

## **PILOT SURVEY STUDIES ON BASIC KNOWLEDGE ON THE TECHNOLOGY OF UNMANNED UNDERWATER VEHICLES**

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### **ABSTRACT**

The article presents results of pilot survey studies on the knowledge of the basic issues regarding the technology of unmanned underwater vehicles. The studies were conducted on a group of male and female students of the Polish Naval Academy and the West-Pomeranian University of Technology. The studies are not linked to any current scientific project nor are they financed from any scientific fund (the authors hereby thank the editorial staff for a free-of-charge publication). The imperative to implement the above research stemmed from the authors' pure curiosity. Despite its realisation on a non-representative sample, the obtained results indicate the potential to conduct further investigation in the specified area, as it seems that regardless of the constant "bombing" with information in the mass media the knowledge on this type of technology is still scarce.

**Key words:** underwater works technology, unmanned underwater vehicle, marine engineering.

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## INTRODUCTION

One may undoubtedly say that all types of unmanned marine, air and land technology have recently conquered the imagination and the way of thinking for almost all humanity. Practically every day we are provided with news concerned with their application in all possible fields of exploitation. Such technology is used in the search for (and subsequent destruction of) mines and narcotics, to provide fire-fighting surveillance from the air or to move around ground that is covered in rubble, it is capable of flying and of moving under water. It lurks from the cinema screen, not only in sci-fi movies.

Almost everyone believes they have knowledge of this technology, and that by using the magic word "drone" with a random modifier indicating the field of exploitation of a particular device, they already place it at the top of technological avant-garde. Moreover, the subject matter is fashionable and popular. Hence, at almost each university there is someone dealing with this matter to a lesser or greater extent, and with varying levels of success. For it is true that even the most outstanding IT solutions will flood in just 50 cm of water if wrapped up in an inadequately waterproofed shell, at which point it is usually stated that the presented equipment was merely a construction model, not even deserving to be called a technology demonstrator, designed to verify the sole architecture of the IT system, which is followed by further joyful spending of the taxpayers' money.

Everyday politicians make references to *unmanned vehicles*, as such solutions are to become the cure for the odd long-term development policy regarding the nation's armament. And even the UN has recently discussed the issue on motion of a Danish diplomat, Michael Moeller, as in his opinion the situation may get out of hand and decisive actions need to be taken towards the adjustment of the international law in such a way as to prohibit construction of overtly autonomous robots capable of taking independent decisions to kill humans.

Unfortunately, this viewpoint depicts a contemporary battlefield that is becoming dehumanised, where soon we will have to face a situation where a robot could make the actual decision to kill a person. As we see, the situation is becoming rather dangerous. But what is the common knowledge on this technology? For now, let us answer this question leaving the ethical aspects and those related to international humanitarian law aside. What is the actual situation? What is the level of knowledge on unmanned remotely operated vehicles?

The authors are well aware of the fact that they are unable to provide a reliable answer to thus formulated questions due to several reasons. First of all, because this would require a proper large scale investigation, and there are no such resources available. On the other hand, however, as academic teachers we had access to certain possibilities which enabled us to conduct at least a pilot survey study in a defined environment of people who will soon be faced with the technology of unmanned underwater vehicles. And this is exactly what we have managed to accomplish.

In the course of everyday teaching at the Mechanical-Electrical Department of the Polish Naval Academy of Gdynia and at the Department of Ship Construction, Mechanics and Transportation of the West-Pomeranian University of Technology of Szczecin a survey study was carried out, the results of which are presented below. Should the collected research material of this pilot study contribute to any further initiative to undertake more complex actions and induce a deeper scientific interest in the discussed field, we will gladly provide it on request.

## METHOD

The study was conducted on a group of male and female students of two technological universities (full-time and part-time programmes of the 1st and 2nd degree), with direct or indirect contact with marine technology, who in the near future are quite certain to work in the sector concerned with maritime affairs.

The primary objective was to verify the knowledge of the respondents with regards to the general history and development and elementary technical issues connected with remotely operated underwater vehicles (the so-called ROVs). The survey consisted of 27 questions in the form of a single-choice test, covering the following thematic areas:

- 1) Personal data such as sex, age and education.
- 2) Individual manner of obtaining information in everyday life, including technical information from various mass media, such as the press, popular science periodicals, scientific journals, television.
- 3) Knowledge within the nomenclature used in relation to ROVs.
- 4) Orientation within the basic technical and constructional and operational issues regarding ROVs.
- 5) Area and scope of ROV application in the world.

The study was participated by 61 students (28 women and 33 men), 28 questionnaires were filled incorrectly. The errors included provision of more than one answer to a particular question or a failure to provide an answer. In the end, after an initial selection and rejection of erroneously filled surveys, further analysis was carried out on 33 questionnaires, of which 33% were submitted by women, and 67% by men - Fig. 1. The majority of subjects were aged between 20-30 years, with higher technical education (1st degree graduates in the course of 2nd degree studies) - 27% of the respondents. Approximately 15% of the participants were persons with general upper-secondary education.

A)

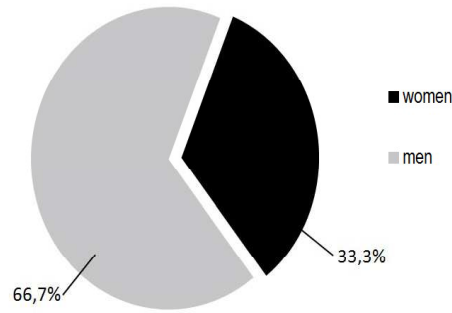


Fig. 1. Answers to questions regarding the personal data of the respondents:  
a) the percentage share of men and women in the study;

B)

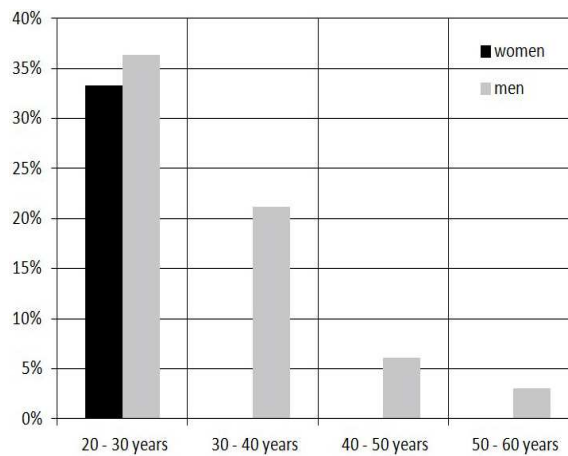


Fig. 1. Answers to questions regarding the personal data of the respondents:  
b) the percentage share of men and women in particular age groups;

C)

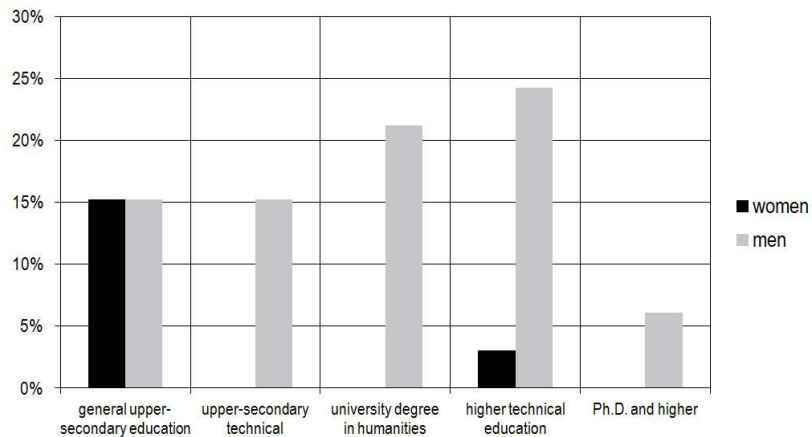


Fig. 1. Answers to questions regarding the personal data of the respondents:  
c) the percentage share of men and women with regard to participants' education.

## RESULTS OF THE PILOT SURVEY STUDY

In the matter regarding the sources of knowledge, the prevailing source among the respondents was television programmes, with regard to women 18% of cases involved popular science programmes (42% - men). For 21% of women the indicated source of knowledge was television in general, with remaining information media present in trace quantities. In the case of men, for 30% the signalled source of knowledge included popular science and scientific books (ca. 12%) – Fig. 2.

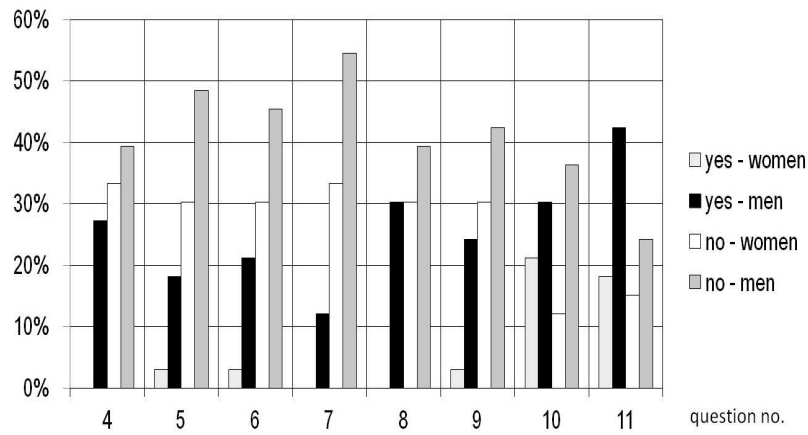


Fig. 2. The list of respondents' answers to questions 4 - 11 connected to obtaining information, where: 4 – reading weekly newspapers, 5 – reading journals, 6 – reading popular science periodicals, 7 – reading scientific periodicals, 8 – reading popular science books, 9 – reading scientific books, 10 – watching TV programmes, 11 – watching popular science TV programmes.

The analysis of survey responses indicated that ca. 21% of women and ca. 42% of men were familiar with the term ROV, whereas almost half of such percentage values, i.e. ca. 12% and 24% respectively had not had an opportunity to become acquainted with the term – Fig. 3. Similar values of 21% and 30% indicate that both men and women knew the meaning of the ROV abbreviation.

A greater discrepancy between the researched groups was noted with respect to the answer regarding the lack of knowledge of the abbreviation and reached ca. 12% and 35% respectively. An even larger split was observed in relation to the next question of a more technical nature. Namely, ca. 27% of women and 63% of men were aware of the fact that an ROV was a submersible. Only a small group of persons did not have such knowledge.

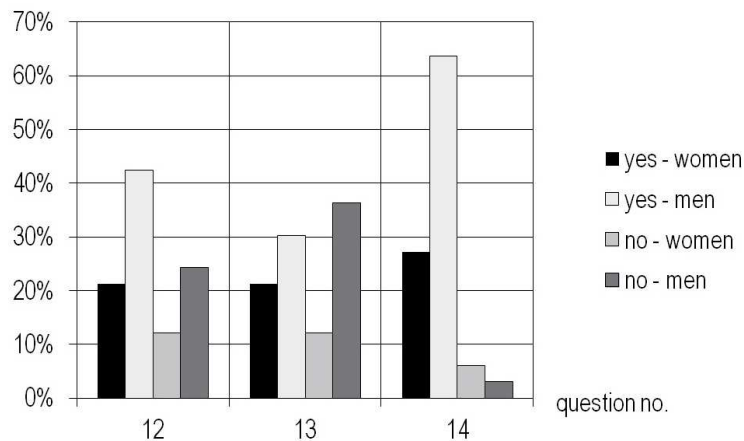


Fig. 3. The list of respondents' answers to questions 12 - 14 connected to the knowledge of the ROV abbreviation, where: 12 – knowledge of the ROV abbreviation, 13 – meaning of the ROV abbreviation, 14 – ROV submersibility.

In the context of question nos. 12-14, question 26 indicates that the fact of having encountered the abbreviation ROV and being familiar with what it stands for is not equivalent with the respondents' knowledge as to the actual meaning of this term.

Nearly 18% of women and 45.5% of men provided correct answers to these questions – Fig. 4. However, the remaining part of those surveyed were convinced that ROV stood for a different type of vehicle, with 3% in both these groups pointing to a bathyscaphe, and over 5% of females to a manned underwater vehicle.

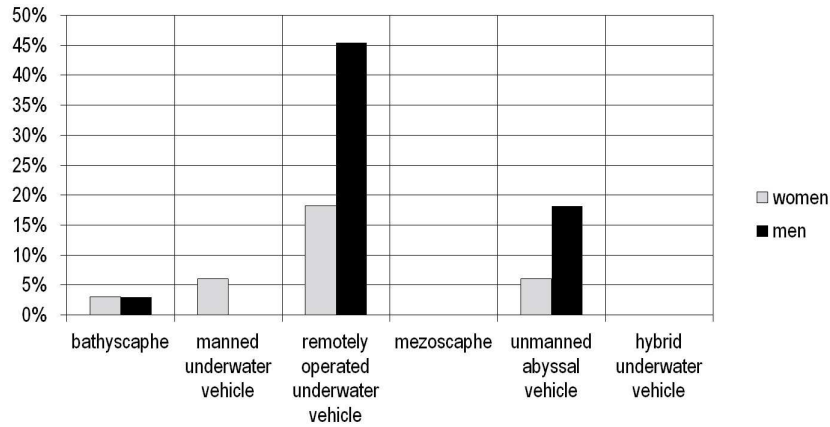


Fig. 4 Respondents' understanding of the location of ROVs in general classification of underwater vehicles (question no. 26).

The answers to questions no. 15, 17, 20 and 27 reveal that the surveyed men were more informed on how an ROV performs its tasks, what type of vehicle it was as well as its operation and use.

The respective correct answers were provided by: women 30% and men 51% – Fig. 5, women 24% and men 61% – Fig. 6, women 24% and men 67% – Fig. 7 and women 33% and men 51% – Fig. 8.

The remaining incorrect answers of both groups were within the range between 9 – 19%.

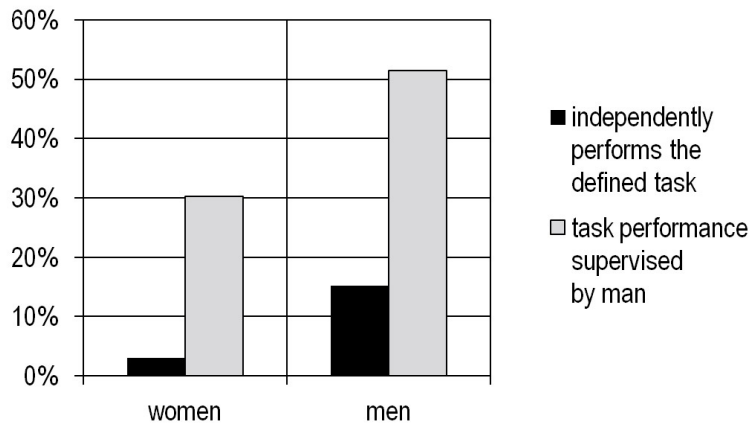


Fig. 5. Respondents' understanding of the type of tasks performed by ROVs (question no. 15).

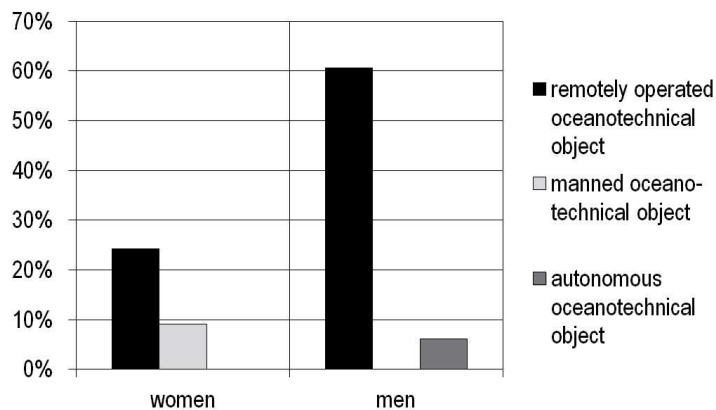


Fig. 6. Respondents' understanding of what type of vehicle an ROV stands for.

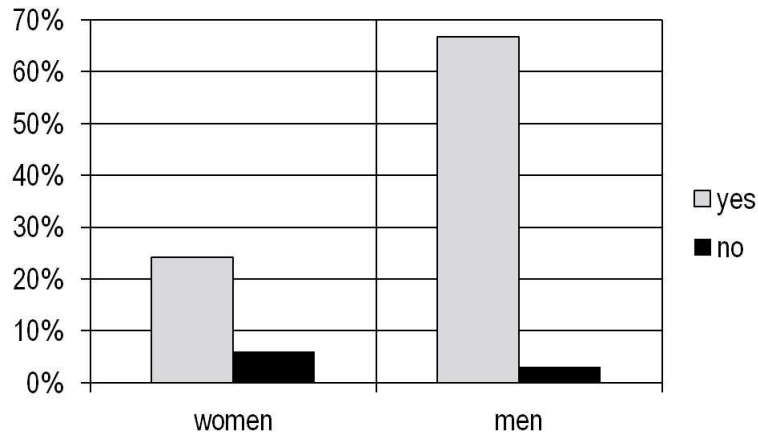


Fig. 7. Respondents' understanding of ROV operation (question no. 27).

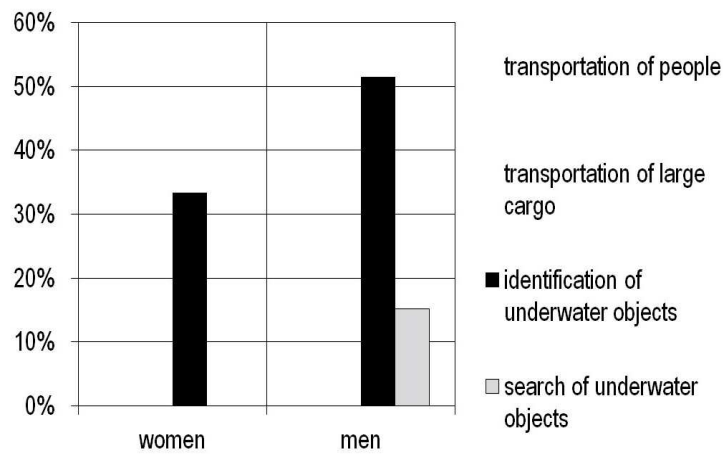


Fig. 8. Respondents' knowledge of ROV application (question no. 20).

Questions: 18, 19, 22 and 23 reflected the basic technical issues related to ROV usage properties. Particular figures show that men's knowledge concerned with the technical standards of the vehicle is broader.

The correct answers to the above questions were submitted respectively by: no. 18 – 24% of women and 42% of men – Fig. 9, no. 19 – 21% of women and 39% of men – Fig. 10, no. 22 – 21 % of women and 58% of men – Fig. 11 and no. 23 – 3% of women and 27% of men – Fig. 9 It should be noted that the knowledge of technical-operational issues regarding ROVs was generally at an average level.

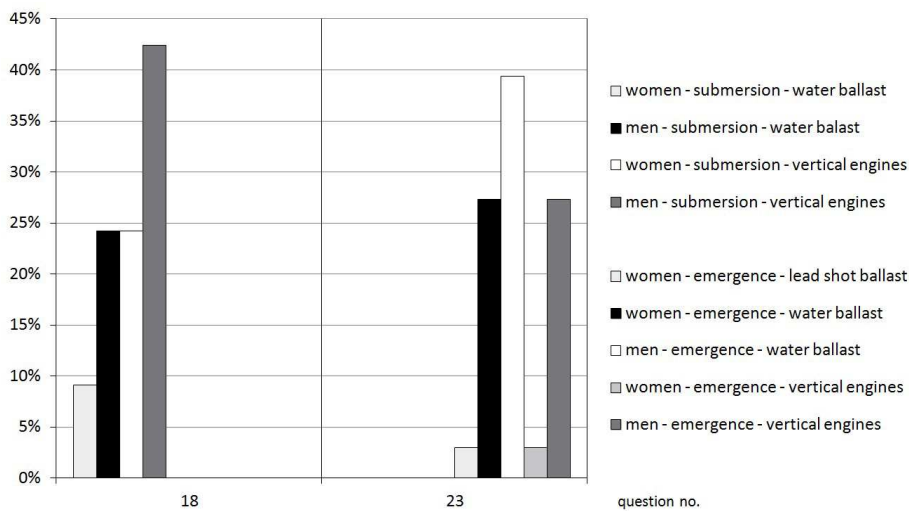


Fig. 9. The list of respondents' answer to questions 18 and 23 connected with ROV submersion and emergence, where: 18 – ROV submersion mechanism, 23 – ROV emergence mechanism.

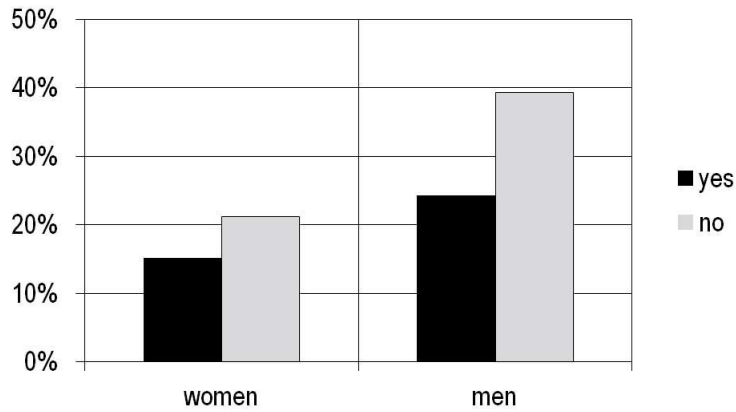


Fig. 10. Respondents' knowledge of speed differences in the vertical and horizontal movement of an ROV (question no. 19).

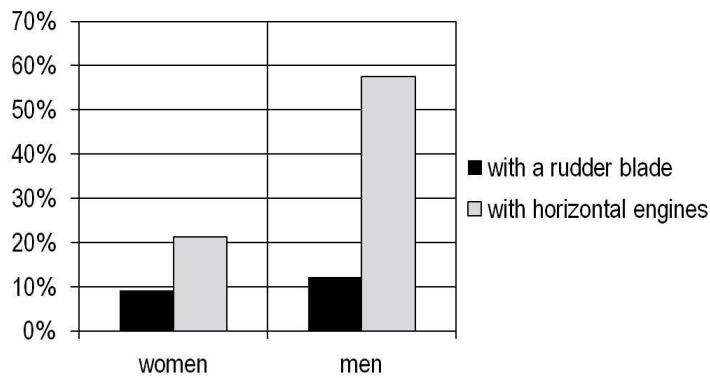


Fig. 11. Respondents' knowledge of ROV manoeuvring under water (question no. 22).

The respondents were equally accurate in specifying the year of establishment of the concept and construction of underwater vehicles. Only 3% of men – Fig. 12 – indicated the year 1898 as the year of construction of the first ROV.

The vast majority placed this historical fact in the second half of the 20th century.

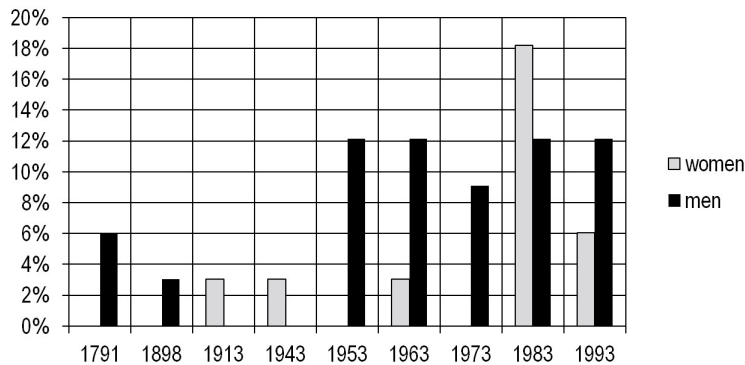


Fig. 12. Specification of the year of construction of the first ROV (question no. 16).

According to market analysis, the greatest number of ROV manufacturers come from Europe. However, the majority of the production takes place in North America.

The respective percentages of respondents were familiar with these facts – Fig. 13: 15% of women and 33% of men, and 6% of women and 24% of men.

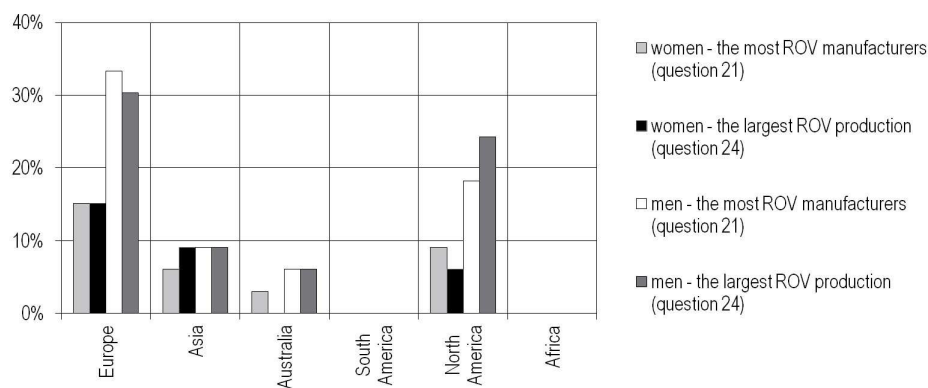


Fig. 13. The list of respondents' answers to questions: no. 21 and 24, where 21 – location of the greatest number of ROV manufacturers, 24 – location of the largest ROV production.

## CONCLUSIONS

The results clearly show that the knowledge of matters related to unmanned underwater vehicles is generally small. This could be justified by the fact that such issues are not generally included in the main curricula of either of the academic institutions participated by the respondents.

Moreover, the subjects tended to indicate television as one of the main sources of information, where reliable reports on the discussed subject matter are scarce. Of course the study was carried out on a non-representative sample, thus it is difficult to have it transposed onto the entire population. This would require a much broader scope of activities.

The presented results are to be treated only as preliminary. Nonetheless, it is possible to conclude that the current state of knowledge on unmanned vehicles encourages the undertaking of broader educational activities in this area, especially given the fact that the prognostics concerned with the development of underwater and other works technologies indicate a significant increase of their meaning in the future.

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