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Fishing Skippers' Perceptions of Integrated Electronic Marine Systems

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Integrated electronic marine systems are becoming part of the numerous screens which are to be found on ships' bridges and in wheelhouses of fishing vessels. This paper continues previous work which has focussed on perceived safety aspects of integrated electronic marine systems, in particular, a small study completed within the last two years which showed that some fishing skippers had negative perceptions of integrated electronic marine systems. This present study uses semi-structured interviews with skippers in the United Kingdom fishing fleet to show that integrated electronic marine systems can be perceived as increasing safety as well as being of good value in terms of need and cost. It is possible that such perceptions are dependent on experiencing the use of integrated electronic marine systems within offshore trawling.

KEY WORDS

1. Integrated systems. 2. marine electronic aids. 3. pelagic trawling. 4. users' perceptions.

1. INTRODUCTION. Since the 1980s, much work has been done to integrate the information needs of the personnel working on a ship's bridge. Military needs acted as an initial driver of this integration but, by a decade or so later, integrated electronic marine systems (IEMS) were being manufactured for the merchant navy as well as being introduced into newly built fishing vessels. Initially, these systems focussed on the electronic chart with integrated radar, sonar and netsonde equipment being developed shortly afterwards; nowadays, sophisticated equipment has evolved which utilises one main screen and allows the officer of the watch to scroll through screens quickly to find the information he requires. Cost has been an important factor in the implementation of IEMS on fishing vessels but as ever with technology, these costs have fallen as the IEMS have matured. Interestingly, legislation has yet to be passed to allow the sole use of an IEMS on the bridge or in the wheelhouse but standards such as IEC 61924 (on integrated navigation systems) are being developed which will no doubt aid the design and implementation of such systems.

This article looks again at the perceptions of IEMS within the United Kingdom's fishing fleet, in particular, the perceptions of such systems by fishing skippers who have used IEMS for working at sea. It continues previous work by the researcher, the most relevant articles here being two studies by Mills in 2006 and 2007. Before relating the study undertaken here, we turn to a short account of previous work undertaken in order to contextualise the present study.

2. BACKGROUND TO THIS STUDY. A previous study (Mills, 2007) concluded that among fishing skippers of small vessels LOA there is a generally negative perception of IEMS due to lack of data integrity and system reliability. In particular, that study found that fishing skippers believed that lack of hardware and software reliability, together with the way in which the system chooses the data which are displayed, could lead to a decrease in safety overall due to a feeling of lack of control by the users. Certainly, control is a major factor in systems satisfaction (Dix *et al*., 1993) since users need to feel that they are not being driven or manipulated by an electronic system. However, the study (Mills, 2007) had severe limitations; in particular, the study's participants did not have IEMS on their fishing vessels and while some of the participants had used IEMS in other situations such as the local lifeboat, none had used one while fishing. In addition, the study focussed on a small port where fishing was mainly inshore using small (9·5 metres LOA to 17·5 metres LOA) vessels. Consequently, there is a need for a study which investigates the perceptions of fishing skippers who did use IEMS while fishing; this present study attempts to address this but, as with any small study, flaws remain which here are mainly beyond the researcher's control within the bounds of this study.

The earlier study by Mills (2007) which, in turn, used work from another study (Mills, 2006) focussed on five areas associated with IEMS. Of these, hardware reliability was of some concern among the participants with one skipper being very vociferous in his comments. Software reliability was divided into the reliability of the data selected for presentation on the display and the reliability of the information being timely and accurate enough for correct decisions to be made. The remaining two areas were cost and need; these last two are related, of course, not only to themselves but also to the profitability of the vessel's fishing. The study used semi-structured interviews based on questions about these five areas, the questions being piloted before use.

There are a number of ways in which the work in the study by Mills (2007) could be taken forward but the paramount suggestion was to investigate the perceptions of skippers who have used IEMS while fishing. This required some preliminary research in order to locate such vessels but a sufficient number of skippers were found to allow a small study to be undertaken. All fishing personnel know that safety is of paramount importance and this featured heavily in the present study.

3. METHOD OF THE STUDY. It is well known within the fishing industry that fishermen, rather like farmers, are practical people who are usually very willing to help others but prefer a verbal, non-written method of recording their thoughts. This has been borne out in this researcher's experience and so semi-structured interviews were used where the researcher recorded the participants' responses in writing as they replied to the questions. The relevance of semi-structured interviews has been recorded elsewhere (e.g. in Faulkner, 2000 and consequently in Mills, 2007) as have the disadvantages of using other legitimate methods such as focus groups and questionnaires (Shneiderman, 1998). In short, it has been found most practical to use semi-structured interviews since these allow for a focussing of the questions while also giving a breadth of response which does not inhibit the participant's response. Further questions for clarification of points may be asked while the method

also permits the participants to give tangential information if they wish (Faulkner, 2000).

Since this work is intended to expand previous studies and especially that of a study which focussed on a small North-East coast fishing village in Scotland, UK (Mills, 2007), similar questions were asked to those in the earlier paper (Mills, 2007) where issues around the reliability of the hardware and software were raised as well as the cost of purchasing and installing the new equipment. Similarly, the aspect of whether the equipment was actually needed produced answers relevant to the type of fishing and also the areas where the fishing took place. Consequently, the questions in this study asked whether the skippers used IEMS and whether they thought the use of such systems justified their cost, increased safety in any way and whether the systems were really needed to enhance the work of fishing. The skippers were also asked for their thoughts as to what the advantages and disadvantages of using IEMS may be with specific questions focussing on the reliability and validity of the hardware and the software as well as the data themselves. Finally, information was gathered about each vessel which the skippers worked in addition to the main type of fishing in which the vessel partook. It should be noted that this method does not need to collect personal data about the skippers themselves except to ascertain that each skipper is qualified ('has a ticket' in fishing parlance).

As the questions in this study mirrored those of previous work (Mills, 2007), it was felt that there was no need to pilot them again; this is usual procedure with semi-structured interviews and questionnaires which have served well previously.

4. PROCEDURE. Because it was felt necessary to interview skippers who had experienced using integrated electronic marine systems while at sea, suitable ports were selected where such skippers could be found. Preliminary research suggested that such is the state of the fishing industry in the United Kingdom that there was really only a choice of three ports available, Newlyn, near Penzance in Cornwall, Fraserburgh and Peterhead, both in North-East Scotland. Smaller ports in Scotland, such as Scrabster and Ullapool, also accommodate vessels in the 60 metres LOA range but only at a much smaller frequency than Newlyn, Fraserburgh and Peterhead. Indeed, Peterhead has become 'one of the foremost whitefish ports in Europe' (*Discover*, 2007) and also receives visits from vessels not only from other Scottish ports such as Ullapool, Banff and Lerwick but also European countries such as Denmark. However, even using Peterhead alone for this study it was unlikely that a dozen different vessels of sufficient LOA would be in port over a period of a week or so and so it was decided to select two of these ports and combine the data collected since the two ports chosen were similar in nature and clientele. Unfortunately, even two ports could not yield a 100% sample of IEMS users.

The data collected came from 11 skippers interviewed over a period of several days and working on vessels of varied LOA. Six skippers regularly fished on vessels in the 60 metres to 71 metres LOA while five skippers worked on vessels in the 20 metres to 27·6 metres LOA range. Most of these smaller vessels are large enough to have an IEMS and since these vessels caught nephthrops (prawns) except for one which specialised in haddock and cod, they form an interesting comparison with the vessels used in previous work (Mills, 2007), which vessels also fished for prawns but in a smaller (and inshore) way.

Fishing trips for the bigger fishing boats in the 60 metres to 71 metres LOA range can last a week or more and often involve fishing in cold waters such as are found in the near Artic. In season, herring and mackerel are caught thus illustrating that these vessels are usually pelagic (mid-water) stern trawlers with gutting and storage facilities built in. The vessels may have a crew of around ten people including an engineer as well as having personnel on shore. Most of these large vessels visited were new or built within the last seven years.

In addition to the fishing skippers, a director of a fishing company, who had previously fished for many years, was interviewed. His thoughts will be recorded separately as he no longer goes to sea and so has not used integrated electronic marine systems at sea. However, such a vast amount of experience of an industry which has emerged from near devastation to a slimmer existence should not be lost.

5. RESULTS. The 11 skippers interviewed can conveniently be categorised into two groups: those fishing in vessels from 60 metres to 71 metres LOA and those working on vessels of 20 metres to 27·6 metres. These two groups can then be further segregated into those skippers who have IEMS onboard and those who do not, thus making four groups in all. The main aspects of the results relating to cost, safety and need are shown in Table 1. A further question was asked about the use of the paper chart since it is still mandatory in UK waters to carry and be able to use such a chart.

Of the first group shown in Table 1, those who use IEMS in the 60 metres to 71 metres LOA group of vessels, three skippers fished with the same vessel, although not at the same time. Similarly, two of the skippers in the 20 metres to 27·6 metres LOA who did not have IEMS, also fished on the same vessel. In all these cases, the respective answers of the skippers were collected separately. This was deemed important since the views of one may have coloured another's thoughts. All the other skippers fished on different vessels and all were interviewed separately.

As we have seen, the larger vessels were all pelagic trawlers fishing for mackerel, herring and whiting while the smaller vessels were also pelagic but specialised in prawns, apart from the vessel already mentioned which caught haddock and cod. This is relevant to the use of IEMS, since the larger vessels travelled to more distant fishing grounds as well as into different types of waters from the smaller vessels which often worked shorter trips of a more inshore nature. That said, one vessel at least regularly visited the Faroe Islands. These smaller vessels may be deemed less likely to have IEMS as was found with very small vessels, from 9·5 metres to 17·5 metres LOA, (Mills, 2007) but where the vessels in the present study were fitted with IEMS, the skippers found them useful and helpful for both fishing and navigation.

Concerning the cost of buying and fitting an IEMS, those skippers who had one fitted in their vessels did not doubt that the cost was beneficial for all aspects of the work of fishing. Even those skippers who did not have them but worked vessels in the 60 metres to 71 metres LOA category felt their fitting justified the cost particularly if the vessel was new. Only the three fishing skippers who did not have IEMS fitted and who worked vessels of the 20 metres to 27·5 metres LOA felt that the cost of IEMS did not justify their potential return. This answer was probably associated with that of need, since the same three skippers did not think an IEMS was necessary for the size of vessel on which they worked and the type of fishing which they

Table 1. Summary of Results.

Vessels and Skippers	Cost justified?	Safety enhanced?	Need?	Usage of Paper-chart
60 m–71 m LOA Four skippers who use IEMS	Yes One skipper: for bigger range detection by sonar	Not by validity of data Yes by: Interchangeable data Clarity of information Ease of screen switching	Three skippers – yes One skipper – no	Yes for unfamiliar waters
60 m–71 m LOA Two skippers who do *not* have IEMS on their vessels but have used them	Probably for a new boat but not essential	Yes by: more data Screens in line of sight Clearer output	One skipper – yes One skipper – no; catch would probably be the same	One skipper: for backup One skipper: yes used frequently and always for new waters
20 m–27·6 m LOA Two skippers who do use IEMS	Yes	Yes by: screens in line of sight Easier to enter port when tired Life saved of colleague through clearer output and instant screen switching	Yes (both skippers)	Used occasionally
20 m–27·6 m LOA Three skippers who do *not* use IEMS	No	Yes by: collision avoidance through better detail and clearer output	No One skipper: for bigger vessels perhaps where manoeuvring decisions must be made earlier	One skipper: occasionally One skipper: rely on electronic chart One skipper: for backup

undertook. Indeed, one of the skippers remarked that with larger vessels such as those in the 60 metres and above LOA range, the need to make decisions about manoeuvres so much earlier than with smaller vessels, may well necessitate an IEMS being fitted.

In the light of earlier findings (Mills, 2007) which suggested that skippers of smaller fishing vessels thought that using an IEMS would not increase safety, it is interesting that all the skippers interviewed thought that the use of an IEMS would increase safety. Reasons stated included the fact that the screen in use is in front of the user and so it is not necessary to turn to the side in order to see vital information. In addition, one skipper pointed out that in a heavy sea, it was sometimes difficult to move around in the wheelhouse and so having all the information in front of the skipper was very helpful and may prevent injury through collision with other objects in the wheelhouse. Similarly, in such conditions, an IEMS allowed the skipper to see when the net was only half filled with fish thus enabling him to haul lighter loads reducing the instability of the vessel while hauling the net. Scrolling through screens was also considered to be more efficient than viewing multiple screens simultaneously since being in front of the screen gives a better line of sight than viewing sideways or at an angle. In this respect, one skipper related an incident in which he was able to identify a man overboard and rescue him through the more efficient viewing and easier identification which an IEMS affords. Linked to this is the similar but different point that the detail on the screen is usually clearer on an IEMS and this was made by a number of the skippers. However, a 'better picture' may be the result of a higher screen resolution or more advanced plasma technology than was used for older non-integrated systems, rather than the actual IEMS itself. One skipper remarked that clearer detail must make the vessel safer since it should help to avoid collisions at sea since distances between vessels are more clearly delineated.

Concerning the data used to produce the information which is viewed on the screen, only one skipper had any problems with the reliability, accuracy and validity of data but he admitted that once he was familiar with the IEMS, this concern disappeared. Even different equipment returning different data was not seen as a problem since now most data is accurate to within a small margin. For example, one skipper pointed out that the Global Positioning System is accurate to within 3 metres and with even small fishing vessels this is enough accuracy for all needs. Where greater accuracy with the data was appreciated was in the sonar and radar systems as these allowed a more accurate picture of the fishing grounds and targeted fish as well as easier navigation.

All but one of the skippers who used IEMS regularly claimed they needed them to do an efficient job in catching fish. The one who dissented was not sure as he compared such systems to heated seats in cars – a luxury which is not essential but gives added comfort. Of the five skippers who did not have IEMS on their vessels, only one skipper said he needed one to give a better picture of the under-water working area as well as adding safety through a more detailed and accurate radar. He seemed to assume that more data meant more accuracy. The remaining four skippers who did not have the use of a IEMS on their usual vessels could not see their worth; interestingly, the one skipper in this group who also worked a vessel in the 60 metres to 71 metres LOA suggested that the catch would probably be the same size whether or not an IEMS was in use on the fishing vessel. The three skippers with vessels in the 20 metres to 27·6 metres LOA group all related the use of IEMS to navigation and

manoeuvring of the vessels which with smaller boats was not difficult without an IEMS.

Of the 11 skippers interviewed, only one used the paper chart regularly while of the remaining 10, seven used it occasionally if steaming into unknown waters. The remaining three skippers used the paper chart as a backup with one of these three stating that he relied in practice on his electronic chart since the company sent regular updates which superseded the detail on the paper charts. Being up to date, he trusted the features shown on the electronic chart more than on the relatively old paper chart. This illustrates well the fact that electronically stored data is much more easily updated than that stored in a hard copy (here paper) form. In a rapidly changing situation, and one may question whether the sea and coastlines would qualify as this, electronic data are the best form to use; however, advantages of hard copy such as always being available even in the light of electricity failure must be considered in matters of safety.

6. PERCEIVED ADVANTAGES AND DISADVANTAGES OF IEMS. When asked for their views about the perceived advantages of IEMS, seven of the 11 skippers said that having one screen in front of the skipper was advantageous, although it should be noted that one skipper preferred side screens. Handier scrolling than looking at multiple screens has already been mentioned positively and this was expressed in phrases such as 'easier to see everything', even though this only happened through scrolling through screens. This one screen in front of the skipper reduced physical movement and facilitated the jobs in hand by reducing stress caused by having to look in different directions for different data. The flexibility of easy changing of screen views was seen as an advantage as was the duplicating of the master screen on other screens so that the mate could also watch the passage while the vessel was steaming or fishing. Clarity of detail has already been noted as has the greater precision of data and the ability to switch screens easily. Most electronic charts allow the user to add data so that the user can easily update the electronic chart with local knowledge; the skipper can also add fishing details such as 'best catch' areas and other useful information. All these advantages were seen as important and helpful in easing the stressful and dangerous work of fishing.

However, such IEMS are not without disadvantages and the skippers were fully aware of the possibility of system failure. If a screen failed, then another could be substituted as the master screen but if the 'box' failed then the vessel had to rely on its backups. One skipper had had to investigate the hardware part of the system in order to make the system work, thus emphasising the need for reliable hardware. Even so, eight of the skippers questioned could not think of any disadvantages beyond this obvious one if the system failed. Another joked that his only problem was remembering where he had left the (wireless) mouse (which is used to interact with the system on his vessel).

It is interesting that none of the skippers had had formal training in using the IEMS. Most who used an IEMS had trained themselves through reading the manual and experimenting by trial and error. As ever, word of mouth and discussion with other users had also played a part in their learning experience. One skipper added detail to his problems with learning to use the system, mentioning that he had found

editing difficult and he felt that he did not maximise the system's full potential. Thus training may be an area which could improve safety further since another skipper suggested that the use of IEMS could, in fact, be a hazard if not used correctly.

Finally, the views of the owner of a fishing company were solicited and these gave a different perspective on fishing electronics. Having used the old systems where the user's perceptions and knowledge were needed to differentiate between good and poor data, he expressed concern about the new systems which could give three sets of the same data with each slightly different. He questioned why multiple sets were needed beyond a duplicate for backup and whether it was wise for the younger generation of fishing skippers and crew to rely on electronics rather than a working knowledge of tried and tested methods.

7. DISCUSSION. A number of points from these results suggest a further exploration as well as a comparison with earlier studies.

It is apparent from Table 1 that the perceptions of usefulness of IEMS follow the practical use of such systems in that those fishing skippers who do not have IEMS fitted do not generally see the need. The one exception is one skipper who fishes from a 60 metres to 71 metres LOA vessel and has seen the systems being used on similar vessels to his own. The longer trips to distant waters and deeper pelagic trawling may also facilitate this perceived need. Those skippers working the smaller LOA group of vessels could see the usefulness of IEMS in certain conditions but since these did not occur during their working schedules, they saw no need for the systems on their vessels. This parallels the findings in Mills (2007) where those fishing skippers who did not have IEMS did not see the need; however, in this study, there is a marked difference: the skippers here who do not have IEMS systems agreed that they may well increase safety and they also had no worries about the integrity of the data used by the systems. The question of need is always difficult as the human is a very resourceful being and will often not really appreciate the need of something until the artefact is accepted into society. For example, few people today would deny the need of electricity in our lives but many people living in Leek, a small town in Staffordshire, UK, in 1906, two years after the inception of electricity in the town in 1904, still could not see its financial worth (Nithsdale, 1992). Cultural lag is well known in history and it may be that as time progresses and new vessels are built with IEMS, they will be seen as necessary by the next generation of fishing skippers. There are small signs, as with the skipper mentioned above, that this is beginning to happen.

None of the skippers interviewed doubted that using an IEMS would enhance safety. As has been noted above, one skipper had already been able to pick up a man overboard because of the clearer delineation and fine detail shown on the IEMS. Furthermore, one skipper was emphatic that the clarity of detail, together with the additional data given by the IEMS, was very helpful in rough seas since he could monitor the fish in the net (with the netsonde screen) and so haul it as load and weather permitted. Stability of fishing vessels when hauling the net can cause problems of instability due to a shift in the centre of gravity of the vessel and the net so being able to see when the net is only half-full and hauling it at that time reduces the shift in the centre of gravity, thus reducing the risk of capsizing and so improving safety. In addition, it allows the skipper and crew to continue fishing in foul weather

when without this facility, the skipper may have returned to port to safeguard the lives of his crew.

Also coupled to the fine delineation of data and the presence of additional data is the object representation of the net so that the skipper can see exactly what is happening while fishing (Mills, 1995). In demersal (sea-bed) trawling another cause of the vessel capsizing is the net snagging on some debris on the seabed and this can have dire consequences for the vessel, the last resource being to cut the net free with the subsequent financial loss of a replacement net. This can occur in pelagic trawling if the net catches a wreck or other object which protrudes above the sea-bed. Thus the value of a netsonde is not to be underestimated in adding to the safety of trawling.

All the skippers, except one, claimed that having a clearer line of sight through having just one screen in front of the officer of the watch made navigation easier, especially when tired and returning to port. Again, in rough seas this negates the need for movement around the wheelhouse by the skipper and other personnel, thus reducing the risk of injury from other objects in the wheelhouse. The use of multiple screens with the ability to switch between them also reduces movement since the mate, while keeping watch, is able to see the same view as the officer of the watch on the screen in front of him.

Being able to scroll quickly through the different screens for the functionality required mirrors the previous experience of skippers by allowing them to view screens which previously would have been separate but viewable all at the same time. This is still possible with an IEMS since it can supplement the previous layout of multiple displays rather than supersede it. In practice, skippers still have the same number of displays but use the IEMS as the main working screen, only using the other displays as secondary sources of information. This design feature of the IEMS is good since it reinforces the previous experience of the fishing skipper while allowing for quicker and easier finding of important information (Diaper, 1989).

In general, the skippers welcomed more data which helped them make decisions more easily. However, with more data comes the risk of information overload. This is important especially when the officer of the watch is tired or the vessel is in foul weather. Interestingly, none of the skippers complained of too much information since they selected what they needed and used only that. Those skippers who were familiar with the IEMS set up the screens they required and used that information to make their decisions. This is usual user practice, rather akin to most people only using a minimal function set of the video-recorder remote control or of office software. One skipper did remark that he was not really conversant with everything the IEMS could do but he had mastered enough to aid his working schedules. This is not an uncommon occurrence in the use of computer systems generally (Dix *et al*., 1993) and naturally links to training. Furthermore, the fact that none of the skippers had had formal training could be seen as a possible hazard in that errors may unwittingly be made. However, the skippers had worked through the tutorials provided by the manufacturer and they discussed the systems with each other, thus sharing user knowledge and experience. Again, this is a usual way of learning software as many users ask another human for help rather than reading the manual. The system itself could be used to help here by initiating dialogue in response to the user's actions (Dix *et al*., 1993). Never-the-less, the training aspect of these systems should not be neglected if they are to play a full part in enhancing safety and the well-being of the fishing vessel's personnel.

An interesting detail to emerge from this study is the possible present profile of the British fishing fleet in terms of LOA of vessels. This predominantly British based study has shown that vessels were easily grouped into two LOA sizes: those from 60 metres LOA to 71 metres LOA and those of 20 metres to 27·5 metres LOA. There seems to be a lack of vessels in the 30 metres to 60 metres LOA range which may be caused by the financial state of the fishing industry. Interestingly, all the large vessels in this study had been built within the last seven years and so may be considered as relatively new. Anecdotal evidence suggests that as the British fishing industry emerges from the doldrums of previous years, new boats are being built which can maximise the time at sea within the fishing quotas enforced by the European Union. These vessels need to be able to withstand foul weather and also to travel speedily to distant fishing grounds as well as support a reasonably sized crew in some comfort. Clearly, these task requirements suggest that larger vessels such as those over 60 metres LOA meet these needs more easily than smaller vessels which are better equipped for shorter trips in reasonably good weather. However, care must be taken in not generalising from the results of such a small study.

8. LIMITATIONS OF THIS STUDY AND SUGGESTIONS FOR FURTHER WORK.

As with any study there are limitations but these need not detract from the work but point to further exploration. However, we should not forget that the fishing industry is severely reduced in size and manpower when compared with its state say 30 years ago; in addition, the type of work a fisherman does can lead to a suspicion of paperwork and written evidence. Past experience of the researcher has shown co-operation can be heavily reduced if personal identity of the participants is sought, although most will happily give their vessel's name and registration number. On the other hand, some fishing skippers are happy to give unsolicited their full identity and this happened with a number of the skippers interviewed in this study. While this lack of personal identity of each skipper does not affect the data gathered, it does prohibit a future replicable study since the skippers would need to be traced through their vessel's registration details. Academically, this may be seen as a serious limitation of this study but practically it is unavoidable if the skippers' honest views were to be obtained. Indeed, a replicable study would be extremely difficult anyway, because of the impossibility of all 11 skippers being in the same ports at the same time again. Bearing in mind that vessels came from Kirkwall in the Isles of Orkney, Scotland, Ullapool, Banff and Fraserburgh as well as other ports, this type of study is not really replicable. Consequently, the data were collected with special care and the necessary but minimal details were taken to identify the required information concerning the vessel and its type of catch.

Another problem with this study and linked in a way to replication is that the numbers of skippers interviewed is too small for statistical analysis. We have already alluded to the difficulty of identifying a larger number of fishing skippers and vessels with an IEMS onboard and in terms of British fishing vessels there are not many which satisfy this condition. This study does not pretend to be exhaustive but it does reflect the practical situation of reduced fishing and hence a severely reduced number of fishing vessels. The changes in the working practices of the fishing industry in the last decade or so (RNMDSF, 2008) have been discussed already but until the industry should grow somewhat, if it does, it is difficult to identify a similar but different group

of skippers at this time. A possibility would be to use the third port, the one not used in this study, but such is the distance travelled by these vessels that some overlap may occur. A further study based abroad may alleviate this problem.

Notwithstanding that the number of participants is too low for statistical analysis, 11 participants are sufficient to give helpful information qualitatively (Shneiderman, 1998). Such has been the use of the data gathered in this study and while it would be unwise to generalise these results, they can be used to look for trends and as pointers to further work. It is worth noting that the fishing industry is closely knit and many skippers know each other from family connections going back many years so a word of mouth method, often called 'snowballing', may increase the number of participants.

Given the small numbers of relevant participants available, the interviews could have been more in-depth. However, fishing skippers are busy people and there is a limit to how much time they have in port. Part of the cycle of fishing is that time away from the vessel is spent with their families and friends, especially as there is the known but unspoken understanding that this may be the last time together (Wife, 2007). Often, if skippers are on their boats in port, they are carrying out important maintenance which must take priority over academic data collection. Consequently, the researcher's past experience was used to formulate questions which yielded the most profitable answers while taking a minimum of time from the participants.

All the vessels in this study were pelagic trawlers with a varied catch of prawns, cod and haddock, and herring and mackerel. This suited the study in that these vessels are most likely to have IEMS fitted. However, it would be worth investigating whether other types of fishing used IEMS and, if so, what the perceived views of the skippers were in these other situations. In addition, the trawlers used in this study divided themselves into two categories with respect to LOA; a closer comparison of the systems used may reveal differences which could usefully inform other similar fishing scenarios. A natural extension of this work would be to compare the different makes of IEMS to see if certain functionality or output design were more or less beneficial in certain situations.

These limitations, then, in many ways, reflect the state of the fishing industry in the United Kingdom particularly with respect to its depleted size but it is pleasing to see the industry is still striving to supply fish for the food chain. Consequently, future work from this study could focus on the use of IEMS in different types of fishing besides trawling, comparisons of different types of IEMS and a further study of IEMS use in trawling but placed abroad where fishing practices are different from those within the UK.

9. CONCLUSION. This study has highlighted several useful features about IEMS. In particular, the perceptions of users of such systems seem to be very positive from the aspects of cost, safety and need. In addition, the perceived disadvantages are minimal beyond hardware breakdown and user training, especially in the initial stages of use. These perceptions, however, are strongly linked to experience and type of fishing which, in turn, is associated with the size of vessel. The results contrast sharply with a previous study (Mills, 2007), thus illustrating the need for experience to change perceptions as well as working conditions which produce a need for more sophisticated electronic marine systems.

However, there is a need for care when interpreting the results of this study as the number of participants is small and the work is focussed on only two ports in the United Kingdom; even so, the results do indicate the need for further work in order to build a more detailed picture of the use of IEMS within the fishing industry.

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REFERENCES

Diaper, D, (1989), *Task Analysis for Human-Computer Interaction*, Chichester: Ellis Horwood Limited.

Discover, (2007), 'Peterhead', *Discover*, 2007, p. 16.

Dix, Alan, Finlay, Janet, Abowd, Gregory and Beale, Russell, (1993), *Human-Computer Interaction*, Hemel Hempstead: Prentice Hall International (UK) Limited.

Faulkner, Xristine, (2000), *Usability Engineering*, Basingstoke: Macmillan Press Ltd.

Mills, Stella, (1995), 'Usability problems of acoustical fishing displays', *Displays*, **16**(3), 115–121.

Mills, Stella (2006), 'Integrated Marine Electronic Systems – Some User Associated Issues for the Designer', *The Journal of Navigation*, **59**, 423–433.

Mills, Stella (2007), 'Perceptions of Integrated Electronic Marine Systems – A Preliminary Study', *The Journal of Navigation*, **60**, 191–200.

Nithsdale, WH, (1992), *In the Highlands of Staffordshire*, Leek: Churnet Valley Books; a facsimile reprint of the same title of 1906.

RNMDSF, (2008), Leaflet requesting help, *The Royal National Mission to Deep Sea Fishermen*, Whiteley.

Shneiderman, Ben, (1998), *Designing the User Interface Strategies for Effective Human-Computer Interaction*, 3rd Edition, Reading, Massachusetts: Addison-Wesley.

Wife, (2007), mentioned to the researcher in a private conversation with a fishing skipper's wife, August 2007.