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# Clustering and performance: the case of maritime clustering in The Netherlands

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Over the last years, the concept of clustering has become a central concept for analysing the competitiveness of nations, industries and firms. The cluster concept can be usefully applied to study clustering of maritime activities. Maritime activities, such as shipping, shipbuilding and port and maritime services, are clearly geographically concentrated in a number of maritime clusters. Due to ongoing internationalization in these industries, the concentration of maritime activities in clusters is likely to increase. This observation leads to two important research questions: what are the advantages for firms to locate in clusters and what factors influence the development of maritime clusters? This study identifies four agglomeration economies that attract firms to cluster: a joint labour pool, a broad supplier and customer base, knowledge spillovers, and low transaction costs. Furthermore, it discusses the effects of aspects of the cluster structure, being the presence of internal competition, the heterogeneity of the cluster population, the entry and exit barriers, and the presence of (above mentioned) agglomeration effects. It also briefly discusses the important issue of cluster governance. This overview allows one to develop a theoretical framework to analyse clusters. In the empirical part, this framework is applied to the maritime cluster in The Netherlands. Based on empirical data, from surveys amongst firms in the maritime cluster, studies commissioned by the Dutch maritime Network and regional statistics, the presence of agglomeration economies in the cluster is shown. Secondly, it is shown that the cluster structure is beneficial for the performance. This paper finishes with conclusions and suggestions for further research.

## 1. Introduction

The concept of clustering has become a central concept for analysing the performance of nations, industries and firms [1–3]. This paper applies the concept of clustering to the maritime industries in The Netherlands. It deals with two research questions. First, what are the advantages for firms to locate in a cluster? (the firm level), and second, what cluster specific factors influence the development of maritime clusters? (the cluster level).

The first section describes the cluster concept and develops an analytical framework to analyse the above-mentioned research questions. Secondly, the concept of clustering is applied to maritime industries in The Netherlands. The paper finishes with conclusions and suggestions for further research.

## 2. Analysing clusters

This section first discusses the definition of a cluster. Secondly, it deals with the issue of identifying and delimiting clusters. Thirdly, it discusses theoretical insights about

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the influence of embeddedness in a cluster on firm performance. Fourthly, it develops a framework to analyse the performance of clusters.

### 2.1. *A cluster definition*

A cluster is defined as ‘a population of geographically concentrated and mutually related business units, associations and public (private) organizations centred around a distinctive economic specialization’.

First, a cluster is a *population*, not an entity. Consequently, the internal heterogeneity of clusters should be taken into account [4]. Secondly, clusters are *geographically concentrated*. This dimension sets clusters apart from networks. The issue of the appropriate geographical unit is discussed later.

Thirdly, the cluster population consists of business units [5], associations, public-private organizations, and public organizations. Associations are defined as ‘organizations that provide services to members’. Associations are included in the ‘population’, if they are ‘cluster specific’, i.e. if the majority of their members is included in the cluster population [3]. Public and public-private organizations (such as education or research institutes) are included in the population if they engage in cluster specific activities. Fourthly, clusters are ‘centred around’ a particular *economic specialization*, that can be regarded as the ‘core’ of the cluster. The notion of a core is implicit in most studies on clustering. Fifthly, clusters consist of business units and associations that are a part of, or relatively strongly related to, the core of the cluster. Such relations are in general both economical and social.

### 2.2. *Constructing clusters*

The delimitation of clusters is not ‘natural’. Rather, clusters are *constructed* [6], both by scientists and by practitioners. Constructing a cluster generally starts by *selecting* a *cluster core* [7]. A cluster core should be relatively primary, in the sense that its location does not depend strongly on the presence of other economic activities. In that case, these other activities are more appropriate as core. Furthermore, a core should consist of a spatial concentration of similar activities. Many firms in the same industry, a relatively large share of an industry in the regional product and a relatively high level of exports [1] are indicators of spatial concentration.

Secondly, the strength of linkages of the core with related organizations is analysed. On the basis of this analysis, a list of *cluster activities* is developed. The following indicators can be used to evaluate the strength of the relations:

- economic transactions with the cluster core,
- use of common cluster resources,
- membership of cluster associations, and
- inclusion in ‘regional learning systems’.

Thirdly, the *relevant cluster region* is delimited. Clusters can be local (for instance a leisure cluster in a city), regional (such as the financial cluster in London), or even interregional (such as the car manufacturing cluster in South Germany). Areas in the proximity of the core region where many economic activities are related to the cluster core [8] are included in the cluster region [9]. Fourthly, the cluster population is defined, consisting of business units associations and public (private) organizations that are *both* strongly linked to the core activity *and* located in the relevant cluster region.

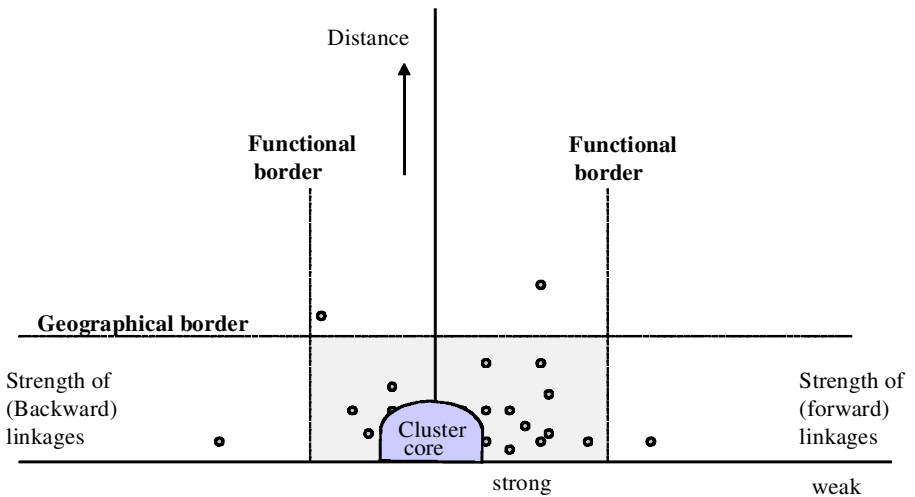


Figure 1. Constructing a cluster.

Figure 1 illustrates the cluster construct. The distinction between forward and backward linkages is used in this figure. This distinction can be of practical use when analysing clusters and rightly points to the importance of *vertical* relations in clusters.

### 2.3. Agglomeration economies

Clusters arise because of agglomeration economies (first discussed by Marshall [10] (p. 268), later applied by Richardson to regional economics and by Krugman to new economic geography [11, 12]). Three agglomeration economies are widely recognized [12]. First, firms cluster together because of the presence of a large *labour pool* inside the cluster. The presence of such a labour pool reduces search costs. Furthermore, such a labour pool allows for the existence of specific training and education programmes, which upgrade the quality of the labour pool. Secondly, firms cluster together because of the presence of suppliers and customers in a cluster. A location in the proximity of suppliers and customers offers cost advantages because of low transport costs. Proximity also enables closer monitoring and frequent face-to-face contacts. Thirdly, firms cluster together because of the presence of '*knowledge spill-overs*' in clusters. Knowledge spills over easier and more rapidly locally, because of frequent interaction and because developments are easily detected locally [13]. These agglomeration economies explain why firms (increasingly) locate in clusters [14].

### 2.4. Cluster performance

The performance of clusters is not simply the sum of the performance of the business units in the cluster [15], but depends on many factors. This paper focuses on *economical* and *institutional* characteristics of clusters. It does not pay attention to national factors, such as wage level or judicial system, government related factors, such as economic policies and industry specific factors, such as growth expectations. The performance of the cluster is measured in value added: a good performance is shown by a rise in the value added generated in the cluster [16]. Two 'growth mechanisms' for the value added in a cluster exist: 'incumbent growth' and 'popula-

tion growth'. The latter is the case when there is a 'entry surplus' defined as more start-ups and entrants than bankruptcies and exits. The former is the growth of firms in the population.

Based on a literature review, a framework has been developed to analyse cluster performance. A distinction is made between variables related to the *cluster structure* and variables related to the *cluster governance*.

Four structural factors that influence the performance of a cluster, either because they enhance the incumbent growth or the population growth, are identified. First, the presence of agglomeration economies influences the performance of a cluster (see section 2.3). The stronger the cluster economies, the better the performance of the cluster. Secondly, *internal competition* adds to the cluster performance because internal competition fosters specialization and, therefore, enhances, from a cluster perspective, the service to specific market segments [1, 13]. Furthermore, competition in clusters is in many cases 'communitarian competition', e.g. not destructive but with a balance between competition and co-operation. Thirdly, *entry and exit barriers* influence the performance of clusters. Entry barriers in general have a detrimental effect on performance, whereas (economic) exit barriers add to the performance of a cluster, because exit barriers 'tie' firms to a cluster. Fourthly, *heterogeneity of the cluster population* adds to the performance of a cluster [17]. Heterogeneity in general adds to performance, because of the opportunities for Schumpeterian 'neue Kombinationen', the opportunities to reduce transaction costs and the 'width' of information spillovers.

Cluster governance is defined as 'the mix of and relations between *different modes of governance*, i.e. mechanisms to co-ordinate interaction in a cluster' [18]. Thus, governance is related to the behaviour of the firms included in the cluster population. Four 'governance related variables' are also identified.

First, the presence of *trust* in a cluster reduces transaction costs. Secondly, the presence of *intermediaries* reduces transaction costs. Thirdly, the presence of 'leader firm behaviour' increases the performance of a cluster, since such firms actively further the interests of the cluster as a whole [19]. The whole cluster benefits from the presence of leader firms, because of 'multiplier effects' and knowledge spillovers. Leader firms have some of the following characteristics:

- firms that engage in structural R&D,
- firms that have access to international markets, and
- firms that have access to international knowledge.

Fourthly, the quality of solutions to collective action problems (CAP's) influences the cluster performance. Collective action problems arise when certain activities are in the collective interest, but may not be undertaken because of the 'free-rider problem': it might be rational for firms not to contribute to these activities, since they cannot be forced to do so [20]. Solutions for such 'collective action problems', for example education and training and innovation, differ between clusters. These solutions can be analysed as 'regimes'. In these regimes, different modes of governance have specific functions. The mix and roles of different governance modes in a regime is *path dependent*. The CAP issue is not discussed in full depth, but is limited to the important issue of the role of *associations* [21]. Such associations act in the interest of their members and provide 'collective goods' to their members. However, associations do not develop spontaneously, because of the CAP [22]. Associations can play a vital role in the governance of clusters. Figure 2 summarizes the framework to

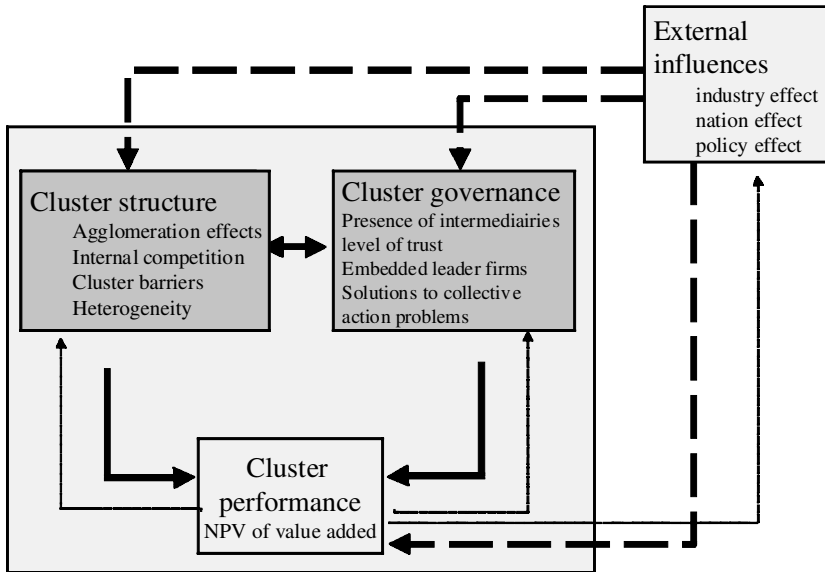


Figure 2. A framework for analysing cluster.

analyse clusters. In section three, we apply this framework to analyse maritime clustering in The Netherlands.

### 3. The Netherlands: maritime clustering and performance

In the empirical part, the theoretical framework is applied to analyse maritime clustering in The Netherlands. First, one presents empirical data on maritime clustering. Secondly, and thirdly, the two research questions are dealt with. To answer these questions, data is presented from a survey amongst firms in the maritime cluster. The sample includes 16 firms, located in the proximity of Rotterdam and active in maritime cargo transport. The author acknowledges that the sample size is too small to draw definite quantitative conclusions. However, the data add to the knowledge of maritime clustering in The Netherlands.

#### 3.1. Maritime clustering in The Netherlands

This section first discusses the studies commissioned by the Dutch Maritime Network, and secondly focuses on the presence of (geographical) ‘cliques’ in the cluster.

3.1.1. *The studies for the Dutch Maritime Network.* The maritime cluster in The Netherlands [23] has extensively been documented in a series of reports commissioned by the ‘Dutch Maritime Network’ and executed by Policy Research Corporation [24, 25]. They have ‘constructed’ [26] a Dutch maritime cluster (DMC) consisting of 11 maritime sectors. This construct is given in figure 3. A major part of the cluster studies consisted of collecting data for each of the identified 11 sectors of the maritime cluster. Table 1 shows some important aspects of the cluster.

The core of the ‘maritime cluster’ is that all activities have to do with the building or operation of *ships*. Activities strongly related to building and operating ships, such

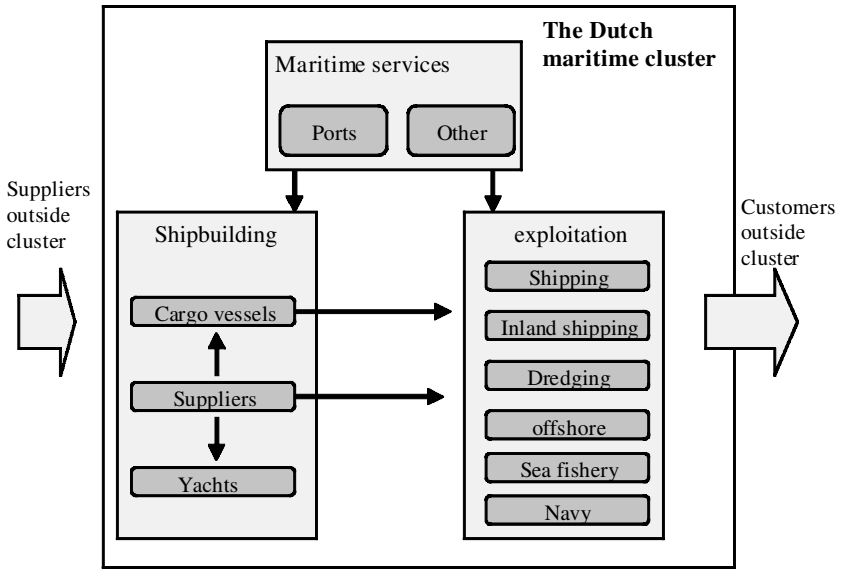


Figure 3. The Dutch Maritime Cluster according to Peeters *et al.* [24].

Table 1. Data on the Dutch maritime cluster.

Sector	Added value (% of cluster total)	Employment (% of cluster total)	Export as % turnover
Shipping	7	4	89
Shipbuilding	6	8	46
Offshore	12	14	49
Inland waterways	8	10	50
Dredging	5	4	57
Ports	29	19	65
Navy	9	13	0
Fishery	3	4	84
Maritime services	7	7	60
Yacht industries	5	8	45
Maritime suppliers	9	9	42
Total	100	100	55
	About 7282 million US\$	137 400 persons	

Source: [24].

as port services, maritime services and ship suppliers are included in the cluster. Although the delimitation makes sense from a practical point of view, the maritime cluster as defined above does not consist of clearly economically related activities. Some activities are tightly interwoven, while others (the Navy and Fishery industry) are more stand-alone. Furthermore, the delimitation of the cluster does not show the strong interrelations of the various sectors with non-maritime activities, such as logistics and trade (these interrelations are acknowledged by DMN, see [24]).

3.1.2. *Geographical cliques.* For the maritime cluster as a whole, The Netherlands is a reasonable geographical delimitation. Since many maritime activities are quite

**Table 2. Concentration of maritime activities in three regions.**

Region	Number of firms in five different industries				
	Shipbuilding	Shipping	Inland shipping	Maritime services	Port services
Rotterdam region	35%	29%	45%	49%	48%
Amsterdam region	14%	13%	15%	19%	23%
Northern Netherlands	17%	40%	7%	3%	10%
Total Netherlands	100%	100%	100%	100%	100%

Source: Statistics Chambers of Commerce [27, 33].

'footloose' they cluster together in specific regions in The Netherlands. Firms in such 'cliques' are more tightly related, and the cliques include relations with other activities. Geographical concentration is analysed, since this is a key indicator of the existence of 'cliques'. Data provided by the Chambers of Commerce enable an analysis of the concentration of maritime activities in certain regions. On the basis of these statistics, three 'cliques' are identified, two in the port regions of Rotterdam and Amsterdam and a 'shipbuilding clique' in the Northern Netherlands. A third, port related clique in Flushing, is hard to detect with national statistics, because the cluster is relatively small. However, an analysis of the share of maritime activities in the region shows that Flushing is a clear clique. Much smaller fishery clusters in a few fishery ports are not dealt with here. Table 2 shows some general data on regional concentration in five maritime sectors [27]:

The cliques in ports consist of port activities, shipping and inland shipping activities maritime services and ship repair activities. Rotterdam is the largest port cluster, with over 70 000 persons employed. Amsterdam is also a 'clique' of substantial size, with ~40 000 persons employed.

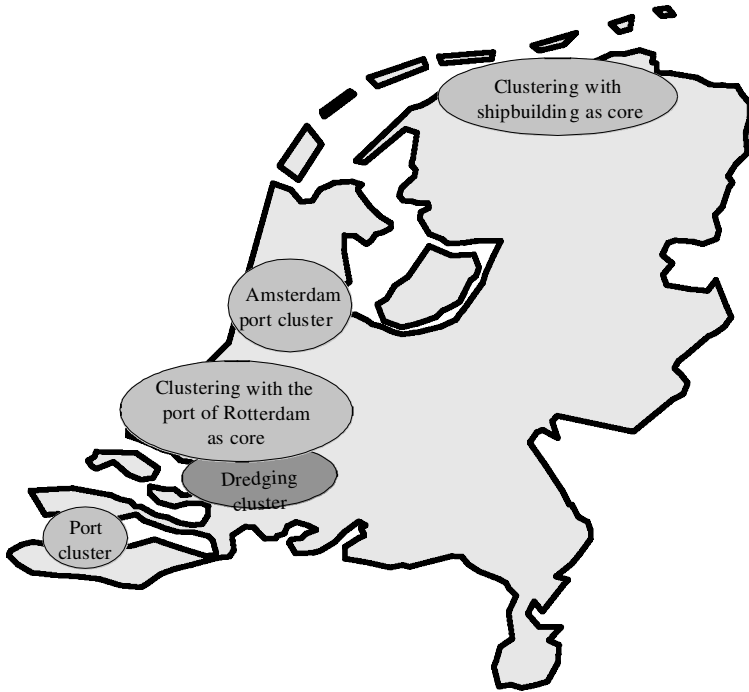
With regard to shipbuilding, a clear 'clique' can be observed in the Northern Netherlands [28]. Shipbuilding is the core of this cluster, suppliers and ship operators are included in the cluster. Finally, the study of the dredging sector provides data that show that the dredging industry is also concentrated in a 'clique' around the 'Drechtsteden' [29, 30]. Figure 4 shows a 'map' of the maritime clustering in The Netherlands.

### 3.2. Performance of the Dutch maritime cluster

A number of variables have been identified, both related to the structure and the governance of clusters, that influence the cluster performance. We discuss agglomeration economies, internal competition, heterogeneity of the DMC and the presence of intermediaries.

3.2.1. *Agglomeration economies.* Three agglomeration economies (proximity of suppliers, knowledge spillovers, and the joint labour pool) are discussed. First, concerning the presence of suppliers, on average 8.1 out of the 10 most important suppliers of the firms in the sample are located inside the cluster. Furthermore, over 50% of the expenditure, on average, is spent inside the cluster. This clearly shows the presence of suppliers inside the cluster. One may conclude that this advantage adds to the competitiveness of firms in the Dutch maritime cluster.





**Figure 4. Maritime clustering in The Netherlands.**

Secondly, Table 3 shows the importance of knowledge spillovers. Local firms provide ~24% of the knowledge of firms in the maritime clusters. Local associations are also an important source of knowledge. The fact that ~40% of the knowledge comes from other actors inside the cluster is a clear indicator of the presence of knowledge spillovers and its effect on the competitiveness of firms in the cluster.

Thirdly, the maritime cluster has a large joint labour pool. The existence of at least 20 different education institutes, specialized in different maritime activities, and the size of the cluster employment, ~135 000 persons, show this.

The empirical evidence suggests that the three agglomeration economies exist in the Dutch maritime cluster. This provides firms with a fertile environment for competing internationally. Firms acknowledge the positive effect of clusters on competitiveness: on a scale from 1 (disagree) to 5 (fully agree) the average score for the proposition 'a strong cluster is of interest for my company' is 3.4. The large

**Table 3. The use of local and non-local knowledge.**

Knowledge source	Percentage information tapped from this source ( <i>n</i> = 16)
Firms inside the DMC	24
Firms outside the DMC	25
Associations in the DMC	14
Associations outside the DMC	8
Others (journals, Internet)	29
Total	100

**Table 4. Number of internal and external competitors.**

Number of competitors	Internal (in the cluster)	External
0	1	—
1–3	6	2
More than 3	9	14

**Table 5. The mode of internationalisation.**

Mode of internationalization	Number of firms in sample
No export	2
Export on demand	5
Offices abroad	3
Profit centre abroad	4
Transnational firm	2

companies in the sample agree stronger than the smaller ones. Furthermore, because of the presence of these agglomeration economies, The Netherlands is a good climate for foreign investment in the maritime cluster.

**3.2.2. Internal competition.** The majority of firms in the cluster face more than three internal competitors (table 4). The number of competitors is related to the fierceness of internal competition. For firms with up to three internal competitors, the fierceness of internal competition is 2.4 on a scale of 1 (weak) to 5 (very strong). For firms with more than three competitors, the internal competition is fiercer, on average 3.9 out of 5. These figures suggest that internal competition is limited for some firms and that the lack of internal competition reduces the fierceness of competition in the cluster and, therefore, the performance of the Dutch maritime cluster.

**3.2.3. The heterogeneity of the DMC.** The heterogeneity of the maritime cluster is analysed on the following dimensions: economic activities, size, international presence, and innovation strategy. The heterogeneity with regard to activities has been shown in the cluster study by Peeters *et al.* [24]. With regard to size, the Dutch maritime cluster includes 163 large firms (over 100 employees). The maritime cluster is very international, as shown by the statistics in table 1 and supported by an overview of the ‘mode of internationalization’ of the firms in the sample (table 5).

Finally, table 6 shows the innovation strategies of firms in the sample. These figures suggest that the cluster is also quite heterogeneous with regard to innovation strategies and more oriented towards organizational innovations than towards technological ones [31]. A study commissioned by the Dutch Maritime Networks [32] also shows the presence of various innovation strategies.

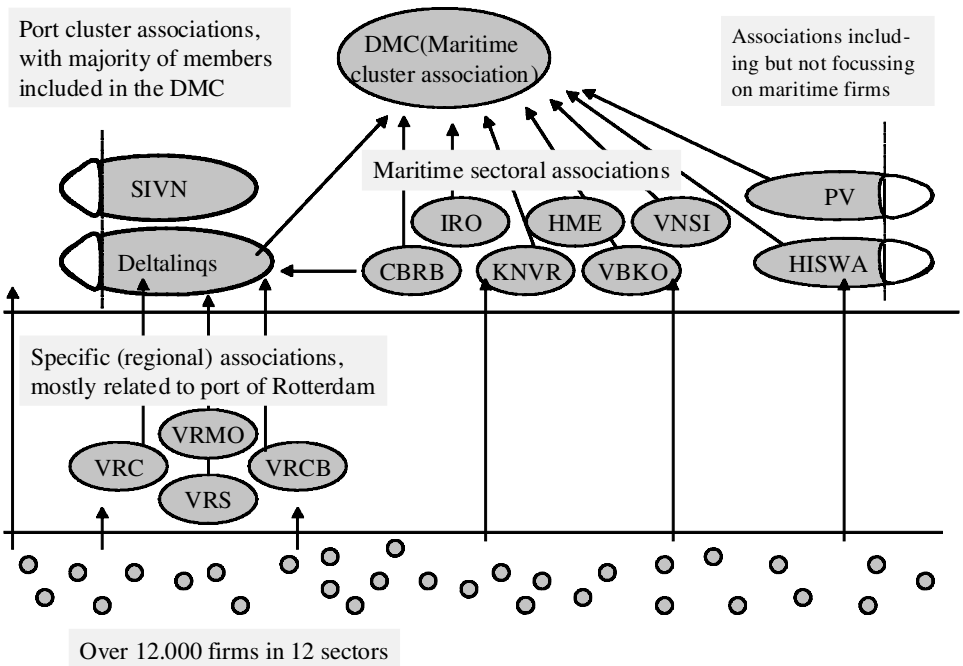
**3.2.4. The presence of intermediaries.** With regard to the presence of intermediaries, only the presence and roles of associations were analysed. The Dutch maritime cluster includes a variety of associations, mostly branch organizations, but also

**Table 6. Innovation strategies of firms in the sample.**

Strategy	Technological innovation	Organizational innovation
Innovator	4	6
Early adopters	3	5
Majority	3	4
Laggards	1	0

knowledge development associations, marketing bodies and meeting platforms. Figure 5 shows the association structure of the DMC.

Table 7 shows the importance the firms in the sample give to different activities associations can perform. Table 7 shows that the intermediary role of associations between firms and governments is regarded as the most important activity. However, clear differences in this respect exist between small and large firms. For small firms,



**Figure 5. The association structure of the DMC.**

**Table 7. Importance of different activities of associations.**

Activities	Importance
Interest representation	2.4
Link to the government	2.8
Diffusion developments in the sector	2.9
Diffusion of innovations	2.9
Meeting place	3.6

Average importance, ranked 1–5, *n* = 16.

the information function of associations is very important, while this function is not important for large firms. The data suggest that small firms regard the search for new information as a proper activity for collective associations. Given the low frequency of interactions between small firms and associations (no more than twice per year), it can be questioned whether associations provide adequate information services.

#### 4. Conclusions

In this paper, the cluster concept was applied to analyse maritime clustering in The Netherlands. Clustering can be observed at different levels. Different maritime industries are clearly clustered in The Netherlands. This cluster includes sectors such as ports, shipbuilding, dredging, offshore and the Navy. At a lower level of aggregation, 'cliques' can be observed. The two ports can be regarded as cores of two large cliques, and the dredging industry and shipbuilding in the Northern Netherlands can also be regarded as cores of regionally concentrated clusters. Furthermore, Flushing is a third, though smaller clique of maritime activities.

The embeddedness of firms in the maritime cluster adds to the performance of these firms. The location in the maritime cluster provides firms with a large supplier base, easy access to knowledge and information and opportunities to reduce transaction costs. The performance of the cluster is influenced by five factors. These factors have been analysed, and results are summarized in table 8.

This paper has presented a framework for analysing the performance of clusters and applied it to maritime clustering in The Netherlands. The empirical data are still limited. Further empirical work would increase the understanding of maritime clustering. Such work should include an analysis of forces promoting concentration in clusters and forces opposing such concentration. Finally, an international comparative study into the relative strengths and weaknesses of various maritime clusters would also add to the existing (limited) body of knowledge in maritime clustering.

**Table 8. Evaluation of the factors of cluster performance.**

Factor	Evaluation
Presence of agglomeration economies	Agglomeration economies related to the presence of suppliers, labour market, existence of knowledge spillovers and low transaction costs are present.
Internal competition	The fierceness of internal competition differs substantially between firms in the cluster. The vast majority of firms face strong international competition.
Entry and exit barriers	Entry and exit barriers have not been studied.
A heterogeneous population	The cluster population of the DMC is rather heterogeneous with regard to the economic activities included in the cluster and includes a substantial number of large firms, internationally active firms and innovative firms.
Cluster governance	The cluster is endowed with a large number of associations. However, their value is predominantly their role as intermediary between firms and governments. An opportunity could be to expand the economic functions of associations (such as diffusion of innovations, marketing etc).

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4. BELUSSI, F. and GOTTARDI, G., 2000, *Evolutionary patterns of local industrial systems: towards a cognitive approach to the industrial district* (Aldershot: Ashgate).
5. Business units are more appropriate units than firms, since (multi-location) firms may be present in various different clusters. Business units can be part of firms ‘outside’ the cluster.
6. Since different cluster cores can be chosen, clusters can *overlap* and include ‘cliques’ or sub-clusters ‘of thick and multiplex networks, with fewer linkages between sub-clusters’ [3]. Consequently, business units can be regarded as ‘members’ of different clusters.
7. The notion of a core is important to delimit clusters, because it allows for the distinction between the core of a cluster and a ‘rim’ around the core. Activities that are strongly related to the ‘rim’ are not included in the cluster.
8. The concept of a ‘relevant region’ is by nature rather imprecise. ‘Natural’ geographic units, such as countries, states or regions are imperfect units of analysis, because of the existence of large cross-border interdependencies (see [12]). It is argued that a perfect geographical unit of analysis does not exist but that the concept relevant region is useful when analysing clusters.
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13. BAPTISTA, R., 2000, Do innovations diffuse faster within geographical clusters? *International Journal of Industrial Organisation*, **18**, 515–535.
14. This paper does not discuss agglomeration diseconomies, forces that oppose geographical concentration, such as land scarcity and congestion. Furthermore, it does not discuss *the reduction of transaction costs*, a fourth agglomeration economy proposed by cluster scholars. This is dealt with later when discussing the governance of the cluster.
15. In fact, these two do not have to be positively related. While the competitiveness of a firm in a cluster might increase if it relocates some activities outside the cluster, this does not add to the competitiveness of the cluster.
16. In fact, these two do not have to be positively related. While the competitiveness of a firm in a cluster might increase if it relocates some activities outside the cluster, this does not add to the competitiveness of the cluster.
17. METCALFE, S., 1998, *Evolutionary economics and creative destruction* (London: Routledge).
18. Value added is taken here in a ‘national accounting manner’: consisting of wages, depreciations and profits. Value added, just as employment, is widely used as indicator of performance.
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21. One does not deal here with the role of public and public-private organizations in cluster governance. The concept of cluster governance is useful for analysing the opportunities and effects of cluster policies. However, since this aspect has not fully been incorporated in the discussion of cluster governance, policy implications are not dealt with in this paper.
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23. In the following, the Dutch maritime cluster is referred to as DMC.
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25. PEETERS, C., LEFEVER, A., VAN DER LINDEN, J., BRUYNSEELS, S. and WEBERS, H., 1999, *De Nederlandse maritieme cluster, beleidsaanbevelingen* (Delft, NL: Delft University Press).
26. The term construct here has to some extent a double meaning: in the process of analysing maritime clustering, two new sector organizations have been set up. In this sense, the theoretical construction of the cluster was to some extent accompanied by the 'practical' construction of the cluster.
27. REACH, 2000, Review and analysis of companies in the Netherlands, datasearch, <http://www.eur.nl/ub/db/icafiles/reach.ica>
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29. Three of the four Dutch globally operating dredging companies are located in the 'Drechtsteden' and about half of the suppliers and other dredging firms as well.
30. PEETERS, C., NIETVELT, J., BRUYNSEELS, S., POUWE, M. and LEFEVER, A., 1997, *De Nederlandse waterbouwsector: economische betekenis en structuur* (Delft, NL: Delft University Press).
31. The data collection was based on the managers beliefs tested with 'control questions' regarding the resources spend on innovations. This method might give a too 'optimistic' impression.
32. EIM, 2000, *De innovativiteit van de Nederlandse maritieme cluster* (Delft, NL: Delft University Press).
33. The absolute figures (number of firms) are not fully reliable, because some firms are classified as maritime, even though in reality they are not engaged in maritime activities. Furthermore, some firms are in fact maritime, but classified more generally, for example as 'consultancy services', or 'trading companies'. Such firms are not included in the figures. The figures might not be fully realistic; the percentages are quite reliable because the shortcomings are not likely to produce differential effects for different cliques.