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Expert Survey Method as a Technique to Support the Decision-making Process During Dredging Activity at the Harbour

A. Kaizer
Gdynia Maritime University, Gdynia, Poland

ABSTRACT: Organization of the dredging works is a multi-faceted issue. The management of the dredging process varies according to the location and it mostly depends on local conditions (Żak, 2014). The paper presents the results of the expert survey which was structured on a questionnaire concerning the dredging techniques in harbours. Respondents, that take part in the research, were experts from different nations, working at the management levels in the enterprises associated with the dredging branch. The aim of the proposed research was to support the selection of the appropriate dredger, the preparation of optimal work technology and the verification of strategic decisions affecting entire project. Taking everything into consideration the author proposes to use the expert survey as a technique to support the decision-making process. It enables to take advantage of the wide knowledge and experience of experts to create the most suitable dredging project.

1 INTRODUCTION

The process of assessing and ranking researched technology may be supported by different methods that are characterized by different levels of advancement. While comparing technologies we can take advantage of quality method as well as quantitative method. The first one concerns the identification of features that can influence the implementation and commercialization effect. The second one should be used to indicate relevant attributes that explain the reasons of distinctions between technologies. Methods used in practice are usually the combination of quality and quantitative altitude . In accordance to researches conducted all over the world it is impossible to choose one method that will be the most appropriate for technology analysis. Moreover, we can observe the tendency to make use of several methods in each proceeding. There is no doubt that the evaluation and selection of technologies are difficult issues. This is because of the multidimensional nature of technology, which leads to uncertainty and thus ambiguity of assessments (judgments), formed by the experts participating in researches that involve ranking (Goossens & Cooke, 1996), (Kaizer & Kuznetsov, 2014).

It is worth saying that in the context of multi-criteria problems, the expert assessment performed by the survey technique, is a convenient tool supporting the selection of appropriate alternative. This type of research allows to evaluate, rank and make selections of the tested variants (Trakhtenberg & Solomakhin, 2013), (Thomas L. Saaty, 1990).

In reference to the organization of dredging works at the harbour the choice of appropriate dredger and consequently the relevant work technology is the fundamental decision for whole enterprise, therefore the author proposes to use the expert survey as a technique to support the decision-making process. It enables to take advantage of the wide knowledge and experience of experts to create the most suitable dredging project in case of dubious modeling results (Mitchell, Wang, & Khodakarami, 2013), (Guida, Baroni, Cojazzi, Pinola, & Sardella, 1996), (Formela & Kaizer, 2013), (Miedema & Becker, 1993).

2 METHOD OF RESEARCH

As part of the study on organization of dredging works in harbours, an expert assessment was carried out, using the questionnaire method addressed to practitioners (Książek & Nowak, 2009).

Respondents, that take part in the research, were 30 experts from different nations, working at the management levels in the enterprises associated with the dredging branch. The aim of the study was to find out which basic parameters affect the selection of dredger and to prepare the ranking of the organizational and technological aspects which have the strongest influence on the efficiency of dredging works in harbours (Smolarek & Kaizer, 2016). In addition, the respondents have an opportunity to share their observations, experiences and suggestions related to the organization of these activities. Statistical results of the study are presented in Figures 1- 9.

3 RESULTS OF SURVEY

In the first part of the questionnaire, which related to the criteria affecting the choice of dredger, the respondents emphasized that features which influence the selection of dredging equipment most strongly are: the type of land (83%), cubic capacity planned for separation (69%) and the location of the project (62%).This result shows that the most important issue during the organization of dredging works is to adjust the working technology to the planned dredge area (Fig. 1, 2, 4). In addition, the results of the survey, signalize that it is also important to consider the ship traffic intensity (59 %) while choosing the dredger (Fig. 3). This point has an influence on work schedule organization and thus it defines the effectiveness of the project implementation (Lund, 1990). Respondents affirmed that hydro-meteorological aspects and environmental activities have an medium impact on the organization of dredging works in harbours (Fig. 5, 6). This result may arise from the general location of harbours in industrial areas and most often at considerable distances from the environmentally protected areas (Smolarek & Kaizer, 2015), (Formela & Kaizer, 2013).

The resulting structure of the first part of the expert assessment focused on parameters affecting the choice of dredger for dredging works in harbours has been presented in the collective diagram in Figure 7.

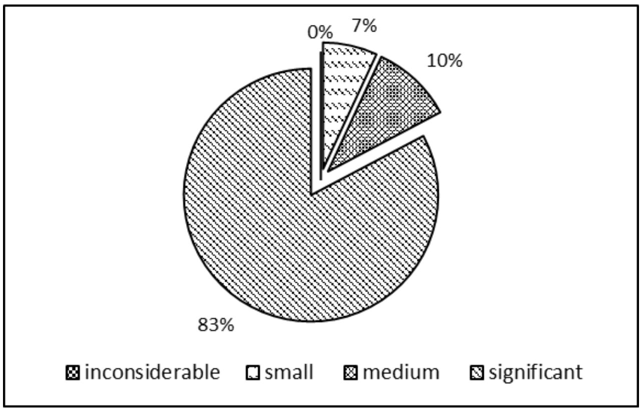

Figure 1. Assessment of the influence that the type of bottom soil has on the choice of dredger, in the opinion of experts.

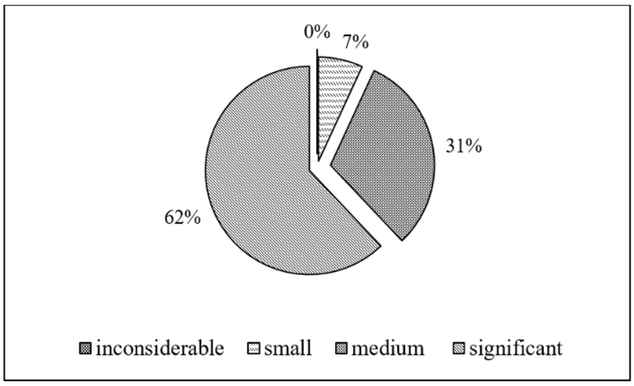

Figure 2. Assessment of the influence that the location of dredging works has on the selection of equipment for dredging works in harbours, in the opinion of experts.

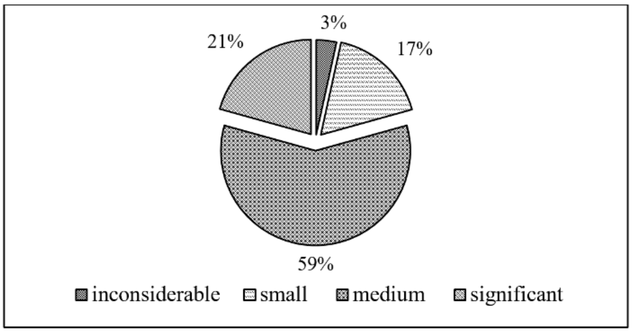

Figure 3. Assessment of the influence that ship traffic intensity has on the choice of dredger for dredging works in harbours, in the opinion of experts.

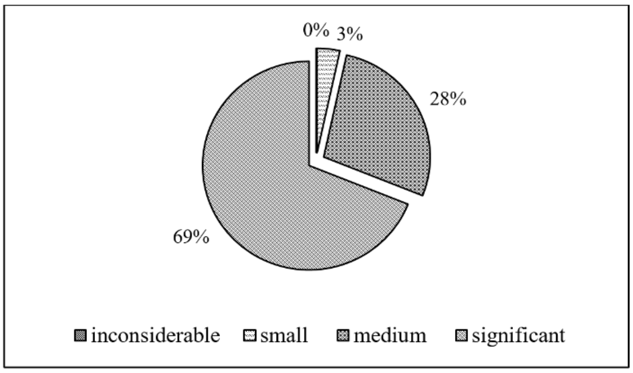

Figure 4. Assessment of the influence that the cubic capacity planned for separation has on the selection of dredger for dredging works in harbours, in the opinion of experts.

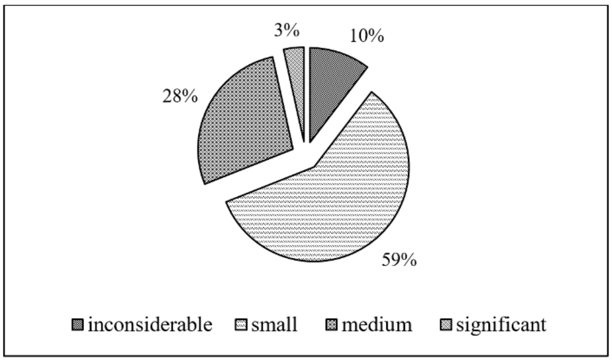

Figure 5. Assessment of the influence that neighboring urban areas and ecological aspects have on the selection of dredger for dredging works in harbours, in the opinion of experts

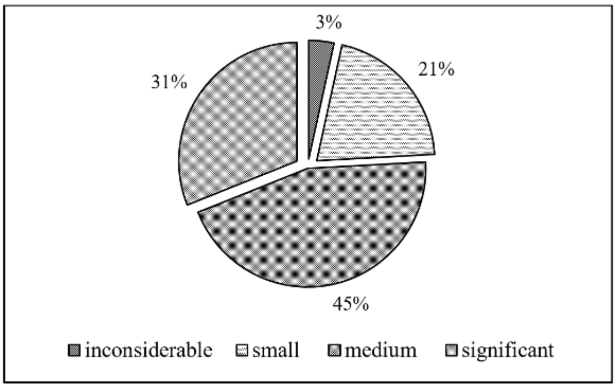

Figure 6. Assessment of the influence that hydrometeorological conditions have on the choice of dredger for dredging works in harbours, in the opinion of experts

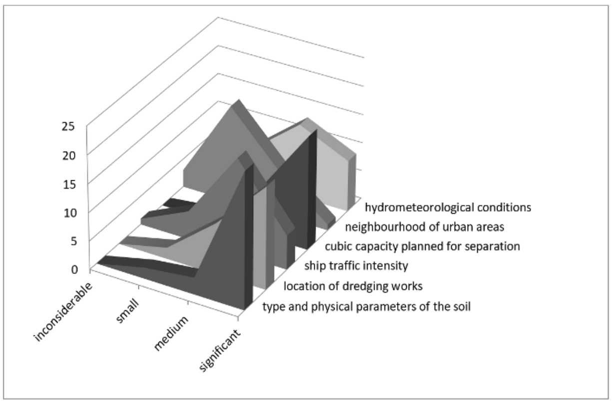

Figure 7. Resulting structure of expert assessments about parameters affecting the choice of dredger for dredging works in harbours.

The second part of the questionnaire survey was focused on the issues leading to the effectiveness of dredging works in harbours. Respondents gave an opinion that the most important factor for effective dredging is the installed power of cutting devices and suction pumps (29%). The experts also assumed that relevant matter is the distance to the dumping area and to the dump-site where the dredging soil is put (26%). On the other hand, ship traffic intensity, dredger's own propulsion, it's good maneuvering characteristics and compliance of work progress with the schedule, represent 14-16 % of entire influence on the efficiency of the dredging projects in harbours (Fig. 8).

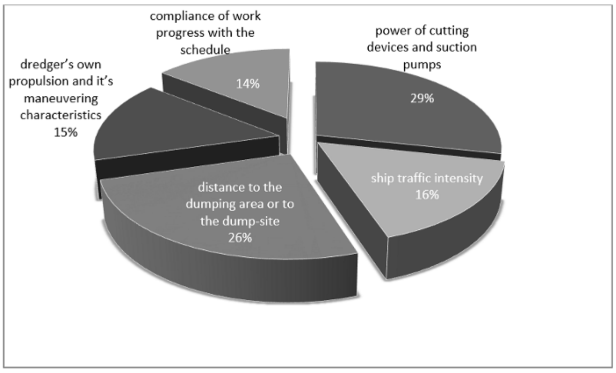

Figure 8. The resulting structure of the experts' assessment concerning aspects that significantly affect the efficiency of dredging works in harbours.

The last question in the survey was: "What type of dredger is the most useful while dredging in harbours?". The respondents reported huge difficulty with making a clear choice because they claimed that this is a multi-criteria decision. Thus, the averaged results given by the respondents according to their own experience gained during the organization of specific dredging works in the harbours, indicate that trailing suction hopper dredgers are most often used (28%). These vessels are self-propelled dredgers with high excavation capacities in non-cohesive soils. In second place came backhoe dredgers (25%), which are best suitable for conducting dredging works at quays and hard-to-reach areas. The next type which was mentioned was cutter suction dredger (21%) which enables to dredge hard soils and ones which are not easily workable. However, work technology of this type of equipment requires setting anchors to stabilize the position of the milling cutter. Relating to cutter dredgers, they often use the floating pipelines. This feature can completely disqualify this type of vessels from working in harbours' areas because of heavy obstruction of shipping. According to the survey, the bucket ladder dredgers are the least often chosen equipment for dredging (12%). At present, these types of vessels are technologically obsolete due to low efficiency parameters and lack of their own propulsion. They also significantly impede ship traffic because of the positioning system with anchor lines (Fig. 9).

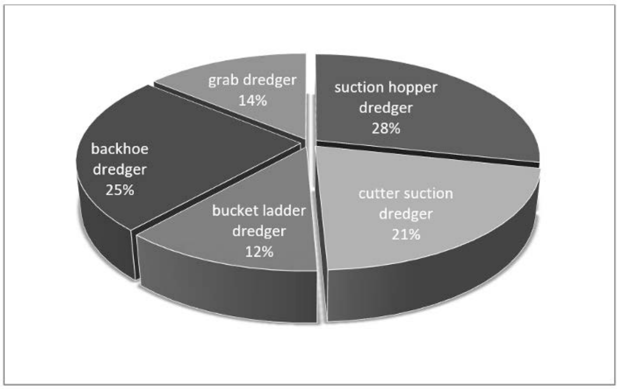

Figure 9. The resulting structure of the experts' opinions about types of dredgers which are most useful during dredging works in harbours.

4 CONCLUSIONS

An expert survey, performed as a questionnaire, was conducted among the group of thirty experienced respondents, associated with the dredging branch. Relatively small number of respondents taking part in the survey, resulted from difficulties with finding the experts in this field and from the fact that there is only a limited number of companies which are involved in the matter of dredging works.

According to the survey results, it is worth mentioning, that the most important features which influence the selection of dredging equipment are type of soil, quantity of dredging spoil and also location and topography of harbportur. This conclusion shows that during the organization of dredging works, it is essential to adjust the working technology to harbour basin. Moreover, in the survey was signalized that it is also important to consider the ship traffic intensity while choosing the dredger. Taking everything into consideration, investing in port infrastructure should be properly planned so as to avoid obstruction of operation of terminals and obstruction of ship traffic (Kaizer, Smolarek, Krośnicka, & Ziajka, 2017).

The survey enabled to gain additional knowledge in the situation of making a decisions about projects with global conditions as well as it gave a statistical values of the assessments concerning parameters required in the studies containing multi-criteria analysis.

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