

Original article

## A Survey on the status of Marine IT Industrial environment for e-navigation SQA – focusing on Korean domestic companies\*

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### Abstract

According to Software Quality Assurance (SQA) and the Human Centred Design (HCD) guidelines for e-navigation by Maritime Safety Committee of International Maritime Organization, software quality related activities and practices will be in demand in the maritime field. To provide high quality software and a usable system to users, e-navigation SQA is supported by Republic of Korea. After merging with the HCD as suggested by Australia, it has been endorsed as IMO Circ.1512 in June 2015.

To apply SQA to the maritime industry, it needs to achieve the current status of maritime software related industries. This article introduces the IMO Circ.1512 and the progress of e-navigation SQA so far including the international workshop held in Busan, Korea as previous accomplishments. Also, the result of a survey on the status of software quality management of the Korean domestic maritime IT related industry will be described. The purpose of survey is to find out how SQA is dealt with in domestic industry, what experiences the industry have had so far and what software project related issues they have.

The questionnaire is composed of two parts. The first part mainly deals with fundamental knowledge about the scale of the company and the number of development teams. The second part consists of three sub-parts with Quality Management, Configuration Management, and Process Management. Otherwise, several questions are surveyed with respect to engineering tools for SQA and education support. Approximately 150 cases were gathered. The outcome of the survey shows some points that both of industry and government can contemplate for the future.

*Keywords:* e-navigation, SQA, HCD, guideline, survey

## **I. Introduction**

Recently, the e-navigation strategy has been introduced and it will soon be enforced. Moreover, ship operating systems are adopting their electronic systems. In particular, because of the expression and transmission of various information and the integration of several devices, it is clear that design and quality assurance is important. Also, e-navigation is designed to reduce the work load of system users who are mariners. Thus, to solve this problem is an important issue. After the significance of software quality was discussed at NAV 58th, the International Maritime Organization (IMO) determined a harmonization (merge) of the SQA, HCD, and UT. Consequently, in IMO MSC 95th, this SQA/HCD guideline was endorsed on June 2015 (IMO, 2015).

The e-navigation SQA/HCD harmonization guideline is an integration of SQA for software quality assurance and Human-centered Design (HCD) for familiar product design. SQA includes product quality, process quality, data quality, and quality in use. SQA supports a software system used in the e-navigation system that has high quality and stability and meets user requirements. With HCD, it is not required for users to adopt systems. HCD supports the design of a familiar system based on the intended user characteristics and their tasks. User Testing (UT) is significant to implementing HCD, as it tests the ability of the system to determine whether the system meets user requirements.

Since endorsing the e-navigation SQA/HCD guideline as an IMO circular document, there has been a lot of activity to see its implementation in the industry. . In February 2015, a workshop of e-navigation guidelines was held for the Korea domestic industry (KMOU, 2015). Also, in April 2015, there was a workshop with many shipbuilding officials and specialists who contributed to the development of the guidelines (KMOU, 2015). They discussed the solutions for integrating SQA and HCD and the way to apply them to the future industry.

This paper looks at how to understand the status of the SQA industry to reveal concrete solutions for the problems it faces. Besides that, it also suggests some approaches to apply to the industry based on survey analysis results. Chapter 2 includes content t from the survey and the responses from the group that participated in the survey. Chapter 3 summarizes the results of the survey analysis, and Chapter 4 suggests the approaches for the adoption this to the industry based on the results.

## **II. Survey on the status of industry for maritime SQA**

In February 2015, through the workshop for Korean domestic industry, the e-navigation SQA/HCD guidelines were revealed to the industrial field. In April 2015, there was an international workshop held with experts and shipbuilding officials, and they discussed the improvements and applications of the guidelines. After the guidelines were endorsed as an IMO circular document, a survey was conducted to understand the status of maritime SQA.

In this survey, five hundred major and minor business companies in the maritime IT field participated over a period of two weeks. The survey was conducted online using the Google Survey system (KMOU, 2015). Approximately 150 people responded in total: the first part with

almost 140 responses and the second part had about 110 responses. The details of the survey are as follows:

- Target and respondents of the survey
  - Workers and experts in maritime IT Industry were questioned in the survey.
  - 153 people responded.
- Method of the survey
  - The survey was carried out over two weeks.(from 22th, September to 8th, October)
  - The survey was conducted online using Google Survey system.

The survey had 2 parts. The first part of the survey consisted of fundamental information about the industry – such as the size of the company and checking the development members. Also, it includes general questions about e-navigation and the maritime SQA. Table 1 shows detailed questions in the first part of survey.

**Table 1: General information of industry and maritime SQA**

Category	Questionnaire contents
General present status of marine industry	General information of companies such as the size of company, the development team, the quality management team, etc.
Maritime Software Quality	The progress of e-navigation SQA, The fundamental questionnaire of maritime SQA, The necessity of SQA certification, etc.

The part consists of two categories. The first category is about the general present status of the marine industry. It has general questions about the marine industrial companies – such as the size of company, the development team, the quality management team and so on. Through this data, some information can be elicited such as the ratio of the company size to the development team, the ratio of the company size to the quality management team and other facts. Next, it surveyed the quality of maritime software. This category includes the progress of e-navigation SQA and the maritime SQA. It also includes the questions about certifications such as the SQA certification.

The second part of survey consists of advanced questions. It is divided into quality management, configuration management, and process management, and includes quality management activities. Because of these specific questions, this part was optional. Table 2 shows detailed questions in this part.

**Table 2: Quality management, Configuration management and Process management**

Category	Questionnaire contents
Quality management	General question about SQA; Effort for quality management; Whether companies are adopting data quality and quality in use, etc. With software development cycle, whether companies are doing test activities and whether the automated tools are used.

Configuration management	How to perform configuration management activities: For example, whether companies apply configuration management, applying method, etc.
Process management	Development process and process management.

In the quality management category, general questions are mostly about SQA – which does not refer to ‘specifics’ such as aviation, or maritime. This category includes effort for quality management and whether companies are adopting quality data standards and whether quality standards are being met. In quality control, it is important to check whether the test activity is working or not on the software development cycle. The check also involves figuring out whether the automation tool works. The configuration category consists of questions about implementation of the application and the method of application. The purpose of this category is to understand how the company carries out the configuration and manages it.

The configuration and quality control activities amongst others are performed on the software development cycle to help figure out development process. As a consequence, the process management category is about the development process and how to manage it.

Additionally, there is a question about education support and engineering tools. It is significant to know the extent to which SQA is applied. They can also be used to figure out how it is applied.

### III. Navigational Aids System based on AR

#### 3.1. Result of survey on fundamental information

About 65 percent of companies surveyed were medium and small business with fewer than 100 employees.

Figure 2 presents the ratio of the entire employees to the employees of the quality management team. The ratio of about 85 percent of companies was less than 20 percent. It shows that the percentage of the quality management activities is small.

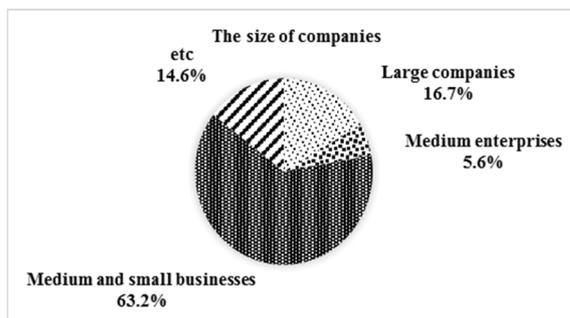


Figure 1: The size of companies

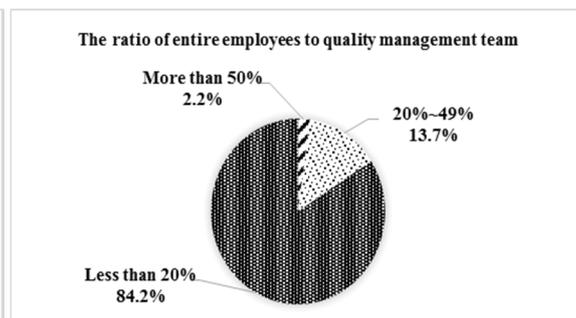


Figure 2: The ratio of entire employees to quality management team

Figure 3 presents quality certified items that the surveyed companies acquired. ISO 9000 was very high, next was the certification of Korean Register.

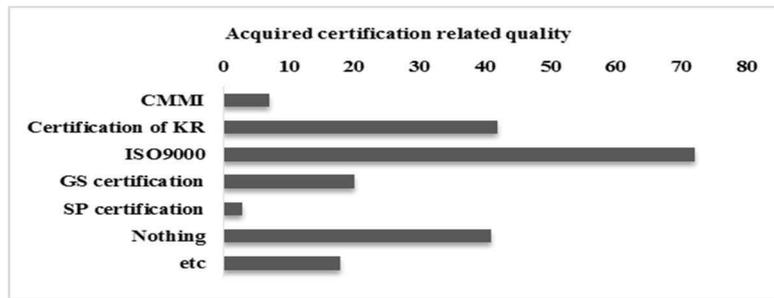


Figure 3: The certification related quality of companies surveyed

More than half of companies were aware of the maritime SQA, but the SQA/HCD guidelines were not well-known.

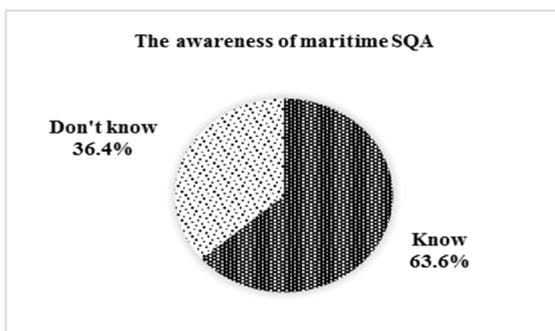


Figure 4: The awareness of maritime SQA

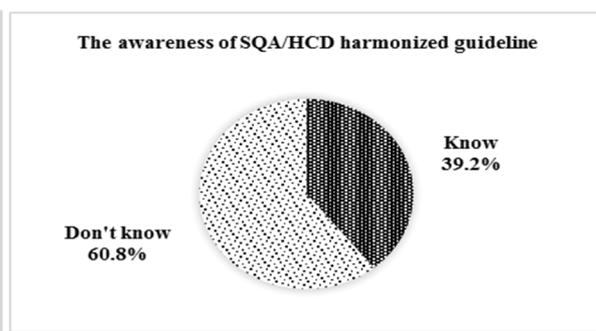


Figure 5: The awareness of SQA/HCD harmonized guideline

The following chart is a result of the questionnaire about the awareness of certification by the national and international ship classifications. Most of the answers regarding this were NO. Bar the classification certification, knowledge about the necessity of other certifications and a certification by government was at 32.9 percent, certification by industry was at 9.8 percent, and certification by the ship-owner organization was 15.4 percent; 39.2 percent of respondents do not need a certificate and other was classed at 2.8 percent.

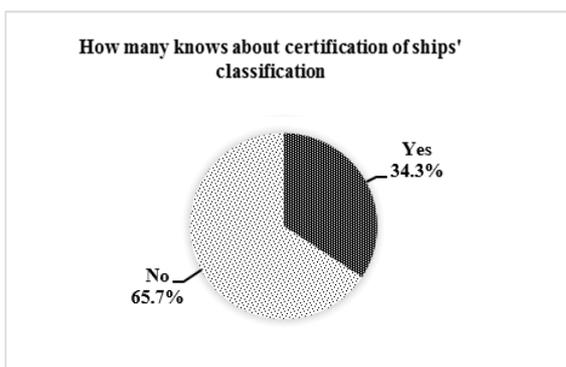


Figure 6: How many knows about certification of ships' classification

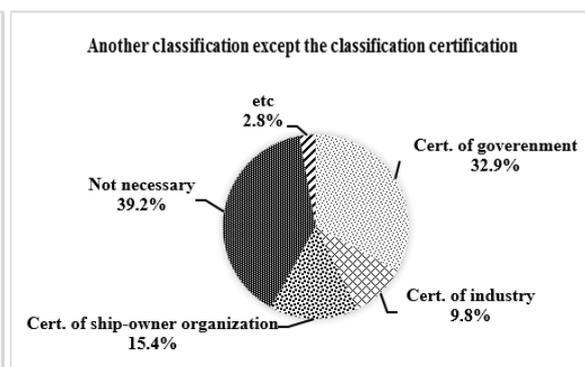


Figure 7: Another classification except the classification certification

There were many opinions about other certifications outside of the classification certification. First of all, the reason why the certification by the government is desired was attributed to its reliability. Also, many opinions were that the certification by the government affords competitiveness and compulsory. As there are varying routes to the classification, a common standard is needed. As for the certification from a ship-owning organization where the main customers are ship owners, a certificate is needed to boost customer satisfaction. On the other hand, the other reason that it does not need to be certified by others is that it would cost the same.

### 3.2. Results of the survey on Quality management, Configuration management and Process management

Part 2, not only surveyed quality management, configuration management, and process management but also examined the present status of the industry and . It was also able to muster up some ideas for future work.



Figure 8: Managing team or organization for quality management

The companies which have teams for quality management accounted for counted 35 percent, and the companies which did not have teams but, instead, had some people working on quality management accounted for 52 percent of the total. In terms of the statistics about quality management, the usability examination results are seen in the chart attached below.

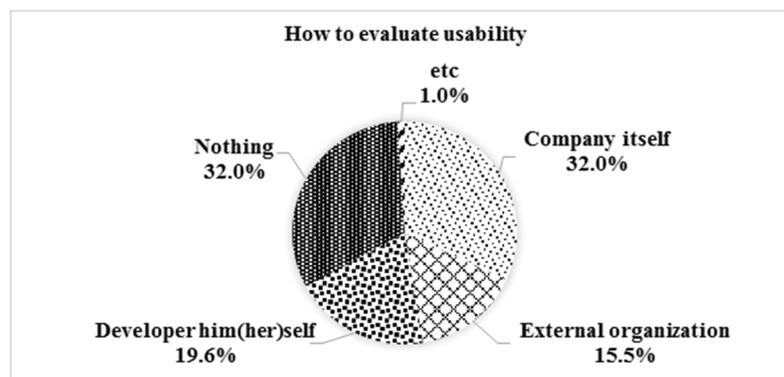


Figure 9: How to evaluate usability

The participants of the survey responded that they apply the usability examination with their own examination rules or temporarily examine the ones used by the developers, and hire external organizations. The other 30 percent of the companies confirmed that they don't conduct usability examinations.

About 75 percent of companies replied that they have heard or knew about not only usability testing but also about data quality. As for the 15 characteristics of data quality (Accuracy, Completeness, Consistency, Credibility, Currentness, Accessibility, Compliance, Confidentiality, Efficiency, Precision, Traceability, Understandability, Availability, Portability and Recoverability), companies prioritized them in the order of reliability, accuracy and efficiency (ISO, 2015). The data which is treated in the maritime industry preferentially is evaluated in the order above.

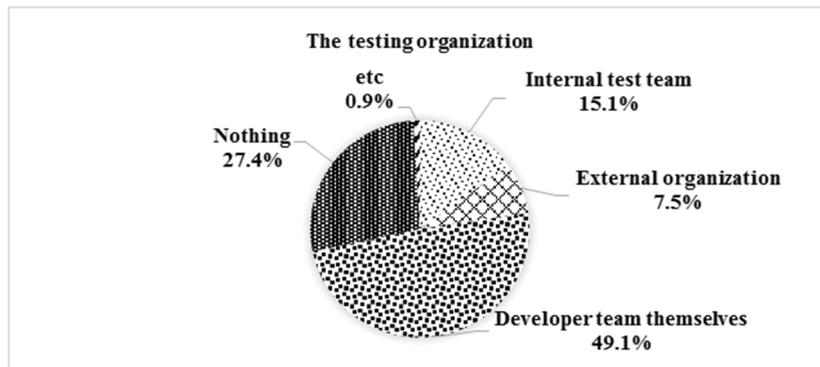


Figure 10: The testing organization

Most companies are performing test activities. However, those performing tests by themselves in a development team was higher than those doing it with a testing team. For test activities, the process should be set up and all tasks such as planning or results should be documented.

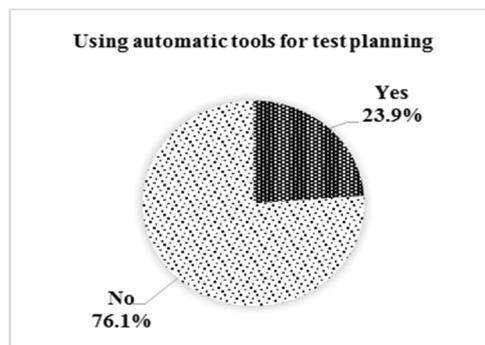


Figure 11: Using automatic tools for test planning

As for using automatic tools for creating test scenarios or test cases, most companies answered NO. Automatic tools can reduce workloads. However, as seen in figure 12, companies find it difficult to imagine using them.

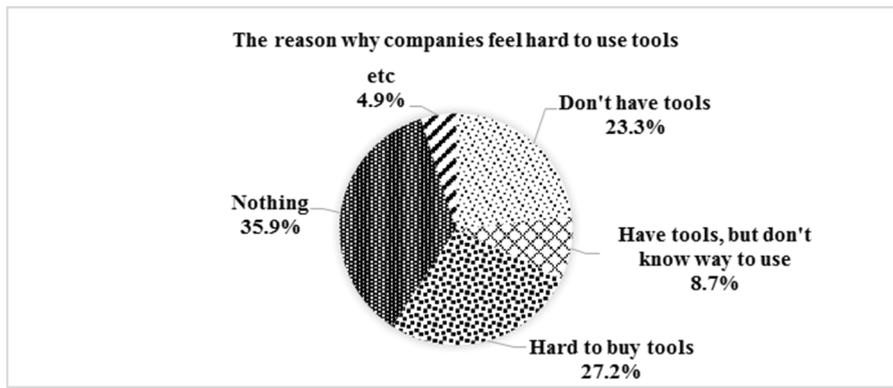


Figure 12: The reason why companies feel hard to use tools

Configuration management means managing outcomes elicited from developing or maintenance activities. Most companies were managing source code. However, configuration is not only managing the source code but it also includes related outcomes and their builds and releases. The entirety of this was managed by about 35 percent of companies.

If the configuration management did not progress, the reasons for this could be attained to lack of necessity or high work load.

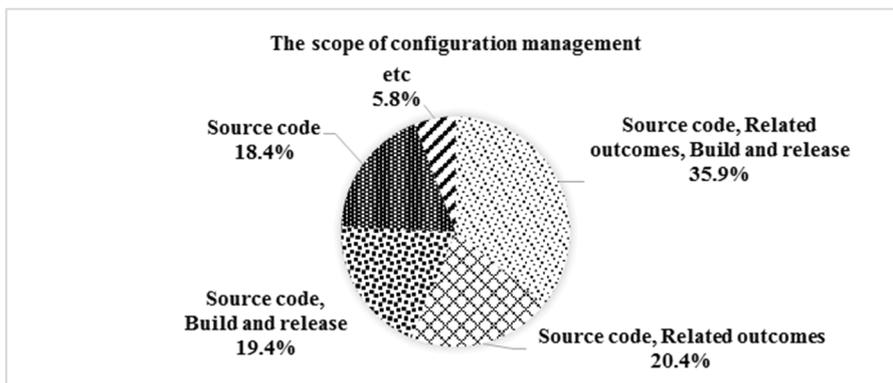


Figure 13: The scope of configuration management

Quality management and configuration management depends on the software life cycle, so it is important to find out whether the process is systematic or not. According to the survey, companies that have such a process were at about 60 percent. However, many companies still do not have a systematic process. To solve this problem, they need to be guided into it and adopt such processes into their business model.

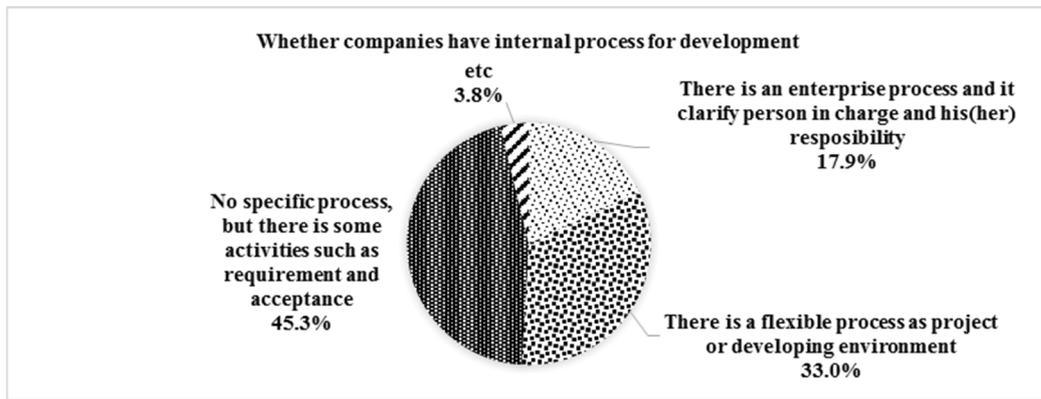


Figure 14: Whether companies have internal process for development

#### IV. Overall result and approaches

This chapter summarizes results elicited from analysis of chapter 3. Based on this, concrete approaches to the supply industry have been established.

##### 4.1. Summary of survey

According to the first part of survey, many of the companies surveyed were medium and small businesses with fewer than 100 employees. The ratio of quality management employees was less than 20 percent. It shows that many companies in the marine industry are medium and small businesses and that the extent of quality management measures carried out are relatively small

For certification, ISO 9000 was very high, following that was the certification of the Korean Register. Use of certification related software such as GS or CMMI was relatively low, and some of the companies had no certification at all. It represents the fact that awareness of software certification is very low. To solve this problem, recognition of the necessity of certification related software needs to be improved. For another certifications, excluding the maritime SQA certifications run by national and international ship's classifications, many companies want certifications are associated with trust by the public. Respondents said that feel more competitive with public certifications. There are also many complications attached to a varying number of certification so they also expressed a want for a united certification. On the other hand, if they are already certified, adding a new certifications incur unnecessary costs.

More than 60 percent of companies knew about the maritime SQA, but the SQA/HCD guideline were not well-known. Before the guidelines are applied, the necessity and understanding of how the guidelines impact them needs to be promoted to the industry. Also, tools are needed to supply the application of the SQA and HCD guideline.

The second part of the survey consisted of advanced questions about current SQA activities in the industry. Half of the companies surveyed had systematic processes. Besides those many companies operated quality management activities but those doing it with a quality management team were far fewer. Quality management activities include evaluating usability and testing. The

number of organizations performing these activities with an external team or with no team was higher than those operating as a dedicated department. Extensive tasks, including development, operate with such a process. Company education is needed to establish and internalize the process it into the business

Various tools for quality management are supplied. However, many companies did not use these tools because they are hard to use and to approach. Automatic tools can reduce workloads. The promotion and education of using tools will help many companies solve quality management problems.

#### 4.2. Approaches to supply industry

Government or public support requires support (some investigation) into the lack of quality management processes. As survey results demonstrated, the support wanted was prioritized the following order: education and training support, professional recruit support, financial support, and testing equipment support. Regarding the many needs for education and training support, the maritime SQA were familiar to the industry.

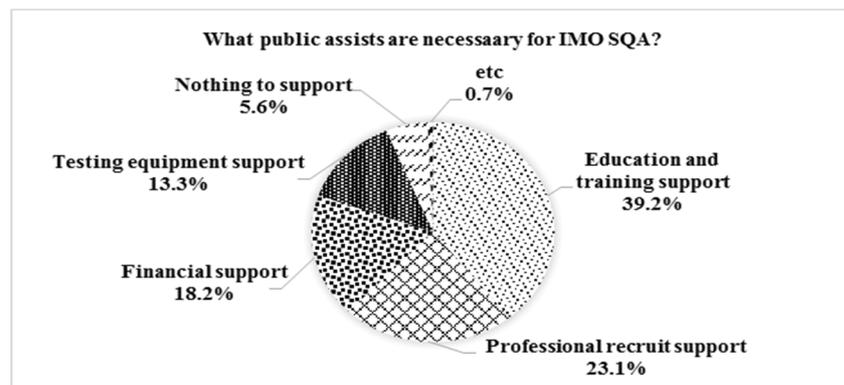


Figure 15: Public assists for IMO SQA

It can support the education program which is linked with schools. Moreover, it can provide experts through related companies to recruit support for the students. Additionally, if the conditions are satisfied, it has a public instruction to return the education fees. It solves financial support problems. The following chart, Figure 16, shows the category of education for maritime SQA.

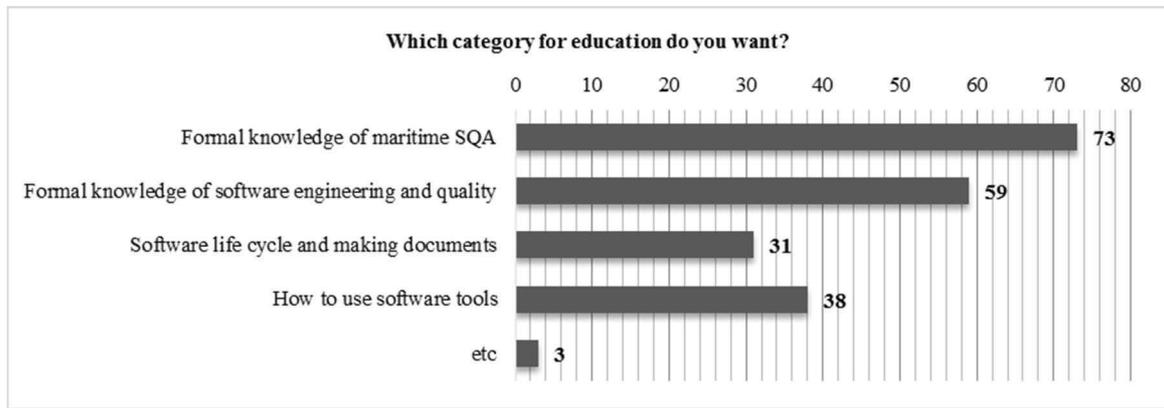


Figure 16: The education category

From this we can see most prominent education need is regarding the fundamental knowledge of maritime SQA. Following this is a desire for the formal knowledge of software engineering and quality. It demonstrates a lack of education about maritime SQA and highlights a need for education along with practical guidelines.

## V. Conclusion

This paper introduced the progress of e-navigation SQA in marine industry field and the survey results about current status of Korea domestic marine IT industry. Several events about adopting the e-navigation SQA and HCD harmonized guidelines have been held in Korea. The domestic workshop of e-navigation SQA guidelines was held in Busan and the international e-navigation SQA and HCD guidelines workshop in April 2015 were the main events. Many experts from shipbuilding, marine IT and seafarers and certificated organizations and specialists who participated in developing the guidelines participated to discuss how to best apply them to the industry

The survey was composed of two parts and was based on the level of knowledge about SQA. Basic level questions were about the basic concept of software quality and the e-navigation SQA. Advanced level of questions regarding SQA were about quality management, configuration management, process management mainly. Meaningful outcomes were derived. Basically, it was found that most of the companies had little knowledge about software quality and the e-navigation SQA. Moreover, there is not enough man-power in companies to be able to handle day to day issues with software quality. These are the main issues for domestic marine IT companies, especially in the smaller ones. To solve these problems, an education program that could be supported by educational or training organizations is needed. Also, it was found that practical guidance is helpful and useful and education materials to build up the SQA capacity need to be developed.

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