Approximately half of the ratings both in engine and deck department are under the age of 40. The largest group of watch officers and watch engineers is under the age of 30. The largest groups of chief engineers and captains are between the age of 50 and 60. Relative number of ratings is quite similar in age groups from 30 up to 60 years which can be related to the limited possibilities of the growth in comparison with engine and deck officers where amplitudes of relative numbers are higher. The relative changes in different capacities shows the career path on board from watch deck/ engine officer to the master or chief engineer.

5 SEAFARERS' POOL DEVELOPMENT (2004 -2014)

The historical development of number of qualified seafarers should be analysed with reflection to the number of seafarers. Trends for three main groups of the seafarers of merchant fleet (deck officers, engine officers, ratings) are shown in figure 3.

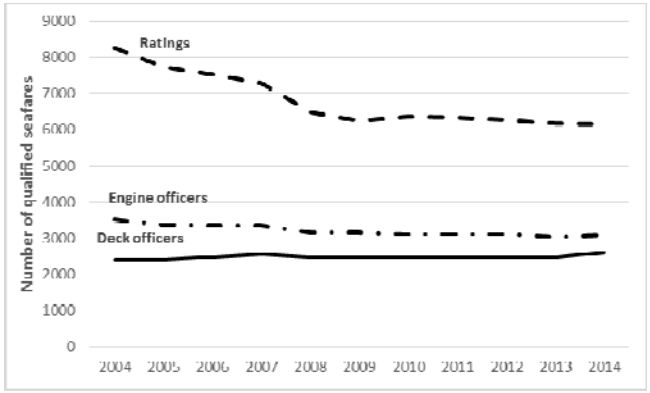

Figure 3. Trends in number of seafarers 2004 – 2014 (MAL 2014)

Trends show that number of certified ratings during past 10 years has been considerably decreased from 2004 till 2009 and remained more or less stable in past five years. The number of certified deck officers remained stable within past 10 years while for engine officers can be distinguished trend of gradual decrease. The detailed comparison between years 2004 and 2014 are shown in table 5.

Table 5. Changes in number of the seafarers of merchant fleet (MAL 2014)

Qualification change	2004	2014	Relative
Master and Chief mate	1625	1820	12%
Navigational officer	785	780	-1%
Chief and second engineer	1740	1865	7%
Watch engineer	1060	660	-38%
Electrical engineer &electricians	545	420	-23%
Ref engineer	170	140	-16%
Deck rating	4590	3130	-32%
Engine rating	2620	1800	-31%
Catering rating	1455	1415	-3%
Total	14585	12030	-18%

It can be seen that the number of persons holding management level certificates both in deck and engine departments has increased. While the number of watch officers remained the same the number of certified watch engineers has decreased by 38% and the number of qualified electrical engineers and reefer engineers has also decreased. The number of deck and engine ratings has decreased almost by 1/3 while the number of catering ratings has remained stable. These figures give an overview of balance between inflow and outflow for those qualifications. Assuming that demand conditions for officers are more favourable than for ratings, it can been concluded that inflow for engineers has not been sufficient to keep pool of qualified engineers in stable condition. The decrease of ratings can be explained by local economic development and decrease of overall demand for ratings from Europe. Balance of inflow and outflow processes can be better analysed by comparing relative changes in age groups as shown in further figures.

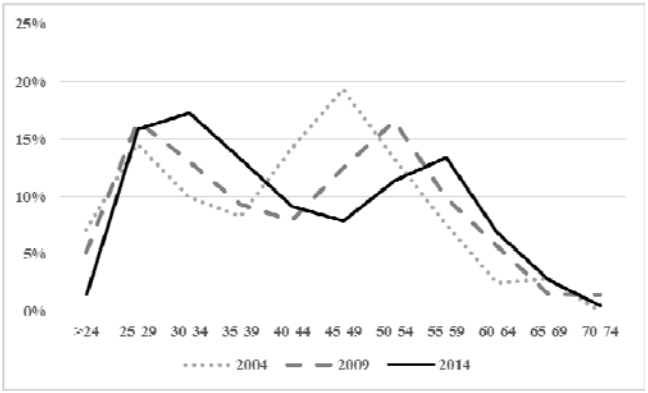

Figure 4. Comparison of age groups for deck officers 2004 - 2014 (MAL 2014)

Comparing age structure of deck officers in 2004 (2410 persons) and in 2014 (2600 persons) gives view that shape of age structure in 2004 moves to right side (see figure 4). Also the peak in age group 45-49 in

2004 (19 % of all deck officers) has moved to age group 55-59 in 2014 and reduced to 13%. The drop of relative share of persons in age less than 25 years can be explained by changes in maritime education system as now graduates from programmes of deck officer and engine officer comes out of institutions in age of 22-25. Almost half of deck officers are under the age of 40; therefore, present conditions can be assessed as stable.

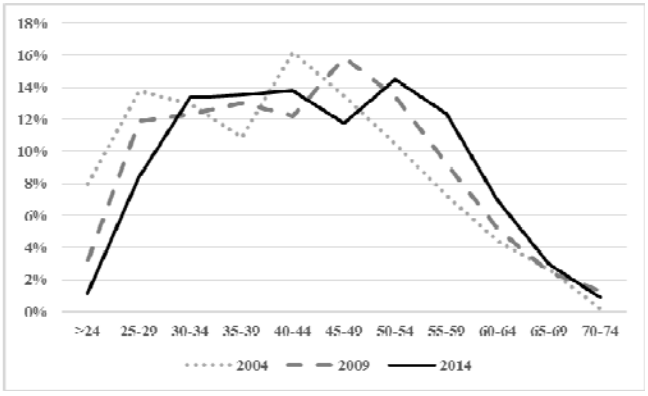

Figure 5. Comparison of age groups for watch engineers and management level engineers 2004 - 2014 (MAL 2014)

The figure 5 shows data about the age structure of engine officers who hold A-III/1 and A-III/2 STCW certificates. The shift of left side of graph to right says that inflow of new engine officers has decreased during past years. Only 36% of engine officers are under the age of 40, which leads to the conclusion that present inflow conditions are not sufficient to keep pool of engineers in stable condition and most likely the decrease of engineers will continue in future (in 2004 were 2800 engineers comparing with 2525 in 2014).

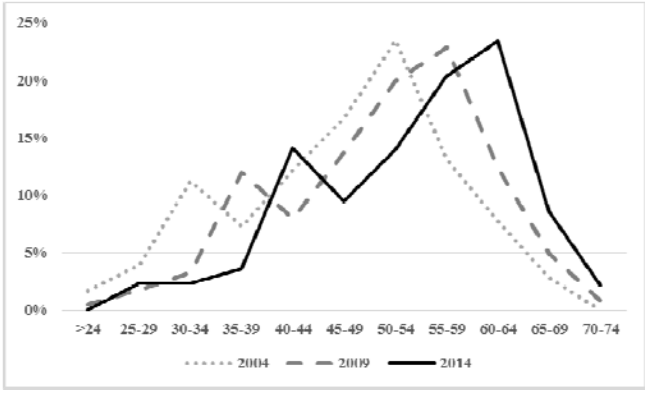

Figure 6. Comparison of age groups for reefer and electrical engineers 2004 -2014 (MAL 2014)

Figure 6 shows the age structure of reefer and electrical engineers in 2004 (715 persons), 2009 and 2014 (560 persons). The shape and movement of the age structure to right side shows that inflow conditions are not sufficient in recent years and decrease of those seafarers will continue. Also only 22% of reefer and electrical engineers are under the age of 40, therefore decrease in coming years is inevitable.

Figure 7. Comparison of age groups for deck and engine ratings 2004 -2014 (MAL 2014)

Figure 7 shows age structure for deck and engine ratings. The shapes of age structure in given years are similar with some movement to right in middle part. In 2004 there were 7210 persons certified as deck and engine ratings but in 2014 there were 4930 persons. It shows that relative inflow and outflow patterns remained almost the same regarding the age groups with exception that relatively less persons obtain ratings qualification in age till 25 in comparison with 2004.

6 INFLOW OF OFFICERS

Inflow to seafarers' pool is linked with maritime education system which prepares the persons who after graduation can obtain qualification and therefore can be employed on board. Maritime education system is also stock system where inflow reflects interest and attractiveness of maritime education in a country. The most important parameter is number of graduates who can be certified as officers and enter active officers' pool for modelling seafarers' resources. The number of students or trainees in system can also be used but then the length of programme and dropout rate from education system should be considered because not all of the persons graduate. Also not all of the persons after graduation obtain qualification; therefore, graduates' dropout rate should be taken into account (Waals, 2002). The figure 8 shows simplified maritime education system in Latvia.

The inflow analysis and outflow analysis focuses on deck officers and engineers and does not cover reefer engineers (at present moment there are not available specially designed educational programmes for them) and electrotechnical officers as the number of graduates who obtained such qualification during past five years is insignificant.

The grey arrows in figure 8 show the possibilities to enter maritime education system from outside, red arrows show possibilities to move from one programme to another and green arrows show the possibility to obtain officers qualification.

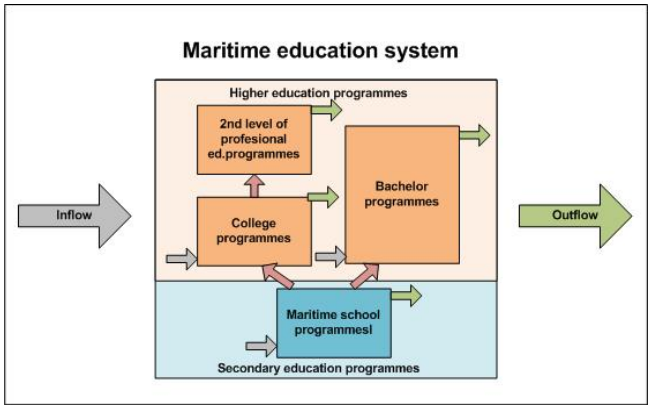

Figure 8. Structure of the maritime education system for officers in Latvia (authors)

The number of graduates is not unambiguous parameter as part of the graduates can enter other programme at the next educational level and therefore remains in education system. Also education system can experience changes. For example, till 2008 graduates from maritime school programmes could candidate to certificates as watch officer (A-II/1) or watch engineer (A-III/1) depending on the programme. However, due to the changes in the education system the graduates can candidate to certificates as watch officers on ships less than 500 GT or watch engineers on ships with main propulsion power up to 750 kW.

During last 10 years the number of graduates, who left educational system from deck and engine officers programmes has decreased (see figure 9).

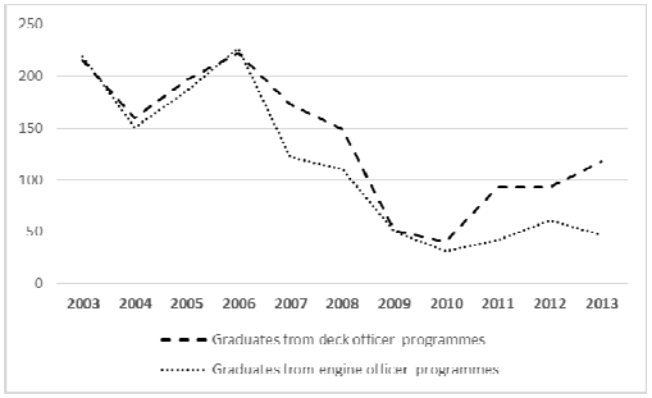

Figure 9. Number of graduates of deck and engine officers' programmes (2003 - 2013) (MAL 2014)

Although the number of graduates of the deck officers' programmes shows growing trend since 2010, the number of graduates of the ship's engineers' programmes remains low and not sufficient to keep engineers' pool in stable condition.

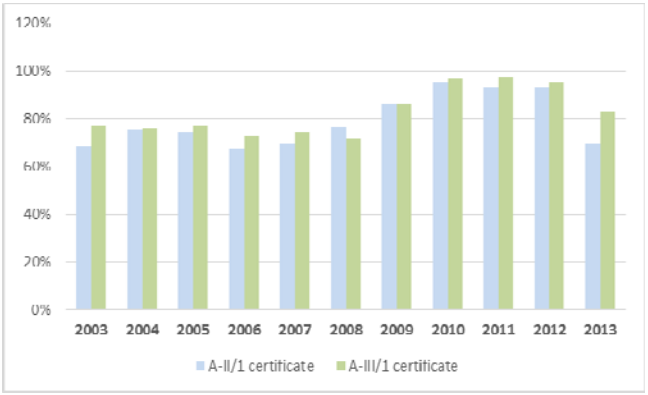

Figure 10. Relative number of graduates obtained certificate (2003 - 2013) (MAL 2014)

Figure 10 shows the relative number of graduates who obtained watch officers or watch engineers' certificate. The relative number of deck and engine officers is similar in the given years. Till 2008 the relative number of graduates who obtained qualification certificate on average was 75% and in recent years this number has increased to 90%. Therefore, it can be concluded that large available number of fresh graduates negatively influences their employment possibilities. After 2009 the demand increased due to decrease of the number of graduates parallel to the increase in demand for officers.

The number of persons obtaining first watch officers (A-II/1) or watch engineers qualification (A-III/1) should be considered as reference point to determine the inflow into the officer's pool as the management level qualifications are based on operational level qualifications.

Comparison between numbers of persons graduating from deck or engine officer programmes with numbers of persons obtaining first officers qualification is shown in figure 11.

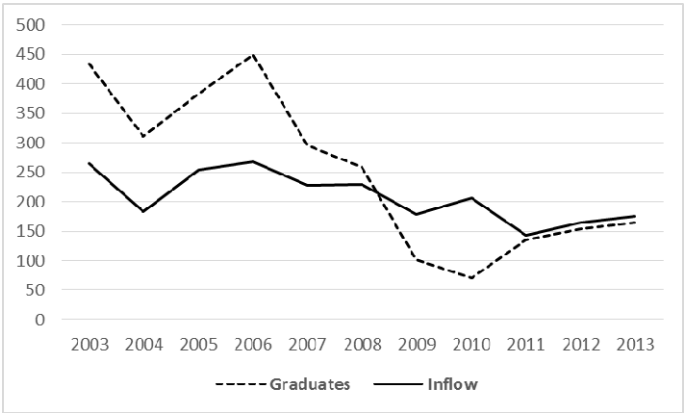

Figure 11. Graduates of the deck engine officer's programmes and inflow into the active pool of officers (2003 - 2013) (MAL 2014)

It can be seen that number of graduates excess officers' inflow till 2008. After 2008 inflow is greater than number of graduates as not all graduates decides to obtain officer's certificate of competency in the year of graduation. The year after graduation in which persons obtained officers' certificate for persons who graduated from 2003 - 2008 is shown in table 6.

Table 6. Year when officer's certificate obtained (graduates 2003-2008) (MAL 2014)

Age group	Year when officers' certificate obtained 0	1	2	3	4	5
20-24	23.4%	28.7%	17.7%	10.6%	5.9%	4.7%
25-29	41.3%	37.2%	8.3%	1.7%	5.8%	2.5%
30-34	46.7%	34.8%	3.3%	2.2%	0.0%	6.5%
35-39	39.4%	33.0%	11.7%	7.4%	4.3%	1.1%
Total	30.5%	31.1%	14.0%	8.0%	5.0%	4.2%

The table 6 shows the reason why inflow after 2008 is greater than number of graduates. It is due to fact that only 30% of graduates on average obtained officer's certificate of competency in year of the graduation. Another 31% of the graduates obtained officer's certificate in the next year. The data does not give clear reason for the "laziness" of graduates. Therefore, additional information such as information about the employment patterns on board, validity of other qualification certificates, in context of graduated programme and institution should be analysed. Starting from 2009 approximately 66% of the graduates obtained certificates of competency in year of graduation and additional 25% in next year.

7 OUTFLOW OF OFFICERS

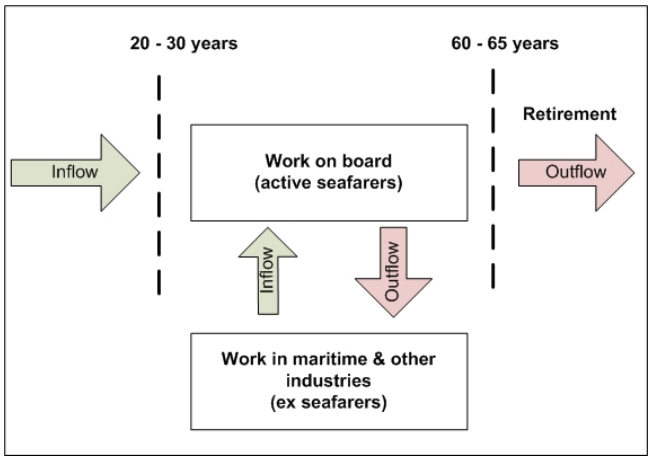

Figure 12. Simplified inflow outflow model (authors)

Outflow of the pool is linked with two factors (see figure 12). One factor is retirement when seafarers reach the age of 65 as it can be concluded from age structure of active seafarers. (Only three percent of active seafarers are in the age over 65.) Other factor is demand from maritime companies ashore which are willing to employ persons with seagoing knowledge and experience and employment possibilities in other industries which can utilise the skills of seafarers in the same time providing competitive or better employment conditions. The figure 13 shows outflow rate for deck and engine officers from 2003 - 2013. As outflow year is regarded last year when certificate of competence is still valid in case if person does not receive new certificate.

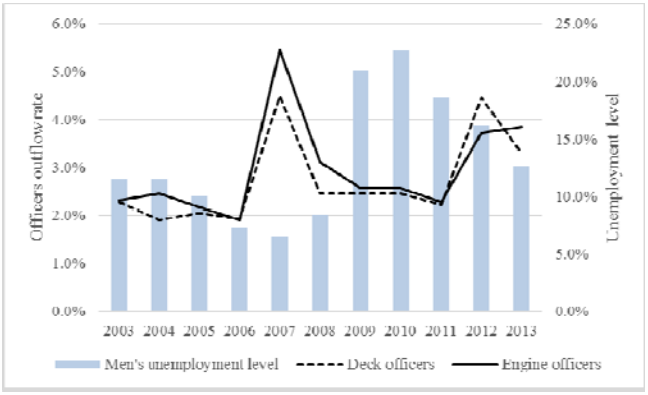

Figure 13. Outflow rate for deck and engine officers (2003 - 2013) (MAL 2014)

From figure above can be concluded that outflow rate fluctuates from year to year and the pattern for deck and engine officers is similar. The fluctuations depend on the number of seafarers in particular age group and also economic situation in Latvia. The unemployment level between men in Latvia is used as indicator which characterises economic conditions. In general higher unemployment reflects in lower outflow rates and reverse.

By comparing outflow rates and officers' age it can be seen that officers are more mobile in age group 25-29 than in further age groups. Lowest outflow is in age groups 40 – 49 and then gradually increases.

Table 7. Outflow rates and age groups for deck and engine officers per year

Age group	Deck officers 2003 -2008	2009-2013	Eng. Officers 2003 -2008	2009-2013
25-29	2.8%	2.4%	4.2%	3.3%
30-34	1.9%	1.9%	2.2%	1.1%
35-39	1.5%	1.9%	1.4%	1.9%
40-44	1.5%	1.1%	1.6%	1.0%
45-49	1.4%	1.6%	2.4%	1.8%
50-54	2.1%	1.8%	2.2%	2.4%
55-59	4.3%	3.8%	2.7%	3.5%
60-64	7.1%	6.2%	7.4%	6.7%
65-69	10.8%	15.4%	13.0%	13.0%
70+	35.7%	28.2%	21.3%	23.3%

Database does not allow to follow up persons' employment ashore to see if they are still working within maritime industry or they are working in other industries as well as pool of seafarers is larger than actual pool of employed seafarers as it includes both seafarers who are working on board and seafarers who only hold valid certificates even they are working ashore.

The data about validity of certificate can be linked only to the active seafarers who can be theoretically employed on board as they have valid certificates on hand even if they have already left the pool of employed seafarers. Outflow rates from employed pool should be considered to better assess the influence of the external factors.

8 CONCLUSIONS

It can be concluded that for present composition of Latvian seafarers' pool (persons with valid qualification certificates) the inflow during past 10 years was not sufficient to keep pool in stable condition. The pool of deck officers can be regarded as sustainable as the age structure and number of entrants is optimal to cover outflow to ashore. Decrease of ratings can be linked to the decrease of demand for them and also increase of employment possibilities ashore, but for engine officers the main obstacle is insufficient number of graduates especially during past five years.

The outflow of officers is linked to the age group and economic conditions ashore; therefore, an analysis of the multiple factors should be carried out including employment analysis to validate this conclusion.

To model seafarers' pool in future careful analysis of the graduates of different maritime education levels and programmes should be analysed to determine differences in outflow parameters.

9 FURTHER RESEARCH

The shortage of seafarers is complex issue as trade and shipping is global therefore it is linked to different factors like local economic development, attraction of other industries which can influence the inflow of youngsters to seafarers' profession. For example this is the case of Philippines where part of youngsters' prefer other courses and programmes instead of maritime programmes as these programmes are considered to be equally financially rewarding. (Magramo, Bernas, Calambuhay, Eler, 2010). This factor is related to the fact that salaries offered by the same shipping company can have different attractiveness for seafarers coming from different countries. It is predicted that in future the majority of marine officers worldwide will be employed from the less developed countries (Glen, 2008; Sencila, Bartuseviciene, Rupšiene , Kalvaitiene, 2010).

Comparison between active seafarers and employed seafarers should be made to have complete picture about processes which influence the condition of the seafarers' pool. It is prerequisite to understand the relationships between those pools as it is obvious that external factors will influence employed seafarers which later will be reflected in the pool of certified seafarers. The analysed factors can be considered as input for modelling the pool of active seafarers, therefore next step is by combing inflow and outflow data create the model which can be validated by using historical data.

The analysis shows that data extracted from the database of the Seamen Registry of Latvian Maritime Administration have considerable value for such model as they represent the primary source of bulk data. Even if the available data reflects local processes of Latvian seafarers' pool the outcome of research will give possibility to apply gained knowledge for modelling seafarers pool processes in other countries and globally.

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