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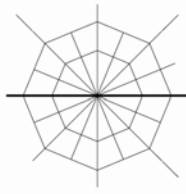
Working Paper 18 2007

Methodological framework for studying fishermen's tactics and strategies

Anne-Sofie Christensen



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Abstract

This paper presents an inductive, mixed methodological framework for studying fishermen's tactics and strategies. Various social sciences offer their approach for studying fishermen's tactics and strategies, but they do not suffice, as the single disciplinary methodological approaches face constraints. Hence, the primary aim of the methodological framework is to increase the validity of bio-economic modelling studies and to increase the reliability and generalisability of the qualitative studies of fishermen's strategies and tactics. The methodological framework is presented step-by-step starting with the explorative sequence interviews conducted with fishermen, followed by a survey and data reduction via factor analysis and construction of indexes. In the end of the paper, an application of the framework is presented.

Keywords: Bio-economic modelling, Fishermen's behaviour, Fishing strategies and tactics, Mixed methodology.

Methodological framework for studying fishermen's tactics and strategies

Anne-Sofie Christensen

Introduction

Among scientists working with fisheries, it is increasingly acknowledged that fisheries, as an area of research, is an empirically defined field, which does not acknowledge the formal disciplinary boundaries; several disciplines offer their contribution to the research. But multi/inter/cross-disciplinarity poses new challenges for the researchers as the different disciplines focus on different kinds of questions using different theoretical frameworks, terminologies, and methodologies.

Degnbol et al. (2006) argue that the contribution of biology, economics, sociology and other relevant disciplines to fisheries research would be improved if they originated from broader, more integrated analytical perspectives that are attuned to the empirical realities of fisheries management. Under the notion of *tunnel vision*, Degnbol et al. also argue that the different disciplines tend to have a preferred solution, *a technical fix*, to the challenges of fisheries management: Biologists and ecologists promote MPAs, economists often argue that the market through ITQs can solve fisheries management problems, and anthropologists and other social scientists often argue for co-management and empowerment of local communities and fishing people.

The aim of this paper is to present a mixed methodology for studying fishermen's behaviour in terms of tactics and strategies: Tactics are to be understood as short-term decisions, such as where to go fishing or which specific gear to use, and so on. Strategies are to be understood as decisions made in longer term perspective, like modernising or buying vessels, investments in catch handling equipment, and so on. By mixing methodologies of different disciplines, the aim is to increase the validity of the bio economic modelling and other statistical studies and the reliability and generalisability of the qualitative studies of fishermen's strategies and tactics.

Why study fishermen's strategies and tactics? The regulations made by fisheries management do not always work as according to the political intention. There are several reasons for this, but to a great extent it can be due to the dynamics in fisheries (Maurstad 2000). This means that when fisheries management implement regulations in fisheries, fishermen will adapt to the new condition by modifying their fishing practice, and a disproportion between intention and result will arise. From a management perspective, it is important to provide insight into fishermen's strategies and tactics and thus the implications for fisheries management (Christensen and Raakjær 2006; Hil-

born and Walters 1992; Charles 1995; Salas and Gaertner 2004). The basis of understanding the complex dynamics of fisheries is to understand fishermen's motivations, their strategies and tactics and the factors influencing their choice of tactics and strategies. In order to understand fishermen's strategies and tactics and thus their response to externalities such as management, different approaches to science have to be invoked.

In this paper, an inductive, mixed methodological framework for studying fishermen's tactics and strategies is presented step-by-step starting with the explorative sequence interviews conducted with fishermen, followed by a survey and data reduction via factor analysis and construction of indexes. This framework provides improvements to the classic single-disciplinary approaches: The qualitative descriptions are tested/supported statistically, which improves reliability and generalisability. The validity of quantitative studies, such as bio economic modelling, are improved in a number of ways as the framework provide a foundation for: 1) understanding the dynamics/ causality between variables in the model, 2) ensuring that relevant variables are in the model or at least knowing which are missing, 3) input to the model in terms of proxies etc, and 4) interpretation of the results. In the end of the paper, the study, from which this framework was developed, is presented. The tables throughout the paper are examples from this study.

Contributions of different disciplines

Fishermen's strategies and tactics are rather complex matters. Danish, and other, fishermen have historically been flexible and adaptive in their fisheries (Vestergaard 1997) as they are constantly in a situation where they have to adapt to weather conditions, changes in fish prices and migration of the fish stocks, or changes in management schemes. The effectiveness of the fisherman is determined by his ability to respond to the changes in his external environment (Hart and Pitcher 1998). But what do they do? What has influence on their decisions? When and what triggers their business investments? How do fishermen operate their vessel to accommodate management regulations? How do they know where and when to go fishing using which specific gear? etc.

No common theoretical or methodological framework for understanding fishermen and fisheries has been developed in social science, but this does not mean that the area has not been studied. Several social science disciplines have contributed to the research done regarding fishermen from different perspectives.

These disciplines can be seen in a spectrum: In one end are the bio economic modelling and other statistical studies. In the other end are the hermeneutic disciplines (e.g. ethnography, anthropology, ethnology and history), which are flirting with humanities. In-between the poles are a range of disciplines, such as sociology and institutional economics, etc. These disciplines tend to orient themselves methodologically more to one side of the spectrum than the other.

Studies such as bio-economic models of fishermen's behaviour are usually based on the general premise that the objective of the fisherman is to maximise his individual profits. Profit maximising behaviour does not necessarily mean that fishers actually obtain the highest level of profits possible, but rather that they respond in a way they think would increase their profitability. Whether or

not the premise of the models is a fair representation of reality is debateable: anthropologists and other social scientist have often argued against (North 1990; Berkes et al. 1989). But no matter which position is taken in this debate, fishermen have to deal with a complexity of variables when deciding where to fish, which gear to use, etc. In bio economic modelling, it is considered almost impossible to identify and model all the possible factors, only the accessible factors in a specific analysis are included in the description of fishermen's behaviour (Knudsen 1991; Andersen 2005). But the assumptions made about fishermen's behaviour are critical for the results, and thus also for the conclusions. If the statistical studies are not rooted in a profound understanding of fisheries and fishermen, the assumptions about their behaviour may implement unusable conclusions (McFadden 1999; Holland and Sutinen 1999; Wilen 1979). The understanding of fisheries and fishermen needs to take into account the relevance of both assumptions on fishermen's behaviour and the variables included in the analysis.

The hermeneutic sciences are in the other end of the spectrum. These tend to have ideals as holism in their understanding of phenomena. Hence, fishermen are most often seen as part of a social and cultural context, namely fisheries and fisheries communities: They follow changes in nature and weather, they respond to changes in management conditions, and they interact with market changes and each other. The main purpose of the research done in this end of the spectrum is to make explorative descriptions of fishermen and fisheries per se. The description of fisheries and fishermen often becomes the goal with little regard to the lacking generalisability. Looking into the body of anthropological literature on Danish fishermen's communities, only few studies have been conducted (Christensen 2002; Vestergaard 1989; Højrup 1989). From a methodological perspective these ethnographic descriptions all point in the same direction; when studying fishermen and fishermen's behaviour, a non-reductionistic and non-formalistic approach is needed. Fisheries have to be described and understood as part of a broader picture; the everyday exchange of knowledge with other fishermen (colleagues and competitors), the management of time in order to make fishermen's activities on land fit with the time at sea and so on.

So far the interaction between the pole-disciplines has been rather limited. This can be due to several reasons; from my perspective at least three reasons are obvious: 1) The key questions asked in the disciplines are fundamentally different, and the theoretical and methodological frameworks are developed to answer the kind of questions, they ask. 2) This also leads to different terminologies making it difficult in practise to cross the disciplinary boundaries. 3) The institutional setup in universities and other research institutions is usually according to discipline rather than empirical orientation.

Methodological framework

The paradigms, *the worldviews*, sketched above suggest different methods for research: The positivist approach of the bio economic modelling and other statistical studies implies the *quantitative* approach, while the hermeneutic orientation implies the *qualitative* approach (Tashakkori and Teddlie 1998). Terms such as paradigm *wars* (e.g. Gage 1989; Guba & Lincoln 1994; House 1994) with the researchers as *wrestlers* or *warriors* have been used to describe the relations between these research orientations. Luckily, more pragmatic, mixed-methods approaches are welcomed today.

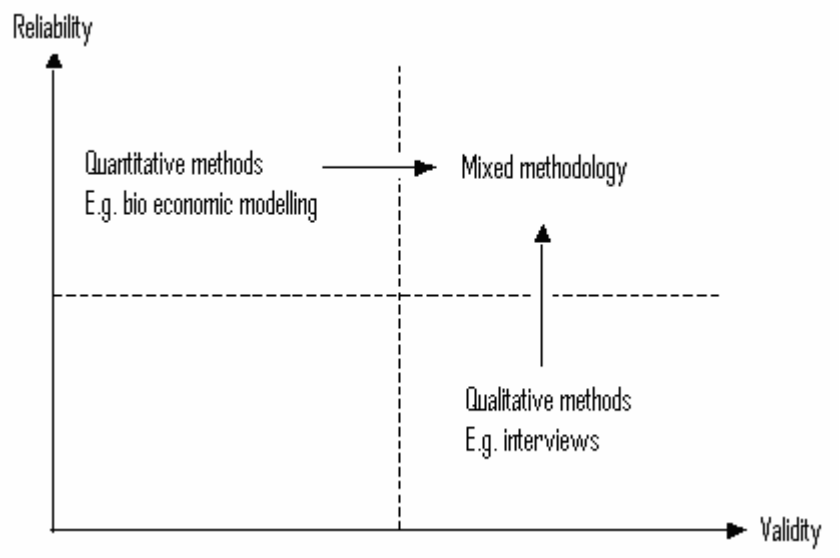

Figure 1 shows the strengths and weaknesses of qualitative and quantitative research methods, where quantitative methods are high on reliability (the extent to which the research yields the same results on repeated trials) but low on validity (the extent to which the research is measuring/ answering the questions that it is supposed to measure/answer)

You often meet the distinction that qualitative sciences deal with words and text, whereas the quantitative sciences deal with numbers and spreadsheets. This is a pragmatic definition, but it does not cover differences comprehensively. Drawing lines between the two approaches is not important here, it is sufficient to point to Figure 1, which shows the strengths and weaknesses of the two approaches and indicates that mixing the methodologies benefits the studies, and Figure 2, which shows the framework as a research process, but also indicates that it allows feedback in the various stages. The validity of quantitative studies are improved in a number of ways as the framework provides a foundation for: 1) Understanding the dynamics/causality between variables in the model, 2) ensuring that relevant variables are in the model or at least knowing which are missing, 3) input to the model in terms of proxies etc., and 4) interpretation of the results. The qualitative descriptions are tested/supported statistically, which improves reliability and generalisability.

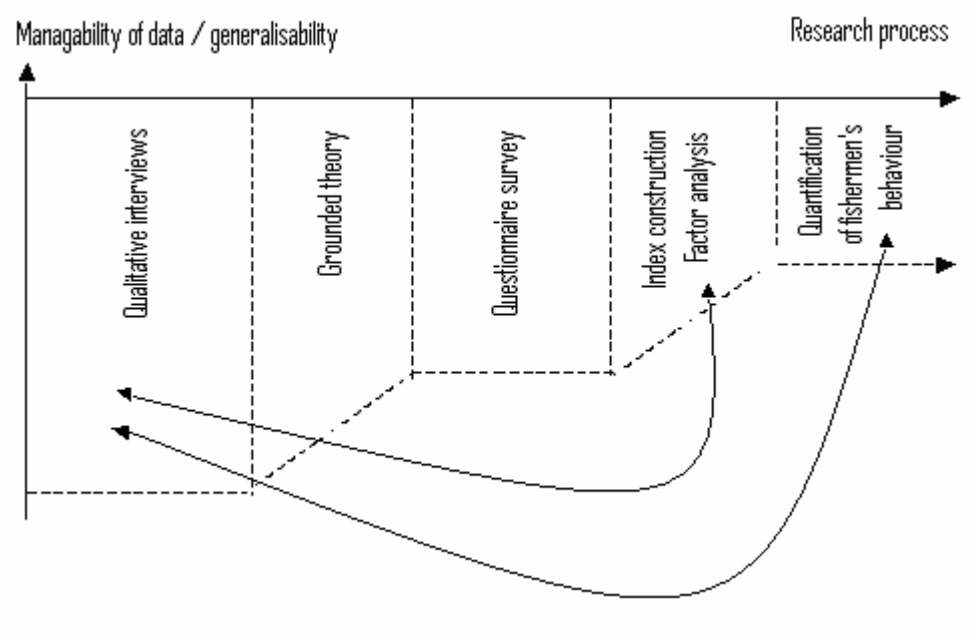

Figure 2 shows the steps in the methodological framework presented in this paper. The arrows from the 'qualitative interviews' indicate the possible feedback between the methods: On one hand, the explanation and validation of the variables in the model and on the other hand, generalisation of the interviews.

Qualitative interviews

As a starting point for the research, a profound understanding of the dynamics in fisheries is needed. This means getting to know the fishermen, their fisheries and their everyday challenges and appreciations. This requires the interviews to be conducted in a way that balances on one hand openness to the informant's associations/answers and on the other hand an agenda for the overall topics of the interview.

Methodologically, the guide for interview can be based on Bernard's ideas for semi-structured interviews (Bernard 1995) and Kvale's writings on *dynamic, positive interaction* (Kvale 2004). Semi-structured interviews are based on tight-rope walking between on one hand openness to the informant's associations from the questions – the informant can, through his answers, influence the directions of the interview. On the other hand, the interviewer has to ensure during the interview that the overall objectives and focuses of the interview guide are covered. Positive and dynamic interaction, according to Kvale, is about translating the research questions into everyday questions in order to promote the informants' motivations to tell about the topics behind the research questions instead of the just answering them shortly.

In order to get fishermen to tell about their fisheries in detail, slow progress is needed. Revisiting informants is often more fruitful than continuing the interviews for longer time. Interviewing in se-

quences further allows an evaluation of the information from one interview when planning the next. By the end of sequence interviews the fishermen often allow access to important information, which is hard to obtain, such as balance sheets, their own (or others'), non-compliance to rules in detail and so on. This information is hard to access when you are outside fisheries, but it is very important when studying fishermen's behaviour.

The sequence interviews need different scopes and purposes for the interviews. For example: The first interviews could be focused on five topics in order to get to know the informant: The informant's, at that time, present fishery, his annual fishing patterns, his history in fisheries, his decision-making from a short term/fishing trip perspective (tactics), his decision-making on a long term /investments perspective (strategies) and the general background of the fisherman.

The overall objective of the second interview could be the establishment of an understanding of the informant in a historical context; how does his experience influence his long-term strategies and short-term tactics? The interview guides have to be made for each interview, based on the analysis of the first interview. The second interview will often contain personal data/information about the informant.

The objective for the third interview could be to get to know the informants' economical performance in exact figures. The informants can be asked to bring their balance sheets, and the interviews can be carried out as a dialogue based on the balance sheet: Why did the fisherman prioritise the way he did this year? What went wrong/well? Which changes in future tactics and strategies are based on the balance sheet? etc.

Each interview can be followed by an evaluation, e.g. considering the questions: 1) Which new information (concepts, reasoning etc.) did the interview provide? 2) Does any of this new information open new perspectives in the answering of the overall research question? 3) How can this new information be tested/broadened in later interviews? and 4) How does the new information fit into information from previous interviews?

Qualitative research does not aim at being representative in a statistical sense (Kvale 2004; Wadel 1991; Spradley 1980). This does, however, not mean that any combination of informants would make a good sample to explore from. The interviewed informants have to be strategically chosen from relevant background variables such as: age, seniority in fisheries, number of days at sea per year, size of vessel, type of gear and participation in fisheries politics.

The interviews will probably show that fishermen apply complex tactics and strategies when adapting to changes in the context of fisheries. The fisherman often includes an array of factors in his decision-making process of tactics or strategies – the degree of flexibility concerning geography and gear, expectations of time off (family and friends), safety, comfort and expectations of economic outcome or willingness to financial risks.

According to Holland and Sutinen (1999, p.148), *'Ethnographic interviews conducted with fishers before conducting the statistical analysis are critical because they allow construction of models that go beyond traditional expected profit formulation and provide a basis for interpretation of the*

results'. Here, further steps will be taken, as qualitative data are used for producing quantitative input to e.g. a bio-economic model.

From interview to questionnaire

The tangible outcome of the interviews is transcriptions (when using a voice recorder) and reports (when taking notes during the interviews). As the interviews are open and explorative, these transcriptions and reports are not structured in an immediately comparable mode. In order to keep the inductive element in the making of the comparable, analytical categories, a methodological approach based on *grounded theory* can be used (Glaser and Strauss 1967). Grounded theory is a general method of comparative analysis, which builds theory through interaction with qualitative data. According to Glaser and Strauss, grounded theory is a strategy for handling data in research, providing modes of conceptualization for describing and explaining behaviour in practical applications. Grounded theory suggests inductive analysis by means of coding and recoding of the text. It is an applied hermeneutic circle, which develops the theoretical categories inductively from the data. In this context, *inductive* means that the codes/categories applied to the text grow from the data material. These are changeable in the process – in most studies; the codes change as the process prospers (Chamaz 1983). If grounded theory was to be followed strictly, the order of work would be: interview, transcription, coding, interview etc. This would increase the degree of inductiveness of the study (Chamaz 1983). Inductiveness is an ideal picture of how social science should work – it is not feasible and probably not even desirable, as it would mean that the interviewer and researcher worked with a tabula rasa in principle, leaving no room for knowledge accumulation process in science. Consequently, an alternative framework for ensuring the highest degree of inductivity as possible has to be applied.

The amounts of text coming out of interviews are rather solid. In order to make the coding process workable, all documents can be inductively analysed using the qualitative data analysis software like NUD*IST. From a theoretical perspective there is a clear connection between the usage of qualitative data analysis software and applying grounded theory to data material. However, it needs to be stressed that making the categories does not ensure that the inductive process takes place as suggested by the grounded theory. The making of the categories for the coding is, of course, what is essential for the outcome of the analytical process - and thus for how the process should be properly described in methodological terms. The inductive research process is ongoing from the interviews until the report of the results of the investigation. Qualitative data analysis software is merely a tool to help getting a general view of and some structure into the unstructured data material right before and during the reporting of the research. As categories are added and changed in the coding process, the coding process is in principle never ending according to grounded theory. This is, of course, not a workable way forward; instead the interviews were coded and recoded leaving a workable database.

Survey by questionnaire

Transforming the qualitative data into numbers is a process that requires standardised methodology such as a scaled questionnaire. The questionnaire for the survey has to be based on the in-

formation from the interviews and the analytical categories from data processing described above.

The questionnaire can contain different kinds of questions; 1) about the respondent and his fishery, 2) about importance of different factors concerning fisheries tactics, 3) about importance of different factors concerning fisheries strategies, and 4) others, for example about the respondent's view on other aspects of fisheries and fisheries politics. The questions in the groups of number 2 and 3 can be posed as 'when deciding [where to go fishing, which target species to go for, or which specific gear to use (mesh size, specific kind of trawls, gill nets or seine)], how important are the following factors for your decision?'. It is very important for the later analysis that the questions are posed in as high a scale of measurement as possible. A number of different factors can then be listed for the respondents to mark the degree of importance.

Table 1: The setup of the questionnaire

In the following questions, we would like you to mark how important the factor is for your decision …

	Very important	Important	Less important	Not important	Don't know
How important are the following factors in general for your choice of fishing ground?					
Experience from previous fishing trip					
Season					
Information about other people's fishery					
Limitation of by-catch					
Use of fuel					
Regulations					
Winds and current					

After making the questionnaire, it has to be tested. A pilot version can be given to relevant informants. They can fill out the questionnaire and give their opinions of the questionnaire; the relevance and sufficiency of the questions, the adequacy of the formulations.

Table 2: The overall questions of the questionnaire divided in two sections

Fishing tactics	Strategies ~ investments
How important are the following factors in general for the choice of fishing ground?	How important are the following factors in general for your considerations concerning investments in rebuilding your vessel? (e.g. prolonging of the boat, flat rear end)
How important are the following factors in general for the choice of target species?	How important are the following factors in general for your considerations concerning investments in mechanic equipment? (e.g. new engine, hydraulics)
How important are the following factors in general for the choice of specific gear? (e.g. mesh size)	How important are the following factors in general for your considerations concerning investments in search and navigation equipment? (e.g. echo sounder, sonar, radar, GPS)
	How important are the following factors in general for your considerations concerning investments in catch handling equipment? (e.g. cold-storage, packaging- and sorting technology)

Distribution of questionnaire and randomisation

The most important thing when conducting a survey is to get people to answer. Fishermen often dislike paper work, bureaucracy, or anything like that. The presentation of the questionnaire to the fishermen is therefore crucial. Careful consideration of distribution of the questionnaire is important. A combination of distribution ways may be advantageous; e.g. face-to-face distribution and by mail.

Fishermen are more likely to answer a questionnaire if they are asked face to face than if they receive it by mail. Notifying the fishermen through relevant newspapers or putting up posters a couple of days before coming to the harbour, may be feasible. Outreach distribution like this has obvious advantages: If the interviewer reads the questionnaire to the fisherman, discussions on the contents are likely to arise. Hence, the process can ensure that proper interpretations of the questionnaire are made later on when analysing the data.

Even though face-to-face distribution ensures high validity of the questionnaires, the method is slow and requires many, many hours in the harbours to provide useful data for a statistical analysis. Most of the fishermen therefore have to participate by mail. Mail survey can follow the face-to-face distribution; the advantage of doing so is that rumours in the local ports can encourage the fishermen to answer back.

The methods sketched above will provide a so-called non-probability sampling and thus do not fulfil the criteria for a randomised sampling (Hellevik 1999; Agresti & Finlay 1997). Due to the general difficulty in getting fishermen to answer questionnaires and in many countries a lack of a cen-

tral register of fishermen, a completely statistically randomised distribution is neither feasible nor possible. To compensate the lack of randomisation in the distribution of the questionnaire representativity has to be ensured by testing the sample against official statistics: Often fishermen are heterogeneous in a number of ways; the size of the vessels, the main target-species, the gear in use, the geographical mobility, the number of days spent at sea per trip or during a year and so on. From register statistics, approximate distributions in each of these categories are known. Hence, the correspondence between the register distribution and the survey distribution in each explaining variable can be tested. The composition of the respondents has to be approximately representative according to registers.

Identification of factors in dependent variables

The information from the questionnaire is entered into statistical software like SPSS. In order to reduce the complexity of the data, a Q-type factor analysis (or other cluster analyses) can be conducted. Factor analysis is a method to reduce the number of variables according to the *assumed latent dimensions*. Two approaches are possible in the factor analysis: An *explorative* and a *confirmative*. When making a *confirmative* factor analysis, two properties of the data must be fulfilled: 1) all variables must be normally distributed, and 2) there must be linearity between all pair-combinations of variables. Our data did not suffice these standards, as most data will not. An explorative approach is in most cases the more feasible approach. Here all relevant (e.g. all variables regarding fishing tactics in the questionnaire.) variables are entered asking the computer to maximise the explained variance, i.e. eigen value when suggesting the latent dimension (the factors) by suggesting which variables are clustered together. In this process, one or two variables may not interact with any of the other variables. These variables have to be removed from the analysis.

Such analysis requires high data quality. Data from strategic variables may often be of a lower quality than the data from tactic variables: When fisheries are in crisis, which is often the case, strategic investments are not a real issue for very many fishermen. This can undermine the data and hence the quantification of fishermen's strategic considerations as many answers would be missing or answered 'don't know'.

Reduction of independent variables

After conducting the factors analysis, the number of independent variables has to be reduced. This can be done trough construction of indexes. The construction of indexes is in principle the same as the factor analysis except that the researcher, a priori, has an idea of which underlying dimensions are desirable to have represented in indexes. Three obvious indexes can be made from the independent variables in Table 3: *mobility* (number of landing harbours, number of fishing waters, number of days at sea per trip), *investmentablity* (Solvency ratio, number of investments within the last five years, age of the vessel) and *size of fishery* (number of horse power, length of boat, number of days at sea per year and number of crewmembers).

Table 3: The list of the explaining variables in the questionnaire concerning the respondent, his fisheries and investments

The age of the fisherman	Number of years in fisheries
Number of years owning a vessel	Length of the vessel
Number of crewmembers other than the skipper	The building year for the vessel
The home harbour of the vessel	Number of different landing harbours in 200X
Number of days at sea in 200X	Most often used landing harbour
Main gear (trawl, gill net, Danish seine or pound net/ hooks)	Regular length of fishing trip (1 day, 2-4 days, 5 days or more)
Number of different kinds of gear used in one year	Number of horsepower
Fishing areas in 2002 - North Sea, Skagerrak, Kattegat, Baltic Sea, other. (More crosses possible)	The two most important target species? Cod, other cod fish, plaice, sole, other flat fish, Nephrops, other.
Do you know who takes over your vessel when leaving fisheries?	Sole owner of the boat?
In the last 5 years, which investments have you made? Building a vessel, rebuilding the vessel, mechanical equipment, electronic equipment, catch handling equipment, safety/work, environment/ comfort, regular maintenance (more crosses possible)	Number of expected years left in fisheries
	How was the revenue in 200X compared to other years? Over average, average, below average.
The debt in the vessel in 200X	Turnover in 200X
The insurance value of the vessel in 200X	Member of the board in the local fishermen's organisation?

If following the structure of the questionnaire suggested in Table 1, the variables have to be recoded so that all variables are on a scale from 1 to 4; 1 being the biggest fishery/most investment-inclined/most mobile and 4 being the smallest fishery/most investment averse/least mobile. Before adding the variables together, two validity tests have to be made: one to see how the variables interacted with each other (item-item analysis where all relations must have a gamma over 0.3) and one to see how the variables interacted with the index (item-scale analysis where all relations must have a gamma value over 0.3). It is likely that there will be more variables in the index from the start than by the end, but a reliability test, an alpha test, is deciding which combination has the highest degree of explanation of the variance.

The index variables from the factor analysis can be cross tabulated with all independent background variables from the questionnaire plus a number of constructed variables of underlying dimensions such as mobility or size of fishery. This is an explorative process allowing a mean value comparison of importance of the index variables on subgroups with a range of independent variables.

Application

This methodological framework was developed as part of two projects: 1) A Danish project *Temas* (Technical measures – Development of an evaluation model and application in Danish fisheries). The aim of the Temas project was to construct a tool for evaluation of technical measures in terms of efficacy of achieving objectives, cost efficiency and acceptance. The tool had to incorporate a fleet selectivity model as an essential component including gear selectivity and the fishing practice. 2) The European project *TecTac* (Technological developments and tactical adaptations of important EU fleets). The overall objective of the TecTac project was to address the poor understanding of the links between management tools, fleet developments and the pressure exerted on fishing communities, or more precisely to supply fisheries managers with a modelling tool that will allow them to evaluate the impact of regulations on the dynamics of fleets and fishing mortality. In the Danish part of both of the two studies, three demersal fisheries were in focus: 1) the mixed demersal fisheries in the North Sea, 2) the Nephrops fisheries in Kattegat, Skagerrak and the North Sea, and 3) the cod fisheries in the Baltic Sea.

How was the methodological framework applied in terms of numbers? As a starting point for the research, 16 fishermen were qualitatively interviewed in sequences: Each fisherman participating was interviewed for an hour and a half or more at least twice over a couple of months. Some informants were interviewed three times. Altogether some 40 interviews were conducted. The fishermen were chosen on the basis of experience of heterogeneity from previous studies among fishermen (Mathiesen et al. 2003 and Christensen, 2002).

When planning the tour around Danish harbours, we wrote an article to Fiskeri Tidende (Fiskeri Tidende 2003), the weekly newspaper of the Danish Fishermen's Association that is distributed to most Danish fishermen, telling the fishermen about the survey and the objectives of the research. Before going to a harbour, we contacted the chair of the local fishermen's organisation telling him about the survey and asking him to spread the word that we were coming. These steps, we think, were essential to the relatively high respondent rate when mailing the questionnaire: 789 questionnaires were sent out – 271 responses, equal to 34%, were returned. No exact statistics are available as to how many fishermen/skippers fished within the three categories in Denmark in 2003. A rough estimate (Economic Situation of the Danish Fishery 2004 and The Danish Directorate of Fisheries) would be less than 1,350 fishermen. This estimate is calculated in the following way: Number of relevant vessels minus the number of irrelevant vessels. Following this method of estimation the real number has to be lower than 1,350 fishermen.

After conducting the factor analysis, the 19 variables were distributed in seven index variables, which were named according to the interpreted dimension (See Table 4). In the two cases where

the factors only consisted of two variables, the scores were multiplied with 1.5 in order for us to make a ranking of the variables as to importance.

Table 4: The distribution of variables in factors suggested from the factor analysis on the tactics variables

	Interpreted dimension	Variable concerning 'fishing ground'	Variable concerning 'target species'	Variable concerning 'specific gear type'
Factor 1	Season	Season	Season	
Factor 2	The present situation	Experience previous trip	Fish prices	
Factor 3	Regulations	Regulations	Regulations	Regulations
Factor 4	Winds and currents	Winds and currents	Winds and currents	Winds and currents
Factor 5	(By-) catch and quality	Limitation of by-catch	Limitation of by-catch	Quality of landed fish
Factor 6	Fishing efficiency/ distance	Use of fuel	Distance to landing port	Fishing time
Factor 7	Information from other fishermen	Information from other fishermen	Information from other fishermen	Other fishermen's gear choice

Concluding remarks

From here we were able to make comparative analyses of how fishermen's decisions are made on where and how to fish by testing the data obtained from this study against the logbook data based on an integration of fishermen's behaviour to a fleet/fishery bio-economic framework based on the example of the gill-netters in the North Sea. The study showed that essential factors such as regulations and weather had to be left out of the logbook analysis (Andersen and Christensen 2006). Another analysis resulted in qualitative descriptions of the different kinds of fishermen in the Danish demersal fishery, showing their different challenges in present management framework, and discussed the possibilities for management to accommodate issues arising from the heterogeneity (Christensen and Raakjær, 2006).

This framework is to be seen only as initial steps towards mixing methodology. The methodology presented is much more time consuming than traditional studies of sales slips, logbooks or other registers. Time consumption increases if for instance time serial data is required. Hence, the next steps would be to consider how to transform or update these data without having to go through this process repeatedly.

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