

# Review the effective factors in increasing the performance of SAR operations in coastal and offshore area of Khorramshahr port

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## ABSTRACT

This research is performed in order to identify and review the effective factors contributing to the improvement of SAR (Search and Rescue) vessel performance in Khorramshahr port. By considering the limitations of search and rescue operations at sea in comparison to those on land, it is necessary for search and rescue operations to be carried out quickly to minimize human loss. It should be noted that the SAR vessel is one of the requirements of this operation. The research method is descriptive-correlational. The statistical population of the research is 70 managers, pilots and responsible persons for search and rescue operations and vessels, VTS officers, and survivors of marine accidents at Khorramshahr port. The sample size was determined based on the table by Morgan, and a statistical sample of 59 people was selected through simple random sampling. Pearson's correlation coefficient and regression analysis were used to analyze the research data, and the SPSS software and structural equation method were used for statistical analysis. The effective factors affecting SAR vessel performance were identified through interviews with experts and by reading the latest articles and sources. The Result of the Skewness and Kurtosis tests show the data distribution is normal; therefore, parametric tests such as Pearson correlation can be used. Findings of research show that it is necessary to buy SAR vessels with high speed and more carrying capacity, night vision equipment such as fog lights, appropriate communication tools, complete and essential medical equipment, advanced navigation equipment, salvage equipment, competent operators and familiarity with Arvand waterways conditions that are affecting on SAR vessel performance in Khorramshahr port.

## 1. Introduction

Today, the shipping industry is of great importance in the economic cycle of countries, because about 90% of exports and imports and in general the transportation of goods in the world is done by sea.

Given the complex nature of SAR operations it is important to differentiate the goals of this paper in study success versus efficiency or effectiveness. These terms have been used in previous work (Greatbatch et al, 2014, Meredith & Greatbatch 2022) to understand SAR operations, whereby success is defined as the number of correct targets identified out of the total possible targets, and effectiveness is the total number of targets identified, out of a combined total of possible targets plus positives (Hannah et al, 2023).

Maritime search and rescue operations are critical missions involving personnel, boats, helicopter, aircrafts in a struggle against time often worsened by adversary sea and weather conditions.

A quick and efficient search and rescue (SAR) operation can prevent a disaster or at least increase the chances of survival. SAR operations are organized and carried out by a Rescue Coordination Centre (RCC) or another vessel in the vicinity. Crucial decisions are made by the SAR coordinator, and their assessment of the situation largely determines the success or failure of the operation (Marzena Malyszko, 2022).

In recent decades, the shipping industry has focused its attention on improving the quality of ships, their

systems and equipment in order to reduce maritime accidents. Due to the use of the shipping industry from the advancement of technology, structures, systems and equipment, ships have become much more reliable than before; but the number of maritime accidents is still high and has not shown significant change. The reason for this issue is the reliability of the ship's structure and equipment which is a relatively small part of the safety equation. The rule and mechanism of the sea is the required and updated training for seafarers or human element, so, human factors play a very important role in maritime accidents.

From healthcare to aviation, significant research time has been dedicated to better understanding how these conditions may influence task performance (Barnett & Kring, 2003; Alexander & Klein, 2019; Martin, Murray, Bates & Lee, 2015; Lawn et al., 2020), though less attention has been directed at SAR professionals or volunteers (Hannah et al, 2023).

## 2. Statement of the problem

After the occurrence of any maritime accident, the first place with which emergency contact is established is the nearest maritime search and rescue center in that area. The Rescue Coordination Centre is responsible for operations such as search and rescue, medical assistance, marine pollution prevention and maritime safety control of an area. Therefore, it is necessary to identify the essential factors that are effective in the success of maritime search and rescue operations. Due to the long route of the Arvand waterway (about 62 nautical miles to the mouth of the Arvand to the Persian Gulf) as a monitoring and operational area of Khorramshahr port. On the other hands, because of the high volume of vessel traffic to Iran and Iraq ports especially high-speed passenger vessels, so, a maritime search and rescue center is vital and necessary for this waterway. The center aims to improve the safety of the Arvand waterway, speed up maritime rescue operations and prevent any maritime accidents to the most complete telecommunications equipment, including VHF MF/HF, as well as high-speed vessels, emergency medical center and work force. Equipped specialist and started his activity in Khorramshahr port. Due to the limitations of maritime rescue operations to land, it is necessary to carry out maritime search and rescue operations in this area in the fastest time and with the least human casualties. One of the requirements of this operation is search and rescue vessels. In this study, first, the number of accidents that have occurred in the port in recent years, along with the number of survivors and deaths, is examined. Finally, increasing the performance and efficiency of SAR operations along the Arvand River and Khorramshahr Port will be surveyed.

## 3. Research purposes

The goals that this research seeks to achieve are:

- Upgrading the maritime search and rescue system along the Arvand River and Khorramshahr port
- Identify the factors affecting the performance of maritime search and the rescue vessels
- Investigation of the situation of Khorramshahr port in relation to the factors affecting for improving the performance of search and rescue operations
- The role of required training for SAR vessel personals.

### 3.1. Research Methodology

The research method is applied in terms of purpose and descriptive-correlational in nature. Inferential analysis and statistical analysis were performed by using SPSS software. The statistical population of this research is 70 managers, pilots and responsible persons of The Rescue Coordination Centre and rescue vessels, VTS officers, and survivors of marine accidents at Khorramshahr port. The sample size was determined based on the table by Morgan, and a statistical sample of 59 people was selected through simple random sampling. Pearson's correlation coefficient and regression analysis were used to analyze the research data, and the SPSS software and structural equation method were used for statistical analysis. The actual factors affecting SAR vessel performance were identified through interviews with experts and by reading the latest articles and sources. The normality of the research data has been calculated by using Kolmogorov Smirnov Test and the ratio of skewness to kurtosis with standard error.

On the other hands, the International Maritime Search and Rescue Convention: Iran became a member of the International Maritime Organization in 1989. The organization has several conventions, one of which is the International Maritime Search and Rescue Convention. The convention adopted in 1979 at the Hamburg World Conference and entered into force in 1985; it was established as an international coordination of search and rescue system and methods for rescuing ships and persons in distress at sea. This convention provides for the organization of search and rescue centers and coordination steps on the coast and effective operational methods, and provides methods of cooperation between several neighboring countries. Although maritime culture and international treaties such as the International Convention for the Safety of Life at Sea (SOLAS 1974) emphasize the need for ships to rush to the aid of emergency vessels, no international search system has been in place until the Convention is rescued. It did not cover search and rescue operations. Implementing the rules and regulations of this convention will reassure more seafarers and passengers at sea and will increase maritime safety, as well as greatly reduce the risks of marine activities and prevent marine pollution and aquatic mortality. It will have a collision of vessels.

### 3.2. Objectives of the Convention

- Establishment of an internationally coordinated system in the field of search and rescue and rescue methods at sea
- Organizing search and rescue centers and coordination steps on the beach
- Determining the methods of cooperation of several neighboring countries
- Establishment of main and secondary search and rescue centers
- Effective operational methods in the event of an accident
- Increase maritime safety

### 3.3. Advantages of marine search and rescue operations

- Reduction of losses and financial and human losses
- Creating a safe environment for related industries of maritime, aviation, tourism, research and Positive publicity for the country
- Protection and sovereignty of the country's waters
- Reduction of liability and freight premiums in the shipping industry
- Provide peace of mind to the relatives of the occupants of the vessels

### 3.4. Areas Covered by the Country's Marine Rescue Coordination Centers

In order to implement the provisions of the International Convention on Maritime Search and Rescue (SAR), and monitor and respond to marine pollution in line with the International Convention for the Prevention of Pollution from Ships (MARPOL), International Convention on Oil Pollution Preparedness, Response and Cooperation (OPRC) and its Protocol on Harmful and Noxious Substances (OPRC-HNS), the Ports and Maritime Organization (PMO) has taken measures to conclude or extend contracts to employ aerial units. For this purpose, 5 special maritime helicopters, 2 hovercrafts and one aerial patrol airplane were acquired from the Transport Services of the I.R.I. Naval Forces, and 3 helicopters from the private sector (namely, PASCO Aviation Services Company). The aerial operations of the above units generally cover areas with the highest navigation traffic in the Persian Gulf, Gulf of Oman, Strait of Hormuz and Caspian Sea. Contracted Helicopters, Hovercrafts and Airplanes

1- Transport Services of the I.R.I. Naval Forces:

- two Sikorsky SH-3D helicopters, stationed in Bandar Abbas and Chabahar;
- three BELL 212 SH-3D helicopters, stationed in Bushehr, Jask and Rasht (Bandar Anzali);
- one Friendship 27 airplane, stationed in Bandar Abbas for aerial patrols and monitoring of

vessels in shipping lines and response to oil spills at sea, as well as search and rescue services for locating vessels in distress and identifying those causing pollution;

- one BH-7 hovercraft, stationed in Bandar Abbas; and
- one SRN-6 hovercraft, stationed in Bandar Abbas.

2- PASCO Aviation Services Company:

- one BELL 412 EP helicopter, stationed in Kish Island;
- one BELL 212 helicopter, stationed in Kish Island; and
- one BO 105 helicopter, stationed in Kish Island.

### 3.5. Area Covered by the Maritime Search and Rescue Provincial Plan

1). Area covered by the main Maritime Search and Rescue Center of Bandar Imam Khomeini:

- Khormosi canal, longitude 49 ° east to 49 ° east, outer anchorage

2). Area covered by Khorramshahr Port Maritime Search and Rescue Center:

- Boundary of Khorramshahr port from north to Basra port and from south to Arvand-knar port (Arvand River), Karun river


3). Area covered by Arvand-knar Port Maritime Search and Rescue Center:

- Arvand-knar port distance from Arvand estuary (Arvand River), longitude 48 in the east to 49 in the east

4). Area covered by Sajafi Port Maritime Search and Rescue Sub-Center:

- Longitude range 49 in the east to 50 in the east, Nowruz and Bahrgan oil region,

**Table 1: Units of Maritime Rescue Coordination Centers of Khuzestan Province**

	Center	Imam Khomeini Port	Arvandkn ar Port	Sajafi Center	Khorra mshahr Port
Equip ment					
Search and rescue boat		✓	✓	-	✓
Search and rescue ship		-	-	-	-
Helicopter		-	-	-	-
AirPlane		-	-	-	-
Firefighting equipment		✓	-	-	-

Ambulance	✓	-	-	-
Tug boat	✓	-	-	-
Medical Advice	✓	-	-	-
Oil pollution control equipment	✓	-	-	-

Source: Research findings

**Tables 2: the number of accidents in Khuzestan province ports in 2011 to 2015**

Year	2011	2012	2013	2014	2015	Total
Jan	2	0	2	5	5	14
Feb	5	2	4	5	5	21
Mar	6	2	2	0	5	15
Apr	6	2	0	7	3	18
May	6	2	1	2	2	13
Jun	4	3	3	23	0	33
Jul	5	8	4	3	4	24
Aug	5	2	2	7	3	19
Sep	4	7	1	6	4	22
Oct	6	3	5	5	6	25
Nov	5	3	4	6	5	23
Dec	4	6	1	4	4	19

Source: Research findings

### 3.6. Research Literature Review

Typically, a SAR operation is organized and coordinated by a Rescue Coordination Centre (RCC). The SAR mission coordinator has advanced search-and-rescue units at their disposal, such as watercraft and aircraft stationed at bases, harbors, and airports. Particular countries are responsible for search and rescue operations within their respective Search and Rescue Regions (SRR), and support operations in other areas as part of international cooperation. In some situations, it would take too long for search and rescue services to reach the distress position or professional SAR resources are insufficient. In such a case, the SAR coordinator can request civil units in the vicinity of the distress position, such as merchant, passenger or fishing vessels, pleasure boats or specialized vessels carrying out offshore works, to render assistance (Miroslaw et al, 2021).

The purpose of this research is to study the service provision of Arvand Maritime Search and Rescue Sub-Center and to identify the factors affecting the conduct of maritime search and rescue operations and to provide scientific and practical solutions to improve the performance of this center. Based on the results of this research, in the field of human resources, the number of people, the level of motivation and job satisfaction of people and the holding of practical exercises; in the field of equipment, their number and type, and the use of updated equipment and the evaluation of their efficiency after each accident; in the field of shipping, preparedness to deal with any accident according to the

type of cargo of the ship and in the field of miscellaneous issues, the amount of approved budget, preparedness to deal with any accident at any hour of the day and night, lack of sufficient independence in making decisions and providing the necessary orders in the sub-center Arvand sea search and rescue are not sufficient and suitable (Yousefi, et al, 2023).

The method is based primarily on search theory and gradient search methods. Thanks to this, it is possible to improve the efficiency of planning and reduce the costs of action. The authors presented a model that takes into account the uncertainty of demand and allows for a balanced distribution of recourses. The method solves the problem for various objective function term weights. The proposed model primarily improves the performance of the SAR system (Karatas, 2021).

A number of large-scale maritime SAR operations were carried out in recent years in Chinese waters. For example, on January 6, 2018, Iranian-owned tanker *Sanchi* collided with the Hong Kong-flagged cargo ship *CF Crystal* and caught fire. Chinese authorities quickly arrived to the scene to search for and rescue missing crew. The timing of SAR is a key factor for severe accidents and of great importance in planning a SAR system; quick response to an incident has a significant impact on victims' survival rate (Zhou et al, 2020).

Mielniczek et al, (2024) stated that SAR units consist of various types of rescue units that are designed to conduct rescue operations at sea. Rescue units usually include:

- Rescue ships - these are units equipped with specialized equipment for carrying out rescue operations at sea. They have large operational ranges and are capable of high speeds, so they can reach the scene quickly. Rescue ships are equipped with special communication systems, radar, sonar, as well as water extinguishing agents and equipment for lifting people from the water. An example of such a unit is the SAR-3000 sea rescue vessel.

- Rescue boats - these are smaller units that allow you to quickly reach the scene of the incident and to thoroughly search small sea areas, bays or ports. Rescue boats are usually equipped with outboard motors and specialized equipment to rescue people from the water. An example of a rescue boat is the Gemini Wave-rider 600 type RIB rescue boat.

- Helicopters are aerial units that enable rapid and efficient rescue operations in expansive marine regions. These versatile aircraft are outfitted with advanced radar and communication systems, as well as rescue equipment such as specialized hoists, cable winches, and medical transport systems, among others. One example of such a helicopter is the Mi-14PL/R, a heavy-duty rescue helicopter. Helicopters play a vital role in maritime search and rescue operations, providing rapid response capabilities and the ability to

cover vast areas quickly. These aircraft are particularly useful in offshore locations and in situations where conventional rescue vessels may not be able to reach the scene of an emergency in time. Helicopter crews are highly trained professionals, well-versed in the use of specialized equipment and techniques required for successful rescue operations. They work closely with other SAR units, such as coastguard vessels and naval ships, to coordinate search and rescue efforts and ensure that all available resources are utilized effectively. In addition to their crucial role in emergency response, helicopters also play an important role in conducting surveillance and monitoring operations, helping to detect potential hazards and prevent accidents before they occur. Equipped with state-of-the-art technology and manned by skilled pilots and technicians, these aerial units are a valuable asset to any SAR team operating in marine environments. In conclusion, helicopters are an indispensable component of modern maritime search and rescue operations, providing a vital link between those in distress and the resources needed to affect a successful rescue. Through ongoing training, equipment upgrades, and close coordination with other SAR units, these aircraft continue to enhance the safety and security of those who work and play in and around the world's oceans.

– Divers - specialists who are used to carry out underwater operations in hard-to-reach places such as submerged ships, underwater caves, or other difficult-to-access locations. Divers are equipped with diving gear as well as equipment for conducting rescue operations underwater. According to information provided by Polish Search and Rescue (SAR), due to the rare cases of diving accidents in Poland, they do not have a specially designated group of divers on standby. However, in situations where a diving accident occurs, SAR can rely on the services of the fire brigade, which has specialized equipment for underwater operations. It should be noted, however, that the fire brigade operates only in coastal areas, and in the event of accidents in open sea, SAR must rely on assistance from other units such as the Air Rescue Service or the Navy. All of these rescue units work according to established procedures and as part of the coordination of actions between different SAR units. These units are equipped with specialized equipment and conduct systematic training, which allows for quick and effective actions in rescue situations. It is important to emphasize the crucial role that divers play in ensuring the safety of individuals who engage in underwater activities or those who work in dangerous underwater environments. Despite the relatively low frequency of diving accidents, the consequences of such incidents can be severe, and the need for swift and efficient rescue operations is paramount.

Therefore, it is essential that all SAR units, including those that rely on assistance from other organizations, maintain a high level of readiness and expertise in carrying out underwater rescue operations. This includes not only the acquisition of specialized equipment and regular training but also the development of effective communication and coordination mechanisms between different units, as well as the establishment of clear and efficient protocols for responding to diving accidents. By working together and maintaining a constant state of readiness, SAR units can ensure that they are able to respond quickly and effectively to any emergency situation, thus reducing the risk of injury or loss of life (Mielniczek et al, 2024).

Communication for processing relevant information plays a paramount role in developing a comprehensive understanding of Search and Rescue (SAR) situations and conducting operations in a successful and reliable manner. Nevertheless, communication systems have not changed considerably in the context of simplifying very high frequency (VHF) maritime communication and enhancing the value of SAR practices. The Automated Transcription of Maritime VHF Radio Communication for SAR Mission Coordination (ARTUS) project approaches this problem with the development of an assistance system which employs AI-based speech recognition and smart direction finding (Aylin et al, 2020).

In 2022, the Maritime Search and Rescue Service (MSPiR) participated in a total of 352 rescue operations, providing assistance to 282 individuals, 139 of whom were rescued from immediate life-threatening situations (Mielniczek et al, 2024).

It is necessary to utilize efficient and effective decision support. DSSs, data management solutions, and AI have been used extensively to help reduce the impacts of disasters. These technologies have received considerable attention in recent years and are being adopted by many different sectors, including business, SAR, and so on (Wajeeha et al, 2023).

#### **4. Analysis the normality of data by using Kolmogorov Smirnov Test and the ratio of skewness to kurtosis with standard error**

If the significance level of the Kolmogorov-Smirnov test is less than the error value of 0.05, it indicates non-normality, and if the significance level of the test is greater than 0.05, it indicates the normality of the data. The absolute value of the skewness and kurtosis coefficient greater than 2 indicates a violation of the normality of the data. Also, if the value of the standard error of the skewness and the kurtosis coefficient is smaller than -2 or larger than +2, then the assumption of normality of the distribution is rejected.

First, the nature of the data is determined by using the Kolmogorov-Smirnov test in order to determine whether the data are normal or not. According to the

test results, it was determined that the value of the significance level is less than 0.05, therefore, the data are not normal and the researcher should use the non-parametric tests it means that Chi-square test is used for statistical analysis of the data. It should be noted that around 59 respondents answered to the questionnaires were examined from three dimensions of job, work experience and education.

In the conceptual model of this research, the maritime search and rescue center and its dimensions (purchase of a high-speed vessel with a high capacity - modern

navigation, medical and rescue equipment for vessels - night vision equipment and fog lights for vessels - necessary training to increase the competence of personnel vessels) as an independent variable and increasing the performance of search and rescue vessels as a dependent variable, which is called a criterion variable in correlational research.

**Table 3: The results of the normality of research variables**

Variable	Skewness		Kurtosis		Kolmogorov Smirnov		Test result
	Std. Error	Statistic	Std. Error	Statistic	Sign	Statistic	
Khorramshahr maritime SAR center	0.251	- 0.024	0.498	0.203	0.20	0.62	Normal
Increasing maritime SAR performance at Khorramshahr port	0.251	- 0.566	0.498	0.264	0.197	0.8	Normal

Source: Research findings

Table No.3 shows that the significance level of the variable of the Khorramshahr maritime SAR center (0.20) and the variable increasing maritime SAR performance in Khorramshahr port (0.197) is higher than the error level of 0.05. Therefore, it is concluded that the data distribution of the studied variables is normal and parametric tests such as Pearson's correlation can be used. The value of the skewness and kurtosis coefficient of the studied variables is in the safe range (+2 and -2) and also the value of the standard error of the skewness and kurtosis coefficient is in the safe range (+2 and -2) and once again the normality of the data distribution conforms that.

**5. Investigation of the Research Hypothesis**

According to the objectives and research questions, the following hypothesis has been proposed:

- 1). Main hypothesis: Khorramshahr Maritime Search and Rescue Center has an effect on increasing the performance of search and rescue operations.
- 2). Sub hypothesis one - The component of purchasing a high-speed rescue ship with a high capacity from the factors of the Maritime SAR Center has a positive and significant effect on increasing the performance of SAR center at Khorramshahr port.
- 3). Sub hypothesis two - SAR boats or ships must be equipped with a complete set of navigation, telecommunications, medical and rescue equipment.
- 4). Sub hypothesis three - SAR boats or ships must be equipped with night vision devices and fog lights.
- 5). Sub hypothesis four - Trainings required to increase the competence of search and rescue ship personnel.

**Main Hypothesis** - Khorramshahr Maritime Search and Rescue Center has an effect on increasing the performance of search and rescue operations.

**Table.4: The impact of Khorramshahr SAR center on increasing the performance of SAR operations**

Variable	R	R <sup>2</sup>	F	Sign
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Khorramshahr SAR center	0.793	0.629	150.312	0.000
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Source: Research findings

Table No.4 shows that in about 63% of the changes in the dependent variable of increasing the performance in the search and rescue operations at Khorramshahr port is from the independent variable of Khorramshahr maritime SAR center.

**Table.5: Variable determination coefficients of Khorramshahr SAR center on increasing the performance of SAR operations**

Variable	NSC B	SC Beta	T value	Sign
Khorramshahr SAR center	0.793	0.793	0.629	0.000

NSC: Non-standard coefficient / SC: Standard coefficient

Table No.5 shows that the variable of Khorramshahr maritime search and rescue center has a positive and significant effect on increasing the performance of search and rescue operations at the five percent level. In other words, if one unit is added to the variable of Khorramshahr SAR center, 0.760 units will be added to the variable of increasing the performance of search and rescue operations.

**Sub hypothesis 1** - The component of purchasing a high-speed ship with a high capacity from the factors of the Maritime SAR Center has a positive and significant effect on increasing the performance of SAR vessels at Khorramshahr port.

**Table.6: The impact of purchasing a high-speed ship with a high capacity on increasing the performance of SAR vessels**

Variable	R	R <sup>2</sup>	F	Sign
Purchasing a high-speed ship with a high capacity	0.765	0.561	138.231	0.000

Source: Research findings

Table No.6 shows that in about 56% of the changes in the variable of increasing the performance of SAR ship at Khorramshahr port is from the variable purchasing a

high-speed ship with a high capacity at Khorramshahr port.

**Table.7: Variable determination coefficients of purchasing a high-speed ship with a high capacity on increasing the performance of SAR vessels**

Variable	NSC B	SC Beta	T value	Sign
Purchasing a high-speed ship with a high capacity	0.671	0.613	11.365	0.004

NSC: Non-standard coefficient / SC: Standard coefficient

Table No.7 shows that the variable of purchasing a high-speed ship with a high capacity has a positive and significant effect on increasing the performance of search and rescue vessels at the five percent level. In other words, if one unit is added to the variable of purchasing a high-speed ship with a high capacity, 0.613 units will be added to the variable of increasing the performance of search and rescue vessels.

**Sub hypothesis 2 - SAR boat or ship must be equipped with a complete set of navigation, telecommunications, medical and rescue equipment.**

**Table.8: The impact of SAR boat or ship must be equipped with the equipment on increasing the performance of the SAR center**

Variable	R	R <sup>2</sup>	F	Sign
SAR boat or ship must be equipped with the required equipment	0.711	0.456	135.129	0.000

Source: Research findings

Table No.8 shows that in about 46% of the changes in the variable of increasing the performance of the SAR center at Khorramshahr port is from the variable SAR boat or ship must be equipped with the required equipment at Khorramshahr port.

**Table.9: Variable determination coefficients of SAR boat or ship must be equipped with the equipment on increasing the performance of the SAR center**

Variable	NSC B	SC Beta	T value	Sign
SAR boat or ship must be equipped with the required equipment	0.531	0.498	12.289	0.004

NSC: Non-standard coefficient / SC: Standard coefficient

Table No.9 shows that the variable of SAR boat or ship must be equipped with the required equipment has a positive and significant effect on increasing the performance of search and rescue center at the five percent level. In other words, if one unit is added to the variable of SAR boat or ship must be equipped with the required equipment, 0.498 units will be added to the variable of increasing the performance of search and rescue center.

**Sub hypothesis 3 - SAR boat or ship must be equipped with night vision devices and fog lights.**

**Table.10: The impact of SAR boat or ship must be equipped with night vision devices and fog lights on increasing the performance of the SAR center**

Variable	R	R <sup>2</sup>	F	Sign
SAR boat or ship must be equipped with night vision devices and fog lights	0.680	0.491	139.812	0.000

Source: Research findings

Table No.10 shows that in about 49% of the changes in the variable of increasing the performance of the SAR center at Khorramshahr port is from the variable SAR boat or ship must be equipped with night vision devices and fog lights.

**Table.11: Variable determination coefficients of SAR boat or ship must be equipped with the equipment on increasing the performance of the SAR center**

Variable	NSC B	SC Beta	T value	Sign
SAR boat or ship must be equipped with night vision devices and fog lights	0.531	0.511	11.231	0.000

Table No.11 shows that the variable of SAR boat or ship must be equipped with night vision devices and fog lights the required equipment has a positive and significant effect on increasing the performance of search and rescue center at the five percent level. In other words, if one unit is added to the variable of SAR boat or ship must be equipped with night vision devices and fog lights, 0.511 units will be added to the variable of increasing the performance of search and rescue center.

**Sub hypothesis 4 - Trainings required to increase the competence of search and rescue ship personnel.**

**Table.12: The impact of Trainings required to increase the competence of SAR ship personnel on increasing the performance of the SAR center**

Variable	R	R <sup>2</sup>	F	Sign
Trainings required to increase the competence of SAR ship personnel	0.578	0.384	126.413	0.000

Source: Research findings

Table No.12 shows that in about 38% of the changes in the variable of increasing the performance of the SAR center at Khorramshahr port is from the variable Trainings required to increase the competence of SAR ship personnel at Khorramshahr port.

**Table.13: Variable determination coefficients of Trainings required to increase the competence of SAR ship personnel on increasing the performance of the SAR center**

Variable	NSC B	SC Beta	T value	Sign
Trainings required to increase the competence of SAR ship personnel	0.489	0.637	10.212	0.000

NSC: Non-standard coefficient / SC: Standard coefficient

Table No.13 shows that the variable of trainings required to increase the competence of SAR ship personnel has a positive and significant effect on increasing the performance of search and rescue center at the five percent level. In other words, if one unit is added to the variable of trainings required to increase the competence of SAR ship personnel, 0.637 units will be added to the variable of increasing the performance of search and rescue center.

## 6. Conclusion

Factors affecting the performance of maritime search and rescue ships have direct impact on improving the maritime search and rescue center at Khorramshahr port. According to the sub-hypothesis 1, the purchase of High-speed rescue boats or ships capable of carrying a large number of passenger is necessary to improve the quality of maritime rescue operations at Khorramshahr port. Purchasing search and rescue ships at a faster rate will improve the performance of these ships in maritime search and rescue operations. The use of search and rescue ships with high carrying capacity is effective in improving the performance of these vessels in marine search and rescue operations.

Referring to the sub-hypothesis.2 of this research that is confirmed the SAR boat or ship must be equipped with a complete set of navigation, telecommunications, medical and rescue equipment. The presence of appropriate means of communication in search and rescue vessels is effective in improving the performance of these vessels in maritime search and rescue operations. The presence of complete and necessary medical equipment in search and rescue ships is effective in improving the performance of these ships in maritime search and rescue operations in Khorramshahr port. Existence of advanced navigation equipment in search and rescue vessels is effective in improving the performance of these vessels in maritime search and rescue operations in Khorramshahr port. The presence of rescue equipment in search and rescue vessels is effective in improving the performance of these ships in maritime search and rescue operations in Khorramshahr port. The use of capable guides for search and rescue ships is effective in improving the performance of these ships in maritime search and rescue operations in Khorramshahr port.

Furthermore, based on the sub-hypothesis.3 SAR boats or ships must be equipped with night-vision equipment and the use of fog lights, for the purpose of increasing the performance of the Khorramshahr SAR center. The use of night vision devices by search and rescue boats

or ships is effective in improving the performance of these vessels in marine search and rescue operations. The use of fog lights in search and rescue ships is effective in improving the performance of these ships in maritime search and rescue operations.

Furthermore, according to the sub-hypothesis.4, the master of search and rescue ship must be skilled and have sufficient experiences for maneuvering of rescue ship on the way to the Arvand river and Khorramshahr port. As the above four hypotheses are confirmed, therefore the result of this research shows that efficiency of the Khorramshahr maritime search and rescue center will be improved by following the hypotheses in order to upgrade maritime search and rescue operations. Familiarity of the master of search and rescue ships with the conditions of the Arvand river or waterway is effective in improving the performance of these ships in the maritime search and rescue operation of Khorramshahr port.

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