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Challenging the 'artisanal vs. industrial' dichotomy in French Atlantic fisheries: an organizational typology of multi-vessel fishing firms

Arne Kinds^{1,2,3}, Pascal Le Floc'h¹, Stijn Speelman², Olivier Guyader¹

1 Unité d'Economie Maritime, UMR 6308, CNRS, Ifremer, Université de Bretagne Occidentale, IUEM, Plouzané, France

2 Department of Agricultural Economics, Faculty of Bioscience Engineering, Ghent University, Belgium

3 Flanders Research Institute for agriculture, fisheries and food (ILVO), Ostend, Belgium

Corresponding author:

Arne Kinds
UMR-AMURE
Technopôle Brest-Iroise
Rue Dumont d'Urville
29280 Plouzané
FRANCE
arnekind@gmail.com

1 **Challenging the ‘artisanal vs. industrial’ dichotomy in French**
2 **Atlantic fisheries: an organizational typology of multi-vessel fishing**
3 **firms**

4
5
6 **Abstract**

7 We put under scrutiny the ‘artisanal vs. industrial’ dichotomy used by French fisheries
8 management for classifying fishing operations. Recent evolutions in the Atlantic fishing
9 sector urge us to question its applicability. In particular the definition of the so-called
10 ‘artisanal fishing model’ is under pressure (e.g., decline of family-based fishing, multi-vessel
11 companies increasingly common, emergence of new forms of firm governance). Using mixed-
12 method research (interviews, multiple correspondence analysis (MCA) and hierarchical
13 clustering), we propose a new typology for classifying multi-vessel fishing firms, based on six
14 organizational attributes (ownership structure, firm structure, management strategy, firm size,
15 fishing strategy and valorization strategy). We have carried out a three-step analysis. First, the
16 MCA suggests that the diversity of organizational forms can be described to a great extent in
17 terms of the profile of the owner and the firm’s management and valorization strategies. The
18 cluster analysis then separates organizational configurations in five types, based on cluster-
19 specific modalities: access to key information, legal form, vessel maintenance and
20 standardization, growth objectives and management structure. The final description of the
21 types draws from additional interview data as well as variables that were not used in the
22 analysis. The typology captures the diversity of governance configurations currently existing
23 in the sector, while providing some insight into their origins and future trajectories. We
24 conclude that the artisanal model is outdated and insufficient for describing the
25 organizational diversity of modern-day fishing firms, especially those in the 12-18 m and 18-
26 24 m segments.

27

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30 1 Introduction

31 For the purpose of research and management, capture fisheries are often divided into
32 discrete categories. A commonly used division is that of small-scale versus large-scale (or
33 industrial) fisheries [1–9]. The concept was first introduced by Thomson [1] in an attempt to
34 distinguish company-owned large-investment fishing units from privately owned/managed
35 small-scale units. Thomson’s classification was subsequently updated by Maclean [2] and
36 later by Berkes *et al.* [4], to include a description of common characteristics of small-scale
37 fisheries. The conceptual framework was further expanded by Ruttan *et al.* [3](separation of
38 the two categories on a relative scale, thus providing a more objective definition of small-
39 scale fisheries), Sumaila *et al.* [5] and Therkildsen [6] (inclusion of a number of policy-relevant
40 socioeconomic and environmental impact indicators). While such dichotomies successfully
41 capture some of the worldwide diversity into manageable categories, they are also criticized
42 for oversimplifying reality and for not being able to provide clear boundaries between the
43 two categories [5,10,11]. Especially the formulation of a universal definition of small-scale
44 fisheries has proven to be difficult, given their diversity [10,12] and the fact that they can be
45 highly specific to certain locations [9–11]. This is further complicated by the fact that
46 countries often use their own criteria for defining SSF [9,13].

47 The main classification used by French fisheries management contrasts ‘artisanal’ fisheries
48 with ‘industrial’ fisheries. Hereby industrial fishing operations are seen as capital-intensive
49 [14] and artisanal operations as small to medium-scale, family-owned [15] and requiring
50 relatively low capital investments [7]. Artisanal fishing is usually described using two
51 elements: first, the fisher (*artisan*) is (co-)owner of their fishing vessel, and has the statute of
52 ‘embarked owner’¹. The owner-operator invests their own capital (sole proprietorship) and
53 manages the firm technically and economically [16]. Second, the owner-operator typically has
54 one fishing vessel, which is generally smaller than 12 meters in length, but may be up to 25 m
55 [17]². Crew size is generally small, with a maximum of 5-10 for larger vessels [18]. Other
56 characteristics of the so-called ‘artisanal fishing model’ include a high degree of family

¹ This statute contrasts fisher-operators (actively fishing) with shore-based managers.

² Artisanal fisheries can be further subdivided into a coastal fleet (*pêche côtière*) (≤12 m vessels fishing inshore) and an offshore fleet (12-25 m vessels fishing offshore) (*pêche hauturière*). Our focus in this paper is on the artisanal vs. industrial dichotomy.

57 involvement, share-based remuneration, strong anchoring in the local economy and the
58 polyvalence of fishing activity [14–16,18–21]. Industrial fishing operations can be understood
59 as those with gross tonnage >50 GT, and of which the owner does not actively fish [22]. The
60 owner has multiple fishing vessels >24 m (and up to 90 m), each employing between 10 and
61 70 crew.

62 French fisheries legislation includes specific provisions for artisanal fisheries [17], and the
63 preservation of the artisanal fishing model is considered of key importance [18,23–25]. Yet, its
64 definition has been named unclear [26,27], as it encompasses a broad range of operations,
65 from subsistence fishing to companies operating multiple trawlers. An increasing trend of
66 multi-ownership [28,29] challenges the '*one man, one vessel*' definition of artisanal fishing. At
67 the same time, family-based fishing is in decline [15,18,30] and new forms of firm
68 structuration and governance are emerging [18] (e.g., joint ventures with corporate fishing
69 firms; [31]). Evidence points towards the existence of a diversity of organizational forms,
70 which to date remain little studied. Evolutions in the industrial fishing sector include
71 horizontal growth through mergers and acquisitions, and backward vertical integration by
72 retailers and processors [32,33]. There is substantial evidence of concentration, most notably
73 in the tuna industry, with the 2011 merger of three fishing companies and the subsequent
74 acquisition by a Dutch corporation in 2017. Foreign investment has increased in recent years,
75 with investments by Dutch, Irish and Icelandic corporations catching the eye [33].

76 In light of these evolutions, we hypothesize that the traditional "industrial vs. artisanal"
77 dichotomy is outdated. The artisanal fishing model in particular seems to no longer match
78 the structural and organizational complexity of modern-day fishing firms as observed in the
79 field. A better understanding is needed of what drives fishing firms to expand horizontally
80 (adding fishing vessels to the fleet) and vertically (venturing into new activities up or down
81 the value chain), and how such expansion is reflected in (or mandated by) the firm's
82 organizational structure. Overall, little research has been carried out on the relationship
83 between organizational structure of fishing firms and their investment behavior. Nøstbakken
84 *et al.* [34] have suggested that organizational structure of fishing firms may be an important
85 determinant of investment behavior, and that the firm (not the vessel) is the main decision-
86 making unit, and thus the appropriate unit of analysis.

87 In this paper, we present a typology of organizational structure of French Atlantic fishing
88 firms operating multiple fishing vessels. The focus on multi-vessel firms ensures that a broad
89 spectrum of operations are included in the analysis, and specifically includes the multi-vessel
90 fishing operations that would otherwise be considered 'artisanal' based on other criteria. The
91 aim is (1) to establish an understanding of what defines French Atlantic fishing firms in terms
92 or organizational attributes, (2) to describe in detail the different organizational forms found
93 in the fishing sector today, and (3) reflect on their trajectories (past, present, future).

94 **2 The fishing firm as an organizational unit**

95 More than a production function in which inputs are transformed into outputs, the firm is an
96 organizational unit whose internal governance structure varies with changes in both the
97 institutional environment (external drivers) and the attributes of economic actors (internal
98 drivers) [35]. Starting with the seminal works of Coase [36] and Williamson [37,38], it is now
99 well-established that the organizational structure of firms is an important determinant of firm
100 strategy [39], innovation [40] and performance [39].

101 Rey *et al.* [26] have developed a classification of French fishing firms based on (1) exploitation
102 strategy (a continuum between profit maximization and diversification/cost minimization)
103 and (2) the mode of unit reproduction (growth-oriented, stable or shrinking). Different
104 systems are then identified based on combinations of two factors of production: labor and
105 (physical) capital. However, in addition to tangible assets (e.g., fishing vessels, warehouses),
106 firms possess a range of idiosyncratic assets that cannot be replicated by the market, but are
107 essential to a firm's competitiveness [39] – and which we argue must be included when
108 describing the organization structure of fishing firms. *Human capital resources* include
109 training, knowledge and experience of workers and managers in the firm, and the
110 relationships between them. In the fishing sector, this may include formal training (i.e., fishing
111 degrees from deckhand to skipper), tacit knowledge on fishing grounds and fish behavior
112 [41] and skipper-crew relationships [30,42]. *Organizational capital resources* refer to how the
113 firm is organized, both internally and in dealing with the external environment (e.g.,
114 competitors, buyers, producer organizations, authorities). It encompasses both formal and
115 informal structures. Formal structures include a firm's reporting structure, coordinating
116 systems, scale, scope, integration and hierarchy. Informal structures refer to the firm's

117 organizational culture (i.e., the set of beliefs and expectations including communication,
118 teamwork, flexibility, trust, work ethic, etc.) [39,40].

119 3 Material and methods

120 3.1 Case study description

121 In 2018, 2905³ fishing vessels were registered in France's Atlantic, Channel and North Sea
122 fishing ports⁴, 811 of which were owned in multi-vessel operations, corresponding to 28% of
123 the entire fleet, 38% of total kW and 43% of landed value⁵. There were 2180 vessels (74.6%)
124 <12 m and 725 (24.8%) >12 m. The fleet is diverse, both in terms of vessel size and fishing
125 techniques. The main components are demersal trawlers/seiners (n=591), drift and fixed
126 netters (n=551), vessels using pots and traps (n=388), vessels using hooks (n=296), and
127 dredgers (n=270) (see [43] for a more complete description).

128 Compared to other fisheries in France, landings from the French Atlantic fleet are
129 characterized by a high species diversity [44]. In 2018, total landings were 410,000 tons for a
130 value of 981 M€, with nearly 75% of this value landed by vessels over 12 m (7 species made
131 up 50% of the landed value). Main species in terms of value are hake (*Merluccius merluccius*),
132 monkfishes (*Lophius spp.*), scallops (*Pecten maximus*), common sole (*Solea solea*), Atlantic cod
133 (*Gadus morhua*) and Norway lobster (*Nephrops norvegicus*). In terms of volume, key species
134 include pelagic species like herring (*Clupea harengus*), sardine (*Sardina pilchardus*), mackerel
135 (*Scomber scombrus*) and saithe (*Pollachius virens*).

136 Fishing fleets are managed under the regulations of the EU's Common Fisheries Policy (CFP)
137 [45]. This includes the use of Total Allowable Catches (TACs) and national quotas as well as
138 input controls such as gear restrictions and effort limitations aimed at limiting entry to the
139 fishery (kW, GT, licenses) [29]. The allocation of fishing opportunities (quotas, licenses) has
140 been delegated to Producer Organizations (POs) for TAC-managed species, and to Fisheries
141 Committees (*Comités des Pêches*) for non-TAC species [46,47]. While market transactions of
142 fishing opportunities are prohibited by law [17], they can be transferred with the fishing

³ We excluded 16 tuna fishing vessels registered in Atlantic ports but operated in other regions (high seas).

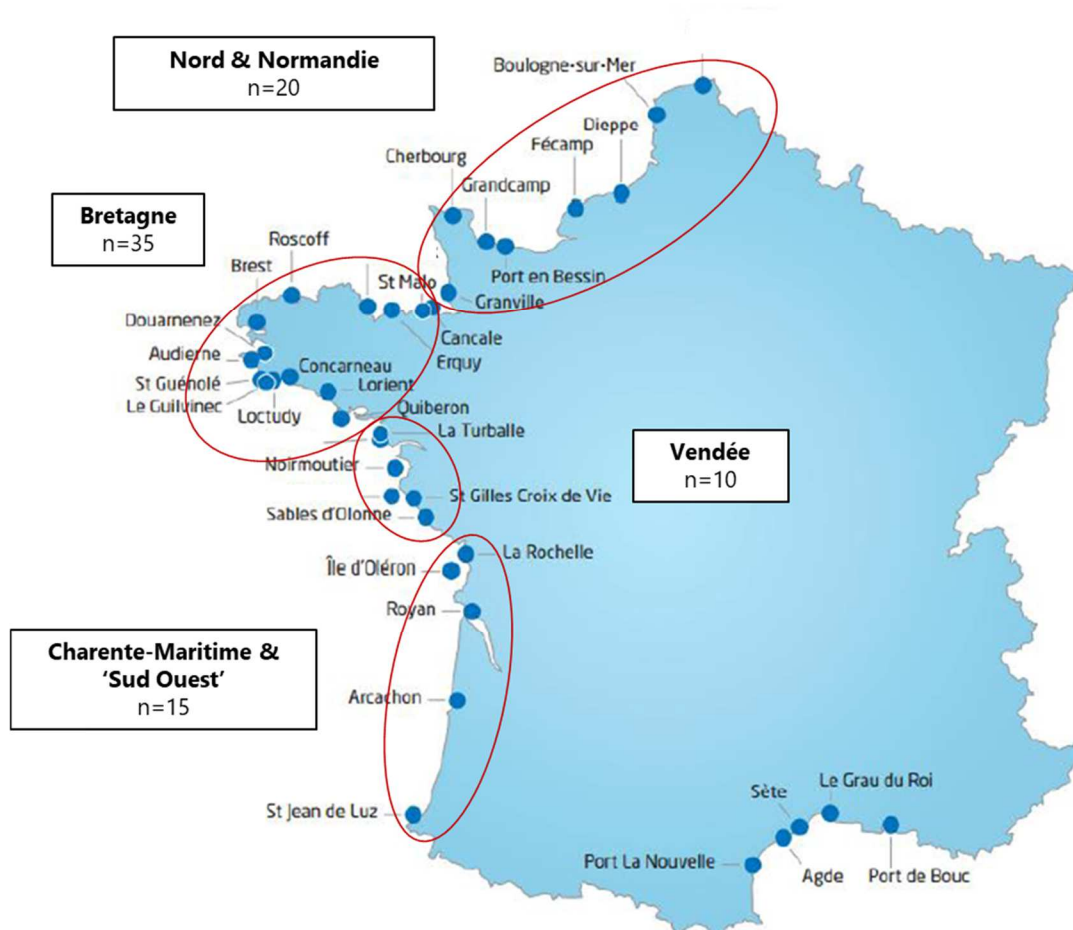
⁴ Throughout this paper, we will use the term 'Atlantic' to group the Atlantic (*sensu stricto*), the Channel and the North Sea.

⁵ We must note that this picture is still an underestimation of multi-ownership. Data on vessel ownership are collected at the level of the registered *operator*, which may be another entity than the *owner*. An owner (a natural or legal person) may in fact own multiple fishing firms, but this cannot be discerned from the data.

143 vessel when the vessel is sold [46]. Historical track records (2001-2003) of fishing vessels form
144 the main criterion for allocations by POs [47], creating an incentive for fishers to invest in
145 second-hand vessels with track records attached. Access to the resource is thus directly
146 linked to a fisher's ability to invest – a setup that has created a deep socioeconomic divide
147 between firms, and which has been named unjust towards new entrants and small-scale
148 fishers [31,48,49]. As a mitigation measure, two track records reserves were created (one PO
149 and one national) to be redistributed to these target groups based on specific criteria (e.g.,
150 environmental, social and economic) (see Articles R. 921-47 and 48 of the Rural Code [17]). A
151 better understanding of the economic organization of fishing firms may thus inform the
152 design of such redistribution criteria in future policy reforms.

153 **3.2 Semi-structured interviews and key information**

154 Semi-structured interviews were conducted with operators with two or more fishing vessels
155 (n=80) along the French Atlantic coastline between December 2017 and April 2019 (Figure 1).
156 This group comprised both vessel owner-operators and managers of fishing firms.
157 Throughout this paper, we will use the generic term 'fishers', to encompass both categories.
158 Participants were selected across fisheries according to a quota sampling method, in order to
159 cover the different fishing districts, vessel sizes and fleet segments. As such, our sample
160 captured 315 vessels, representing 39% of vessels and 71% in terms of landed value of the
161 subpopulation (operators with ≥ 2 fishing vessels) (Table 1).



162
 163 Figure 1: Study area. Interviews (n=80) were conducted with operators with two or more fishing vessels registered in
 164 Atlantic fishing ports. Figure adapted from FranceAgriMer [50].
 165

166 Interview questions were prepared based on theory, expert knowledge and evidence from
 167 the field (see further). The interviews were conducted in the homes of fishers, at their landing
 168 sites or in their dockside offices. Interviews lasted between 1 and 3 hours. Respondents were
 169 asked about key elements related to the organization of their businesses, including
 170 ownership structure, firm structuration, funding strategy, management strategy, firm size,
 171 fishing strategy, valorization strategy. Additional information was collected about the fisher's
 172 personal history (age, education, generational fishing, activities prior to fishing, etc.) and firm
 173 development (access to fishing opportunities, perspectives on fisheries management,
 174 involvement in collective action, personal motives for investing, etc.).

175

176

177

178 Table 1: Ownership structure of the French Atlantic fleet (2018). NB: tuna vessels registered in Atlantic ports but fishing
 179 in other regions were excluded. (*): % of the total population; (**): % of sub-population interviewed. Operators were
 180 adjusted based on survey results. Sources: DPMA-Ifremer Fisheries Information System (SIH) (2018) and our survey.

No. vessels/operator	1	2	3-5	5-9	≥10	Total population	Sub- population >1 vessel*	Survey sample**
No. operators	2094	236	64	11	6	2411	317 (13%)	80 (25%)
No. vessels concerned	2094	472	194	72	73	2905	811 (28%)	315 (39%)
Total hp (10 ³ kW)	310	75	46	31	40	502	192 (38%)	115 (60%)
Landed volume (10 ³ tons)	229	52	54	35	39	409	180 (44%)	123 (68%)
Landed value (M€)	560	124	97	91	109	981	421 (43%)	301 (71%)

181
 182 The interviews were transcribed verbatim. Then, each transcript was read through several
 183 times and coded manually following the framework set out by Riessman [51] for thematic
 184 narrative analysis. Participants' answers were converted to discrete values (Table 1), and the
 185 resulting categorical variables were included in a database for further analysis. Finally,
 186 information collected via interviews was supplemented with data that we obtained indirectly
 187 (e.g., via other respondents, fishing industry magazine articles, internet broadcasts), as well as
 188 data compiled from Ifremer's SIH (*Systèmes d'Informations Halieutiques*) database⁶ (landings,
 189 fishing activity, characteristics of vessels and operators).

190 In addition to the interviews with fishers, 20 semi-structured interviews were performed with
 191 key actors including fisheries administration (national and regional, n=2), representatives of
 192 POs (n=4) and fisheries committees (n=6), business lawyers (n=2), financial experts/vessel
 193 brokers (n=2), bank executives (n=2), wholesalers (n=1) and shipyards (n=1).

194 3.3 Selection of firm attributes for typology construction

195 Commonly used organizational attributes in the field of strategic management include firm
 196 size [52,53], ownership and/or management structure [53–57]; organizational culture and
 197 values [40,58]; the degree of market power, rivalry and competition [40,59]; the proportion of
 198 debt and equity funding [40]; human resource management [60]; and the presence of
 199 strategic resources within the firm [39,61–64].

200 To develop a typology of firm organization adapted to the fishing industry, we also took the
 201 following elements into account. First, we consider that fishing firms can grow in two basic

⁶ See <https://sih.ifremer.fr/> (Accessed on 18/12/2020)

202 ways: either by adding vessels to their fleet (horizontally), or by expanding activities beyond
203 fishing (e.g., processing, developing sales, etc.) (vertically). A second consideration is related
204 to the specifics of fishing as an economic activity (e.g., its rural and family character, the
205 organization of labor, crew remuneration, etc.), its position within a broader socio-economic
206 context, and more specifically, a complex institutional environment (fisheries management).
207 Finally, the French fishing industry exhibits a number of particularities in the way fisheries
208 production is organized: e.g., the common property and the non-transferability of fisheries
209 resources [46,47], the organization of labor in trade unions [65], the strong cooperative
210 tradition [66], and, more generally, labor and fiscal law.

211 Six attributes (themes) were selected for typology construction: ownership structure, firm
212 structure, management strategy, firm size, fishing strategy and valorization strategy. For each
213 attribute, one or more variables were constructed (17 in total). Then, for each variable,
214 discrete categories were decided upon. Table 2 summarizes these themes and variables, and
215 their modalities.

216 **Ownership structure.** Ownership structure has implications for firm governance and
217 performance [67–69]. In fisheries, the variety of ownership structures is commonly placed on
218 a spectrum, sometimes including elements of geographical location and the mode of
219 production: i.e., from household producers and self-employed owner-operators (private
220 businesses) to “capitalist”⁷ fishing firms and (multinational) corporate fishing companies
221 [7,15,42,70–72]. A fishing company may be owned by one or more individuals, a family, or a
222 corporation [15,33,70,73]. In addition to this, different forms of joint ownership exist –
223 between individuals, companies (joint ventures) or a combination of these. The profile of the
224 owner(s) has implications for the way production is organized in terms of crew management
225 and remuneration [15,30,42,70], fishing strategy [74,75], marketing strategy [76,77], local
226 embeddedness [78], and succession of the business [15,71]. Another aspect of ownership
227 structure is access to and use of different sources of funding (debt, equity, corporate).

228 **Firm structure.** The choice of legal form determines to a great extent the entrepreneur’s
229 outlook in terms of investment opportunities, tax regime and transmission of the company at
230 retirement. Across the EU fishing industry, there seems to be a shift from simple legal forms

⁷ For an examination of what makes a fishing firm “capitalist”, we refer to St Martin (2007) and McCall Howard (2012), who present different perspectives.

231 (sole proprietorship or partnership companies) to limited liability companies (LLCs) [15,79–
232 81]. LLCs have a number of advantages for artisanal fishers, including tax optimization and a
233 better protection of the co-owning partners as well as their spouses against debt, divorce or
234 decease [79]. Under firm structure we also understand the objectives and direction of growth
235 of the firm. Other aspects of firm structure are included as proxies for structural complexity:
236 the presence of holdings, advanced structuration (i.e., a company structure for each vessel,
237 held together by a holding, see [81]). The embeddedness of the entrepreneur and the firm in
238 local, regional and national networks [29] is furthermore included, as well as the objectives
239 and direction of growth [82].

240 **Management strategy.** In France, family-based fishing has been a key element in the
241 development of the artisanal fleet in the post-war period [15,19,66,83,84]. Family firms are
242 typically characterized by the alignment of ownership, management and control [85,86]. The
243 economic model of family fishing firms in France based on (a) keeping productive capital
244 within the family, (b) securing employment for family members on board fishing vessels and
245 (c) the possibility of drawing upon un(der)paid labor [15]. In non-family firms, the owners (the
246 principals) delegate a part of the decision-making authority to another person (the agent) in
247 order to avoid agency problems due to information asymmetry or moral hazard [55,87]. In its
248 most simple form, the agent is the skipper who is responsible for monitoring the fishing
249 operation at sea. In large fishing firms ownership and control are separated, and salaried
250 managers may be employed to oversee the fishing operations from shore. This constitutes
251 two additional agency relationships: between the manager and the skippers [87], and
252 between the manager and the shareholders [55,56]. For the purpose of this paper, we are
253 particularly interested in the choice of the 'right type' of agent (see [87]) (e.g., a family
254 member with a stake in the business versus an 'external' skipper or manager) and the
255 incentive contracts that underlie these relationships.

256 **Firm size.** Decisions to invest or disinvest in physical capital are often based on economic
257 incentives [88–91]. The number and size of vessels are important factors in this decision
258 [92,93] and serve as proxies for firm size in our analysis. Also the total number of crew is
259 taken into consideration.

260 **Fishing strategy.** Fishing firms may diversify their fishing activity to mitigate risk and
261 maintain profitability [74,94]. Generalist firms aim to keep total variable costs to a minimum

262 so they can easily switch between fisheries. Diversification is commonly accepted as the
263 default for small-scale and artisanal fishing in France [14,20]. Specialization may simply be a
264 consequence of the fishing opportunities available to the firm at a given point in time (and
265 the markets that exist for them), but it may also be part of a broader strategic trajectory. Such
266 trajectory is focused around realizing economies of scale and scope [59] through vertical
267 integration, internalization of peripheral activities (e.g., bookkeeping, crew management,
268 vessel maintenance) and standardization (e.g., a fleet of standardized fishing vessels) [74,95].
269 These aspects may be associated with significant efficiency gains for the firm.

270 **Valorization strategy.** In 2001, Guillotreau and Le Grel [96] described a general trend of
271 formalization and contracts along European fish supply chains, in particular for larger
272 companies – a trend that has steadily continued [32,33,73]. Also in other parts of the world,
273 the default modes of selling fish on spot markets and through competitive auctions are being
274 replaced with short and long-term contracts, sometimes involving exclusive dealing and
275 ownership interests in vessels by downstream actors [76,77,97]. In addition to contracts, a
276 trend of full vertical integration (vertical ownership, hierarchy) [57] is observed for both
277 producers (forward integration) and downstream actors (traders, retailers, processors)
278 (backward integration) [41,96]. Empirical studies have shown that transaction costs as well as
279 strategic considerations play an important role in a firm’s decision to vertically integrate
280 [41,76,77,97–99].

281 **3.4 Multiple Correspondence Analysis with hierarchical clustering**

282 We use Multiple Correspondence Analysis (MCA) in combination with hierarchical clustering
283 to reveal patterns in our dataset. In MCA, the dataset is represented as a cloud of points in a
284 multidimensional Euclidean space. This is then transformed into a low-dimensional space in
285 which the relative positions of the points and their distribution along these dimensions form
286 the basis for interpretation. Its power lies in its capacity to uncover groups in complex
287 multivariate datasets without needing to meet any *a priori* assumptions about the data [100].
288 This makes it a useful tool for typology construction. We selected 10 variables that captured
289 the structure of the phenomenon under study well [101], and for which frequency
290 distributions were balanced and association was low (Cramer’s V kept as low as possible) (see
291 Table 2). In a second step, a cluster analysis was carried out on the MCA results, to separate

292 individuals into groups. The MCA and the subsequent cluster analyses were performed using
293 the FactoMineR package [102] in R Studio (version 1.1.463).
294

295
296

Table 2: Themes and variables considered for typology construction. (-) not included in the quantitative analysis; (S) not included in the quantitative analysis; supplementary variable. Count: number of occurrences in the interviews.

Theme	Variable	Categories	Count	
Ownership structure	Owner profile	OWN1	Individual	40
		OWN2	Family	23
		OWN3	Shared (capital holdings)	11
		OWN4	Corporate	6
	Foreign ownership ^(S)	FOREIGN0	No foreign ownership	70
		FOREIGN1	Foreign ownership	10
	Capital funding ⁽⁻⁾	FUND1	Mainly own funding	5
		FUND2	Mainly bank funding	66
		FUND3	Mainly corporate funding	4
		FUND4	Mixed	5
Firm structure	Legal definition	LEG1	Sole proprietorship	35
		LEG2	Combination of sole proprietorship and limited liability company	10
		LEG3	Limited liability company	35
	Level of structuration ⁽⁻⁾	STRUCT1	Simple (little structuration)	39
		STRUCT2	Medium (some structuration; with holding)	20
		STRUCT3	Completed (fully structured; as the owner wants it to be)	16
		STRUCT4	Advanced (company for each vessel)	5
	Growth objective and direction	GROW0	No real growth objectives	42
		GROW1	Focus on acquisition of fishing vessels	32
		GROW2	Acquiring vessels and expanding activities	6
	External advice and information	ADVICE1	Weak (no enabling environment)	38
		ADVICE2	Medium (access to good bookkeeping advice, sometimes also legal advice)	25
		ADVICE3	Strong (enabling environment with high level legal advice)	17
Management strategy	Management strategy	MANSTR1	Simple (owner = manager, embarked)	44
		MANSTR2	Medium (owner = manager, shore-based)	14

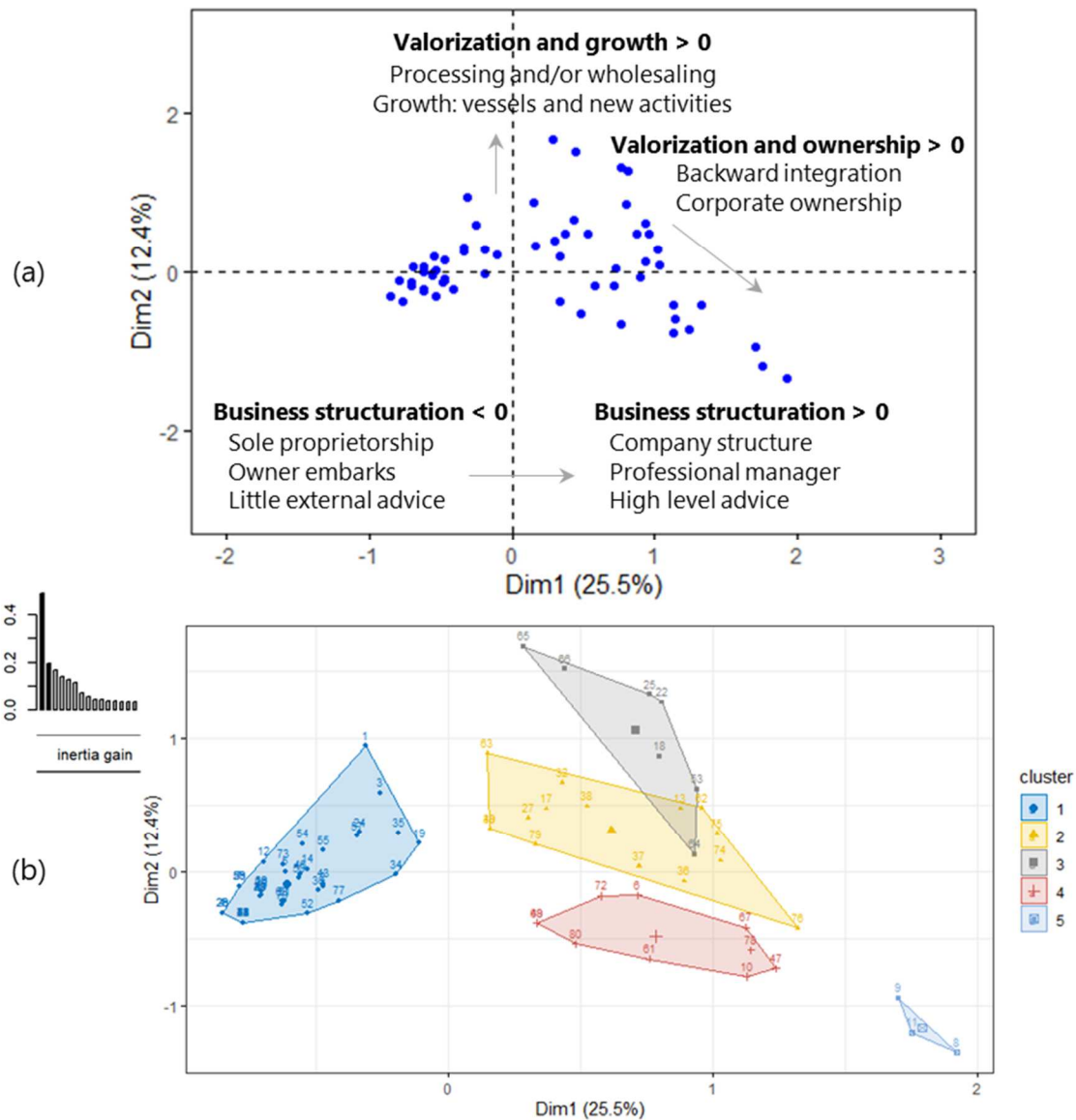
		MANSTR3	High (owner ≠ manager, salaried)	16	
		MANSTR4	Outsourced (owner ≠ manager; third party)	6	
Firm size	Number of vessels ^(S)	VES1	2 vessels	35	
		VES2	3-5 vessels	28	
		VES3	6-10 vessels	12	
		VES4	> 10 vessels	5	
	Crew size ^(S)	CREW1	0 to 2	6	
		CREW2	3 to 5	17	
		CREW3	6 to 10	15	
		CREW4	11 to 15	13	
		CREW5	16 to 30	11	
		CREW6	>30	18	
	Fishing strategy	Size of vessels ^(S)	SIZE1	<=12m	33
			SIZE2	>12m	35
SIZE3			Mix	12	
Specialization		SPEC0	No specialization strategy	26	
		SPEC1	Specialization in a portfolio of target species	17	
		SPEC2	Specialization in 1 or 2 target species or species groups	37	
Complementarity ^(S)		COMPL0	No complementarity of activity	67	
		COMPL1	Complementarity of activity	13	
Standardization		STAND0	No standardization of fishing vessels	47	
		STAND1	Standardization of fishing vessels: one fleet	24	
		STAND2	Standardization of fishing vessels: subfleets	9	
Vessel maintenance		MAINT1	Simple (most maintenance is externalized)	60	
		MAINT2	Medium (manpower dedicated to maintenance)	15	
		MAINT3	Strong (internalization of maintenance, incl. workshops)	5	
Crew rotation		ROT1	None or opportunistic	57	
	ROT2	Extensive	14		

		ROT3	Intensive	9
		VALOR1	Spot markets	49
Valorization strategy	Valorization strategy	VALOR2	Direct sales + spot markets	20
		VALOR3	Processing and/or wholesaling	7
		VALOR4	Processing with sourcing strategy and/or backward integration	4

297 **4 Results**

298 **4.1 Multiple Correspondence Analysis and Hierarchical Clustering**

299 In this section, only the main outputs of the Multiple Correspondence Analysis (MCA) and
300 Hierarchical Clustering are included. For a step-by-step description of the analysis, we refer to
301 Annex I. Figure 2 shows the results of the MCA and the hierarchical clustering. A stable five
302 cluster solution was retained. Firms in Cluster 1 are characterized mainly by an embarked
303 owner-operator (95.6% of individuals in the cluster), who is the single owner (84.4%) of a sole
304 proprietorship (77.8%). Entrepreneurs do not benefit from good external advice (84.4%).
305 Firms in Cluster 2 are limited liability companies (86.7%) owned by families (80.0%).
306 Outsourcing of management is found for 40.0% of firms in the cluster. Cluster 3 is
307 characterized by shore-based managers (ex owner-operators; 85.7%) and the valorization
308 through forward vertical integration (processing and/or wholesaling; 100%). Cluster 4 is
309 characterized by 'ownership sharing' between skippers and owners (shareholders) (90.0%),
310 shore-based managers (external, salaried; 100%) and a focus on the acquisition of fishing
311 vessels (100%). Cluster 5 is characterized by backward vertical integration (valorization and
312 supply security; 100%), strong internalization of vessel maintenance (100%) and corporate
313 ownership (100%).



314

315 Figure 2: (a) result of the MCA with interpretation of the axes: business structuration on the horizontal axis, valorization
 316 on the vertical axis and a third dimension (not plotted) describing ownership structure; (b) result of hierarchical
 317 clustering.

318

319 4.2 Review of organizational types

320 In this section, the description of the Types based on the MCA and cluster analysis is enriched
 321 with additional interview data.

322 **Type 1: Small-multi-owners** (n=45). This group comprises small fishing firms generally
 323 composed of 2 to 3 fishing vessels (n=38) smaller than 12 m (n=32). The firm is owned and
 324 managed by an individual, and has a simple legal structure (sole proprietorship).

325 Management is characterized by an embarked owner-operator who either alternates
326 between vessels (often seasonally) or commands one vessel while delegating the operation
327 of their other vessel(s) to someone else (mostly their son). The owner's spouse is rarely
328 involved, and if they are, they have little decision power. There is generally no real growth
329 objective among small multi-owners. They became multi-owner out of practical
330 considerations: access to fishing opportunities (diversification), out of fiscal considerations, or
331 simply when opportunities came up.

332 Besides the shared characteristics which define Cluster 1 at the selected threshold (WSS=1.09;
333 BSS=0.1, see Annex I), there is quite some variation between the firms, which causes some of
334 them to break away from the core of the cluster. These 'emerging entrepreneurs' (n=9) have
335 grown their companies up to 3 to 4 vessels, and may be on their way to acquire more. As
336 such, they start resembling fishing firms in the periphery of Cluster 2. They often combine
337 sole proprietorship with a company structure, and are in the middle of restructuring the firm
338 and formalizing management roles. Fishing is characterized by more specialization, which
339 sometimes goes hand in hand with a proactive marketing approach (e.g., developing new
340 markets, direct sales).

341 **Type 2: Medium to large-scale family fishing firms** (n=16). Fishing firms within this group
342 are family-owned and managed. They are characterized by a sole focus on fishing, targeting
343 either a portfolio of target species (n=9) or one specific target species for which strong spot
344 markets exist (auctions) (n=7). The firms are owned by fishing families (n=12), with large
345 fishing fleets up to 16 vessels (5.7 vessels on average; SD=4.2), all >12 m. In most cases
346 (n=14), vessel size is greater than 18 m (18-24 m: 7 firms; 24-40 m: 7 firms). These companies
347 strive towards optimization of production by standardizing their fleets and maximizing vessel
348 time at sea. In its most simple form, the standardization strategy consists in investing in
349 vessels of similar size and equipped for fishing with the same gears. For more profitable
350 firms, a fleet renewal strategy is observed. Vessel replacement with state-of-the-art vessels,
351 often 'sister ships', allows for the internalization of vessel maintenance. This ranges from the
352 allocation of manpower (n=6) to having a proper workshop with a constant stock of spare
353 parts (n=1). Vessel time at sea is maximized by ingenious crew rotation schemes (n=13),
354 either 'extensive' (replacement of a couple of crew members at a time, n=7), or 'intensive'
355 (replacement of the entire crew between fishing trips, n=6). The latter is sometimes

356 combined with 'remote bases' (n=4), satellite fishing ports (in France or abroad) where the
357 vessels regularly dock, fish is landed, and where crew is flown into. These companies often
358 employ a person or a small team for overseeing crew management and other administrative
359 tasks.

360 A closer look at ownership and management reveals a subgroup (n=6), characterized by the
361 complete outsourcing of management. These are Spanish fishing families that own vessels in
362 both Spain and France, specialized in trawling and mainly targeting European hake. Their
363 French vessels are managed and operated by legal entities in France (required by law⁸), who
364 take care of everything from crew management and bookkeeping to vessel operations,
365 maintenance, negotiations with POs, and bringing the catch to market.

366 **Type 3: Fisher-processors** (n=7). Fishing firms in this group specialize in one target species
367 or species group (crustaceans: n=2; scallops: n=3; pelagics: n=2). Their specialization strategy
368 encompasses all stages of the production process: harvesting, processing and marketing.
369 First, they have grown their fleet by investing in fishing vessels with interesting licenses and
370 track records attached. They own and operate fishing fleets up to 13 vessels (6.3 vessels on
371 average; SD=3.8). Within firms, vessels are mostly of similar size and equipped for fishing
372 with the same set(s) of gears. This clear focus on growth and standardization has allowed
373 them to establish market dominance in their respective ports or regions. In turn, this has led
374 them to structure their businesses and to venture into new activities, most notably the
375 processing and marketing of their own catch. In terms of firm structure, we see that all firms
376 have a company structure, with a holding overarching the different activities. Administrative
377 tasks such as bookkeeping and crew management are often internalized once the business
378 has reached a certain size. Companies with more than three vessels (n=4) have dedicated
379 manpower to deal with maintenance tasks. Firm management is characterized by a strong
380 involvement of family members. The fisher's spouse often plays a pivotal role in the business.
381 Her responsibilities include tasks like crew management, bookkeeping, managing orders and
382 deliveries. Sometimes the owner's children are involved or being prepared to lead the
383 company when their parents retire. In most cases, the owner is a self-taught manager (n=6),
384 who started their career as deckhand.

⁸ Article R921-4 of the Code Rural.

385 **Type 4: Ownership-sharing models** (n=9). Firms in this group all have shared ownership in
386 one form or another, and have a strong focus on the acquisition of fishing vessels (>12 m)
387 with track records or licenses attached. The firms are heterogeneous in terms of size (crew
388 size, number of vessels) and fishing strategies. This may be explained to a great extent by the
389 relative newness of some of these firms and the uncertainty in which direction they will
390 develop. Most firms in this group (n=6) belong to the cooperative tradition that has
391 historically shaped the French fishing sector. In its original form (n=3), it is characterized by
392 shared ownership between the cooperative structure on the one hand and the skipper-
393 owners on the other. The main aim is to allow skippers to gradually acquire shares until they
394 have full ownership over their vessels. The cooperative is characterized by a hierarchical
395 management structure, with at the top a shore-based manager who has the double
396 responsibility of managing the company (e.g., human resource management, administration,
397 negotiation with banks, etc.) and following up production for each vessel.
398 Recently, a new type of cooperative emerged from this tradition, including new elements
399 designed to make the cooperative model "more adapted" to the current economic context
400 (n=3). Finally, we also find three private fishing companies for which ownership is shared with
401 skippers. These companies are part of a corporate ownership structure, for which they
402 constitute only a fraction of total production.

403 **Type 5: Corporate fishing groups** (n=3). Despite the presence of only a few cases in our
404 sample, these fishing firms form a distinct and well-defined group in the Atlantic fishing
405 sector. They operate large vessels (≥ 40 m) in a corporate ownership structure sometimes
406 involving multiple mother companies. Management is overseen by a salaried manager, who
407 mostly runs the fishing company independently of the corporate group. There is a
408 pronounced internalization of vessel maintenance and administrative tasks. Besides
409 employing a team of people in administration, these firms also have their own workshops
410 and a team of mechanics to oversee maintenance. Similar to firms in Type 2, vessel time at
411 sea is optimized through crew rotation schemes (intensive) and remote bases. Their
412 valorization strategy is based on volume: they specialize in species for which demand is high
413 and for which strong markets and/or integrated value chains exist, such as Atlantic cod
414 (*Gadus morhua*), blue whiting (*Micromesistius poutassou*), and saithe (*Pollachius virens*). The
415 market for saithe is heavily integrated. One fishing company is responsible for 79% of

416 landings, which are bought directly by a processor who then distributes the frozen filets
417 through its own retailing branch.

418 5 Discussion

419 5.1 Growth of “artisanal” fishing firms

420 Based on literature, we may take the traditional one-vessel, polyvalent and family-based
421 fishing firm – the so-called “artisanal” firm – as the default organizational form (vessels <25
422 m), from which more modern configurations may arise [14–16,18–20]. This perspective is
423 validated by the interviews. However, the fieldwork also revealed that the development of
424 multi-vessel enterprises and the concentration of capital was more significant than envisaged
425 at the start of the study.

426 Multi-vessel ownership is a major way to increase resource access and expand production.
427 Expansion happens gradually in artisanal firms, through the stepwise acquisition of second-
428 hand vessels with track records attached. This is in sheer contrast with corporate companies
429 of Type 5, which are able to acquire entire fleets at once through mergers [33]. However, not
430 all artisanal firms grow out to be large companies. Most Type 1 firms did not have an
431 objective of growing beyond their current size (2-3 vessels <12 m). Our results show that
432 investment decisions depend on a range of factors, including the age and personal situation
433 of the entrepreneur, the type of fishery, the availability of fishing opportunities, and the
434 entrepreneur’s financial capacity to invest. Furthermore, the involvement of family members
435 reduces the business’s cost structure. The ability to draw upon un(der)paid family labor has
436 certain economic advantages for family fishing firms [15]. Often, administrative tasks are
437 carried out by the fisher’s spouse, allowing the fisher to focus solely on fishing [103].

438 The interviews furthermore show that the development of fishing firms happens in phases
439 that are closely linked with the life/career stages of the entrepreneur: they start out as crew
440 members, become skippers and eventually become owner. Once a critical size⁹ has been
441 reached, the entrepreneur may decide to shift from embarked owner-operator to shore-
442 based manager (rarely before the age of 50). As the firm grows, incremental changes are
443 made to its structure. Small multi-owners are driven by a logic of risk aversion, income
444 diversification and cost optimization through internalization of maintenance tasks and the
445 outsourcing of bookkeeping [104,105]. Later in the firm’s development, bookkeeping is

⁹ The rule of thumb unanimously evoked by interviewed fishers is a minimum of three fishing vessels for this to be worthwhile .

446 internalized, people are hired to oversee crew management, etc. Our results show a
447 substantial diversity in the organization of small and medium-sized fishing firms, despite their
448 common origins. This confirms our hypothesis that the artisanal vs. industrial dichotomy is
449 insufficient and outdated.

450

451 **5.2 Drivers of horizontal integration**

452 The number of “mass species” for which economies of scale may typically be realized through
453 specialization, standardization of vessels and vertical integration [41,106], is limited.
454 Exceptions include Atlantic cod, saithe, blue whiting, Atlantic herring and Atlantic mackerel,
455 which are harvested by ≥ 40 m trawlers (Type 5). Yet, also in other fisheries and fleet
456 segments, firms pursue specialization (species or species groups) and standardization. Their
457 main objective is cost efficiency, which is accomplished through cost reduction (e.g., more
458 efficient engines, modern technology), and sometimes the ability to negotiate fish prices
459 based on volume of landings. All Types are concerned, and include firms specialized in
460 trawling or Danish seine for demersal species in the Channel and the Celtic Sea (18-24 m),
461 scallop dredgers in the Channel (10-16 m), nephrops trawlers (10-18 m) in the Bay of Biscay,
462 and small-scale netters and whelk potters (<12 m).

463 For most entrepreneurs in Type 1, the strategy of having several vessels is governed by
464 regulatory factors (e.g., license allocation mechanisms, seasonal closures) and their risk averse
465 attitude [75], rather than a search for scale economies. Each vessel is dedicated to one fishery
466 and cannot be used in another (specific vessel/gear combinations; switching costs are high).
467 Examples include coastal fisheries for scallop, glass eel, Atlantic salmon and macroalgae.
468 Recently, fishery bans due to harmful algal blooms (HABs) in coastal areas have forced
469 operators to invest in additional vessels to diversify their income.
470 Specialization/standardization is limited by the financial capacity of operators to acquire
471 second-hand vessels with adequate track records, let alone build new vessels [29,31].

472 In contrast to small independent firms (Type 1), many larger firms exhibit, in addition to a
473 focus on fleet expansion, a pronounced fleet renewal strategy. This is accomplished through
474 the stepwise replacement of old vessels with standardized *sister ships*, financed by the vessels
475 currently in the company. This, in turn, creates an opportunity for the integration of vessel
476 maintenance. One fishing company in Brittany (Type 2) has its own workshop in which it

477 employs 40 people for maintaining their 16 trawlers. Such full integration of vessel
478 maintenance was seen only in a handful of cases (in Type 2, n=2; and Type 5, n=2). A more
479 common strategy is to employ someone for day-to-day maintenance tasks and the creation
480 of a stock of spare parts (seen across Types). Finally, companies with large fishing vessels
481 (mainly 24-40 m and >40 m, some 18-24 m) are preoccupied with maximizing vessel time at
482 sea through sophisticated crew rotation schemes (replacement of a large proportion of crew
483 after every fishing trip) and the use of remote bases.

484 Crew is increasingly found outside the family network, and even outside the communities in
485 which they are embedded. It is not uncommon to see Spanish, Portuguese and Senegalese
486 crew working on board large and even medium-sized ("artisanal") fishing vessels. This is
487 consistent with [107]), which reports 12% foreign crew at national level (8% EU, 4% non-EU).

488 **5.3 Forward and backward vertical integration**

489 The default mode of selling landed fish in France is through auctions, even though direct
490 sales to consumers is also common for small-scale vessels [108]. Of the small multi-owners of
491 Type 1, 14 (33%) use marketing channels outside the auction, and 5 (14%) rely heavily on
492 them (mostly fish stalls managed by family members). For fisher-processors (Type 3), forward
493 vertical integration may be understood as a way to increase efficiency and consolidate
494 market dominance after having gathered vessels with ample fishing opportunities. It mostly
495 concerns non-TAC species (e.g., crustaceans, scallops) for which markets are traditionally
496 dominated by retailers and processors (e.g., [109]). However, dominant fishing firms may try
497 to capture economic rents by integrating (part of) the value chain (processing, sales). This is
498 implemented through contracts or mutual agreements with buyers, and the establishment of
499 processing and water tank facilities. These give producers more control over the market and
500 give them access to high-end niche markets (live scallops, crabs, lobster).

501 The acquisition of fishing vessels by processors and retailers (backward vertical integration)
502 can be understood by their dominance in retail markets for a number of high volume species
503 (Atlantic cod, saithe, blue whiting). To consolidate this dominance and achieve a sustained
504 competitive advantage, they seek to control the harvesting sector [41]. Other than strategic,
505 this approach is transaction cost economizing, as the processing companies in the corporate

506 group buy the raw product directly from the company owning the ship (contractual
507 agreements).

508 **5.4 Towards new ownership models**

509 The past twenty years have been marked by very limited possibilities for the renewal of
510 vessels due to policies aimed at reducing and controlling fleet capacity [110,111]. While the
511 last five years have been more favorable (i.e., new possibilities for vessel construction and a
512 higher supply of vessels on the second-hand market due to a spike in retirement rates), the
513 ban on subsidies for vessel construction and the purchase of second-hand vessels pose
514 greater constraints to the financing of investments. In addition, the price of new vessels is
515 very high for independent entrepreneurs¹⁰, considering that entering the sector or growing
516 businesses implies the need for acquisition of second-hand vessels and associated fishing
517 opportunities [29]. Most multi-vessel companies only have recourse to bank loans (with the
518 exception of corporate firms which have access to corporate funding), with generally 20%
519 self-financing by the operators themselves or by local actors (shipyards, fish merchants,
520 cooperatives) and in a few cases regional public funds. The general strategy of multi-vessel
521 companies across Types is to repay the loans of a new vessel with the cash flows of vessels
522 that are already paid off [81].

523 More and more multi-vessel firms are securing their capital by creating as many companies
524 as they own vessels, and by consolidating their management through a holding company,
525 using legal forms such as SAS and SASU¹¹. These are considered more adapted to the needs
526 of modern-day fishing firms by financial experts, in terms of investment, depreciation, tax
527 optimization and transmission to children [81]. They also provide a way around the
528 preemption of track records (20%) associated with vessel transactions [31]. To avoid such
529 loss, companies are usually sold in their entirety (all vessels at once). But when companies are
530 large, investments become too heavy for peers (independent fishing firms) to bear, and firms
531 become interesting targets for corporate (and foreign) investors. This point was evoked by
532 multiple respondents. Advanced structuration with a holding is a way around this limitation,

¹⁰ Vessel prices (interviews): 11 m: 0.4 M€ (2016); 16 m: 1.2 M€ (2018); 20.5m: 3 M€ (2017); 22 m: 2.3 M€ (constructed in Morocco in 2019; "30% cheaper than in France"); 24 m: 3.5 M€ (constructed in Spain in 2016) [36].

¹¹ Respectively Société par Actions Simplifiée and Société par Actions Simplifiée à Associé Unique.

533 as it allows to sell off vessels separately [81] and thus to avoid the loss of (or control over)
534 local fishing capital.

535 There are few traditional cooperative fishing firms remaining along the Atlantic coast
536 compared to their peak in the 1980s (about 20 structures) [66]. The cooperative model has
537 been of major importance for the development of the 12-24 m segment. It allowed skippers
538 to progressively acquire full ownership of their vessel until they were the single owner, while
539 most of the financial risk was borne by the cooperative structure. Additional vessels were
540 financed with the profit generated by vessels already in the structure, and with subsidies. As
541 such, these firms have been severely impacted by the end of EU subsidies for vessel
542 construction and capacity reduction. Our study shows that new models of ownership sharing
543 are arising from the ashes of the cooperative model, organized around private structures, and
544 backed by financial institutions, local investors and POs [31]. They strive to maintain the
545 means of production and associated fishing opportunities in the territory (most cases
546 encountered), and favor access to capital for young fishers (all cases encountered). However,
547 full ownership by skippers is no longer the rule. This has two reasons: (1) equity of skippers is
548 limited relative to investments needed [66], and (2) the lack of subsidies has urged firms to
549 look for investors to match funding, which they usually find locally (value chain actors, see
550 below).

551 Ownership sharing is also seen by some respondents as a means of retaining skilled skippers
552 and encouraging them to operate and maintain the fishing unit properly. However, for most
553 firms, the share-based remuneration system [112] is considered sufficient as an incentive
554 scheme – and it allows owners to maintain full ownership and control over the vessel and
555 attached track records. Monitoring at sea is difficult and costly, and all the more difficult
556 when shore-based managers are unacquainted with the conditions on board a fishing vessel.
557 Agency problems related to shirking and monitoring of team production are less of a
558 problem in family fishing firms because in most cases, skippers as well as executive managers
559 are the children of the owner [87]. Our results confirm this.

560 A particular ownership model was introduced in France with the so-called 'quota hoppers'
561 that were attracted by freed-up capacity and fishing opportunities in the 1990s. In the case of
562 France, these are mainly Spanish fishing families investing in French fishing capital because of
563 quota constraints in their home country [113]. In 2016 there were an estimated 65 Spanish-

564 owned vessels fishing under the French flag, with a projected further increase [114]. As part
565 of demonstrating a 'real economic link' with France, operations need to be run by a "stable
566 establishment situated on French territory, [which disposes of the] infrastructure, material
567 means and human assets necessary to operate and manage a fishing operation in France"
568 (Article R921-4 of the *Rural Code*) [17]. Over the years, this has led to the emergence of
569 specialized companies representing multiple Spanish fishing firms. One such company
570 currently represents 17 vessels and functions as a large organization from which collective
571 scale advantages arise. Their role far surpasses any legal requirement, and includes
572 negotiations with POs over quota opportunities, organizing collective freight transport of fish
573 to Spain, sophisticated crew rotation platforms, collective vessel adaptations, etc. For
574 analytical purposes, the question rises whether they should be treated as separate entities or
575 as *de facto* large-scale fishing companies.

576 **5.5 Outlook**

577 A significant improvement in the economic performance of the French fishing industry in
578 recent years combined with an aging population of vessel owners [115] has fostered a
579 dynamic of creation and growth of multi-vessel companies. The industry benefits from bank
580 loans at historically low rates and strong competition between banking operators, many of
581 which have reorganized internally to more adequately finance blue growth. Some of them
582 offer investment fund mechanisms to finance capital operations. These seem to have limited
583 success, however, as most operators wish to maintain their capital independence and
584 because investment funds require much higher returns than bank loans. Even though fishing
585 opportunities cannot be integrated into companies' balance sheets as is the case in other
586 countries [79,116], banks report that they do take into account the fishing opportunities
587 portfolios of operators before financing a project. Because fishing opportunities are not
588 considered specific assets, vessels are financed much like any other physical asset, and loans
589 are relatively short term (7 to 12 years) compared to the significant amounts and long-term
590 character of these investments. A high burden of debt repayment could weaken companies,
591 especially if their overall economic situation were to deteriorate.

592 One of the positive points is that the fishing sector attracts investors. On the one hand, there
593 are the investors already active in the local maritime economy (e.g., fish mongers,
594 shipyards, etc.) investing in the 12-18 m and 18-24 m segments. They are strongly driven by

595 their conviction to keep the vessels and associated fishing opportunities in their territory
596 (fishing port or maritime sector). On the other hand, there are the private investors that have
597 historically been important for the development of the larger fleet segments (24-40 m and
598 ≥ 40 m). A well-known example is the retailer *Intermarché* and its corporate group *Les*
599 *Mousquetaires*, who have their own fishing company, *Scapêche* [32,33,73]. In recent years,
600 Scapêche has diversified its fishing portfolio by buying shares in structures operating vessels
601 in smaller fleet segments (< 24 m)¹². This is also seen for other corporate fishing companies.
602 The aim of association with companies or (formerly) independent producers is to secure
603 supplies and capture economic rent generated by fleets for which profit margins are weak.
604 Operators report a significant need for funding to finance fleet renewal. Vessels are often old
605 and, in some cases, repair and maintenance costs can be as high as the loan repayment
606 charge for new vessels [81]. For them, such joint ventures are part of the solution. In all
607 examples encountered, the operators were majority shareholder, and thus the legal owner of
608 the track records attached to the vessel [46].

609 The uncertainties regarding Brexit negotiations are likely to weaken companies (multi-vessel
610 or other) whose whole or part of their activity is located in the UK EEZ. Dependence on UK
611 waters is estimated at 19% in terms of value and 24% in terms of volume [117], but this
612 dependence could be higher for certain multi-vessel firms. Dépalle *et al.* [118] have
613 considered the implication of effort re-allocation in case of UK EEZ closures, but the medium-
614 long term consequences of the various scenarios (including 'no deal') on companies'
615 (dis)investment strategies is more difficult to anticipate. The same holds for the
616 consequences of the current COVID-19 health crisis, which are expected to be severe [119].

617 **5.6 Conclusions and recommendations**

618 We argue that the definition of the "artisanal" fishing model insufficiently captures the
619 organizational diversity found in the field. The diversity can instead best be described in
620 terms of organizational attributes, most notably access to information (knowledge networks),
621 legal structure, vessel maintenance and standardization, growth objectives and management
622 structure. We have furthermore shown that elements that are typically associated with

¹² E.g., https://www.armement-apak.fr/wp-content/uploads/2017/03/P%C3%AAache.-Un-nouvel-armement-artisanal-%C3%A0-Lorient-Mer-LeTelegramme.fr_-1.pdf (Accessed on 17/12/2020)

623 industrial fishing, such as vertical integration, the separation of management and control and
624 accumulation of fishing capital, also make their appearance in smaller fleet segments.

625 In a context that is marked by recovering fish stocks for French fleets [120], limited fishing
626 opportunities due to entry barriers and increasingly competitive markets [30,72], firms are
627 urged to rethink themselves to remain competitive [121]. We have shown that this can be
628 accomplished in a myriad of ways, but the general response is the same: scale increase,
629 rationalization of management, product valorization and access to information. The role of
630 knowledge networks (POs, Fisheries Committees, shipbroker and fish trading networks) in the
631 development of fishing firms deserves more attention, especially with regards to access to
632 fishing opportunities.

633 This typology may find a use in fisheries management, as a basis for adjusting public policies
634 such as the allocation of funds through the European Maritime and Fisheries Fund (EMFF) or
635 the allocation of fishing opportunities to specific producer profiles. This is particularly
636 relevant given the failure up until present to redistribute the track records in the national
637 reserve to the fishers they were intended for [31], based on a set of environmental, social and
638 economic criteria [17]. We argue that a similar analysis could be useful for case studies in
639 other EU Member States.

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