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Strategy, policy, and the formulation of maritime cluster typologies

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Strategy, policy, and the formulation of maritime cluster typologies

In recent years, clusters of industry have attracted multilateral attention, from academia and practice, alike. Clusters of industry relate to harbouring regional competitiveness; as such, they have come to be considered as important constructs for strategy and policy, that can be deemed as complementary domains. At the same time, maritime clusters are regarded as dynamic cases from a multitude of viewpoints. The concepts of strategic policy, particularly as they pertain to maritime clusters, require deeper understanding and more thorough analysis. In this context, cluster typologies surface as a useful instrument that can offer valuable insight. While this field instils the eventuality of facilitating policy and strategy within clusters, it remains relatively barren. This instance may present the opportunity to better elaborate on the formulation of models and frameworks that address the intricacies within maritime clusters. The research conducted introduces a three-tier framework for the generation of maritime cluster typologies, that bears the potential to enrich strategic management and its eventual policy implications, towards a more streamlined and informed manifestation.

Keywords: strategic management; cluster policy; strategic policy; maritime cluster; cluster typology; framework.

1 Introduction

Industrial clusters have been on the spotlight due to their capacity to improve regional competitiveness, especially in a turmoiled economy. Cluster theory is being currently revisited to attract business, improve competitiveness, and increase the gross regional product. Even more so, maritime clusters are regarded not only as dynamic groups, but are witnessed to attract a broad range of entities and undertakings, not exclusively active in the maritime domain. Maritime clusters are distinctly important, since wherever the maritime industry homes, the locality therein seems to prosper, as the sea provides a wealth of lateral implications for the industry and region. These types of clusters stand out, both as cases of industrial cluster theory, and as cornerstones of regional competitiveness. All the interesting, romantic, and eccentric dynamics of the maritime industry seem to transcend to these clusters, as well. At the same time, from a purely fiscal sense, the industry, though relatively low in financial returns and not that attractive for inexperienced investors, has provided the context for some of the most legendary success stories in business.

The peculiarities and distinctions of maritime clusters have been acknowledged from academia, managerial practice, and policymaking entities, in a converging attempt to foster their healthy materialization, and better develop, organize, and understand them. For these reasons, maritime clusters have been selected as the analytical case for this work. Maritime clusters pertain to dynamic cases that may function as the base for many interesting topics of strategy and policy, for decades to come. One of the reasons enabling this manifestation, may be that the formulation of instruments for the facilitation of strategic management and policy formulation within industrial clusters is a significant field, that remains relatively barren, nonetheless. As the domain has portrayed significant momentum from a variety of viewpoints, it would not be unfounded to expect that industry and academia will tap into this noteworthy sector and relinquish frameworks and models that will assist towards an increasingly stepwise appreciation of these clusters of industry.

The present work aims to contribute within the above domain, through the development of a novel application for strategic policy of maritime clusters. The instrument is founded with the selection of two categorical variables that pertain to a dichotomy of states. Through this dichotomy, a ranking of each categorical variable is performed, to extract a basic contingency table. The subsequent manipulation of the categorical variables will give way towards quantitative methodologies, including statistical treatment, and the calculation of measures of association. By extracting the relative positions of the variables through specific measures of association, clear definitions as to the case at hand can be drafted. In a succeeding step, each measure of association may be assigned to different classes, and depending on the class wherein the calculation resides, relevant typologies will be extracted. These typologies may provide insight as to the intricacies of maritime clusters, and enhance strategic management, policy, and governance.

This paper contributes to the understanding of the cluster classification typologies that facilitate policy and strategy initiatives and frameworks. It does so, through developing a three-tier framework for the formulation of maritime cluster typologies that streamlines the classification of cluster attributes. More precisely, the methodological framework based on this classification of categorical dichotomous variables will initiate statistical hypothesis testing, for the investigation of causality between the variables, and the subsequent formulation of typologies, through the calculation of measures of association. Compared to other studies, this research innovates in terms of introducing a robust framework for the extraction of cluster typologies, that improves the effectiveness of strategic management and business / cluster policies; this, for variables selected ad hoc, insofar conquering a profound level of versatility for the instrument. Therefore, the framework developed not so much challenges previous research, as it rather complements its formulated body of knowledge.

2 Literature Review

2.1 Overview

The agglomeration of economic activity within a region, prevalently coined as an industrial cluster, can be described as an intricate network of firms, within a discretely defined industry. What may set an industrial cluster apart from any other industrial composition, is that the network of firms within the cluster, shares a culture of trust (Dayasindhu 2002) and a common vision (Shinohara 2010); these traits facilitate efficient cooperation and mutually benefiting competition. In addition, the outcome of a cluster's manifestation translates into knowledge creation and constructive innovation (Bell 2005). Through this mechanism, entities with conflicting stakes are seen to co-exist within a locality, wherein, in other terms, their dynamics would mainly exhibit themselves through zero-sum tactics.

Clusters can establish themselves around a core-activity of a variety of industries; though, there are some cluster types that stand out, such as technology, entertainment, and cultural clusters, among others. Due to the extended and dynamic nature of the maritime industry and the fact that maritime industries exhibit many cluster traits, they can be considered as the cornerstones of regional (and/or national) competitiveness, for the localities wherein they reside. In addition, maritime clusters provide a fertile spawning ground for many scientific domains, wherein theories may be tested and models along with frameworks may be formulated and assessed. Outstanding examples of these domains, are strategic management and policy, as they seem to share many fraternal characteristics (Cohen and Ernesto Amorós 2014; Jasper and Crossan 2012; Munian and Subramaniam 2009; Ramia 2003). Policy making entities have provided distinct effort and support in the crystallization of both generic and specific maritime clusters (De Langen 2006; DG MARE 2008; Pardali, Kounoupas, and Lainos 2016; Zagkas and Lyridis 2011).

From the widely-accepted instigation of industrial cluster theory, with Alfred Marshall's (1920/1890) economies of agglomeration, to its modern germination, that many times revolves around Michael Porter's (2000) contributions, a situation in twain can be observed. On the one hand, the theory has firmly grasped that clusters of industry can be deemed as very important locational constructs, for they may hold the key of a definitive competitive advantage (Doronina et al. 2016). On the other hand, clusters of industry are riddled with paradox; this cluster characteristic renders their eventual deconstruction, at times, elusive. This situation arrives to the point that any generalization with respect to clusters may hold its own caveats and be, ultimately, erroneous. Cluster paradox, can be witnessed within Porter's 'location paradox,' all the way back to Marshall's work and his cryptic notion, regarding the beneficial attributes that are passed on within clusters among generations, as if they are 'in the air.'

Within this context, the disciplines of strategic management and policy find very resonating applications. With respect to the management of strategy within clusters, a unifying extract would be that corporate growth strategies shoot for the stars; and get there; since growth is a predominant feature within clusters of industry. Within a business strategy context, differentiation strategy seems to guide operations. The cluster steers firms towards competitive dynamics that blossom into innovation, which in turn creates new needs, ideas, and markets. At the same time, a cluster cannot move to present these advantages, without the facilitation of policy and governance (De Langen 2004; Stavroulakis and Papadimitriou 2016). As one could conclude that the importance of strategic management and policy within a cluster cannot be overstated, at the same time, strategy and policy seem to morph into a complementary concept. The latter could be coined as strategic policy (herein, strategic policy refers to the complementary nature of strategic management, policy, and governance; thus, it pertains to a unifying construct).

If the objective was to contribute to the field of strategic policy for industry clusters through model and framework development, a cluster type could be selected, as a baseline. This selection would facilitate the process of needs' assessment through a narrower and more streamlined scope, thereby assisting the specialization and targeting of the instruments formulated. At the same time, lest extremely differentiated cases, nothing would restrict the constructs from being applicable to generic clusters, as well. Herein, the maritime domain provided the instigation for the extraction of the framework introduced, though the latter could find pertinent applications within other clusters.

As already hinted to, the domain of analytical models and frameworks for generic industrial clusters, and maritime clusters specifically, remains to be harvested. The framework within, provides a contribution to the domain of strategic policy for maritime clusters, as it provides a floor-to-ceiling integrated and versatile construct. Its integration can manifest from a multilateral potential of applicability, as its impact on scholarly knowledge, as well as managerial practice, can prove significant. The framework can pertain to a stepping stone for theoretical and empirical practice, as it can provide a reference point to test and assess theories. The latter may benefit from its array of straightforward, yet evidence-based methodologies. At the same time, the framework is structured upon the ad hoc selection of the variables within. Therefore, the case requirements will formulate the instrument, not the other way around; this fact provides a versatility to the construct that may be the reason for its eventual effectiveness. Strategy and policy are both domains that are structurally fluent; they require high levels of adaptability and responsiveness, as their reason of existence is the perpetual change that is embedded in nearly all of nature's systems. For this reason, versatile instruments can provide definitive contributions to topics of strategic policy, from an academic and a managerial perspective. The work relinquished aspires to contribute in this direction, and as such, its importance, impact, and potential may be assessed.

2.2 Strategic policy and industrial cluster typologies' review

Industrial clusters hold a distinct effect upon the firms within, and provide dynamic cases that can facilitate the extraction and documentation of strategic decisions (Gu 2008). These decisions can surface from the domain of strategic management, for an industrial cluster, with diverse and novel instruments (Kim et al. 2014). Strategic management has found an important ally with respect to clustering within an industry (Magay 2014), though its effects spill-over many other disciplines and aspects, such as knowledge management (Lai et al. 2014) and policy (Chen, Chien, and Lai 2013). As innovation is a direct corollary of a healthy industrial cluster, specific strategies that instigate different types of innovation may be investigated (Kachba, Hatakeyama, and Ferreira 2012). Through these methodologies, a synergy may be achieved between strategic management applications and the cluster case, to explore many other instances of the cluster's innovative aspects, as well.

The spatial configuration of industries can be reviewed effectively with the extraction of typologies (Lachininskii, Lachininskii, and Semenova 2016), since the latter facilitate the assessment of strategic decisions within the context of industries (Park and Ahn 2012). Typologies themselves may be the object of examination, as they are found to be dynamic implements, that may coexist in harmony within the particularities of an industrial cluster (He and Fallah 2011). Many proposed typologies can be retrieved, for a diverse array of industrial cluster formations (Nosova 2013). These typologies may relate not only to the cluster itself, but to its origins and resources (Evaldo Fensterseifer and Rastoin 2013), in addition to the latter's renewal process

(Samaganova 2009). The typology formulated can aid the health of the cluster, or the discrete strategic decision of firms within (Zelbst, Frazier, and Sower 2010).

A variety of methods to address typologies of industrial clusters can be accessed within the literature. These range from qualitative constructs (Markusen 1996), to quantitative (Tristão, Oprime, and Pimenta 2016) and combined, hybrid approaches (Naghizadeh et al. 2015). These typologies can facilitate a wide range of functions, from strategic-decision applications for emerging economies (Baron-Gutty, Figuière, and Simon 2009), local value creation and upgrading (Edgington and Hayter 2013), to corporate social responsibility (CSR) and human rights within industrial clusters (Giuliani 2016). The study of industrial clusters within a typology perspective can extend to the formulation of typologies for distinct cluster parameters, such as innovation (Becerra Rodríguez and Naranjo Valencia 2008; Gong, Jiang, and Greeven 2012), regional competitiveness (Cappellin 2012), intrinsic cluster dynamics (Caniëls and Romijn 2005), and cluster life-cycle analysis (Handayani et al. 2012). In addition, cluster typologies can be rooted within the generic agglomeration economies themselves (Zelbst, Frazier, and Sower 2010) and can be utilized for the comparison of different industrial clusters (Pedersen 1994). The literature referring to industrial cluster typologies that resonates with the research conducted herein, has been included within Table 1. As can be extracted, the field of typology formulation for industrial clusters is diverse, utilizing many different methodologies, to address as many different topics.

Table 1. *Selected literature on industrial cluster typologies.*

Contributor(s)	Premise	Methodology / Specifics
Baron-Gutty, Figuière, and Simon 2009	Typology for clusters in emerging economies	Industry cluster case study in Thailand
Becerra Rodríguez and Naranjo Valencia 2008	Typology for innovation	Graphic models – system of innovation both for the production system and individual firms

Caniëls and Romijn 2005	Typology for learning and innovation	Local knowledge spill-overs and regional innovative activity
Cappellin 2012	Typology for regional competitiveness	Different policy fields
Edgington and Hayter 2013	Typology of direct foreign investment clusters	Portray commitment to local value creation and upgrading
Evaldo Fensterseifer and Rastoin 2013	Typology formulation for cluster resources	Mapping of a cluster's resources' profile
Giuliani 2016	Typology with extended applicability	CSR and human rights in developing countries
Gong, Jiang, and Greeven 2012	Typology for innovation platforms	Comparative case study in China
Handayani et al. 2012	Typology for cluster life-cycle analysis	Delphi method employed to extract and assess typologies
He and Fallah 2011	Typology assessment	Mixed typologies prevalent in clusters / shaped by the industry
Kachba, Hatakeyama, and Ferreira 2012	Innovation types in clusters	Consolidation strategies and innovation management
Lachininskii, Lachininskii, and Semenova 2016	Typology formulation	Geoeconomic elements (transport hubs, complexes, and areas) are determined
Markusen 1996	Typology assessment	Typology of industrial districts
Naghizadeh et al. 2015	Regional typology assessment	Combination of quantitative (co-word analysis) and qualitative (meta-synthesis) methods
Nosova 2013	Typology formulation	Cluster formation mechanisms
Park and Ahn 2012	Typology for strategic decision assessment	Typology model for the analysis of strategic environmental management types
Pedersen 1994	Typology of enterprise clusters	Cluster comparison
Samaganova 2009	Typology of resources	Renewal process of territorial resources to analyse cultural resources in a software industry cluster
Tristão, Oprime, and Pimenta 2016	Typology of industry clusters	Descriptive statistics and multivariate exploratory methods
Zelbst, Frazier, and Sower 2010	Typology of cluster concentrations	Agglomeration economies, location, and strategic decision assessment

As typologies provide effective instruments for strategic policy within clusters of industry, one could pursue the formulation of typology generating methodologies, that stem from the study and needs of a specific domain. This process would venture to apply the benefits of generic typologies' formulation, to a designated type of industry cluster. For example, if one was to formulate instruments to be applied to maritime clusters, attention should be directed to the fact that the sector is highly cyclical, and therefore, instruments for strategic policy should be very versatile. The maritime industry provides instances of near-perfect competition, and at its heart, holds a tremendous effect and impact upon the economy that encapsulates its activities (Lee at al. 2014). For these two industry-specific reasons, it is not surprising that maritime clusters pertain to special-interest cases, within the domain of clusters of industry. Of course, this goes not to assume that clusters of other industries do not hold lateral interest. In fact, clusters of many activities and origins, extremely differentiated from the maritime sector, have exhibited astounding merit. But, simultaneously, one could accept, that maritime clusters provide a coherent base for the analysis of strategic policy topics (Wu et al. 2016), even from the most definitive perspective (Doloreux 2017). Literature has already extracted that policy is an important aspect of the maritime domain (Roe 2007), as well as, maritime clusters (Doloreux and Melançon 2006; Doloreux and Shearmur 2009; Pinto, Cruz, and Combe 2015).

A subsequent factor that may render the selection of maritime clusters as a desirable case, is that the concentration of maritime activities assists cluster visibility and formulation (De Langen 2002). Another relevant factor is the fact that the maritime sector, most of the time, provides outstanding differentiation within a regional economy, towards its sustainable competitive advantage (Doloreux, Shearmur, and Figueiredo 2016). This fact draws resonance to the point that a maritime cluster's present or potential manifestation may be the reason behind a region's not only regional and national (Chang 2011), but international competitiveness (Jenssen 2003). At the same time, competitiveness within clusters can reach novel lengths, to render notions of sustainable competitiveness (Shinohara 2010). Correlations with many other implicative factors, such as policy and governance (Doloreux and Shearmur 2009), play an important part as well, within a maritime cluster's contextual setting.

Within these types of clusters, classifications, taxonomies, and typologies can pertain to facilitating the analysis of a diverse array of facets, in addition to providing the baseline for the formulation of models, for the implementation of policy and strategy, as well as their eventual forecasting (Stavroulakis and Papadimitriou 2017). These may include typologies of innovation within maritime clusters (Makkonen, Inkinen, and Saarni 2013), benchmarking and differentiation frameworks among different clusters (Monteiro, De Noronha, and Neto 2013), as well as types of materialization paths (Fløysand, Jakobsen, and Bjarnar 2012). Typologies can be useful when classifying maritime clusters, to analyse their evolutionary potential, and extract models that govern their rudiments and evolution (Zhang and Lam 2013); these may extend to pertinent empirical investigations (Zhang and Lam 2017). Consequently, a typology generation methodology can be further utilized to formulate novel strategic directions (Salvador 2014). Thus, strategic and policy directions within maritime clusters can be well fortified through the utilization of typologies. Simultaneously, the field may benefit from the formulation of new frameworks and models to create and assess maritime cluster typologies. The literature with reference to maritime cluster typologies compiles Table 2. As with generic industrial clusters, differentiation and versatility is prevalent, within this subdomain of industrial cluster research.

Table 2. *Selected literature on maritime cluster typologies.*

Contributor(s)	Premise	Methodology / Specifics
De Langen 2002	Conceptual framework	Instrument for maritime cluster analysis
De Langen 2006	Typology of stakes	Conflicts of interest in port clusters
Fløysand, Jakobsen, and Bjarnar 2012	Typology for maritime cluster manifestation	Types of development paths for maritime clusters
Makkonen, Inkinen, and Saarni 2013	Typology for innovation	Statistical survey methods to investigate types of innovation in the Finnish maritime cluster
Monteiro, De Noronha, and Neto 2013	Typology – differentiation framework	Differentiation framework for maritime clusters – cluster comparison
Salvador 2014	Typology for strategic decision assessment	Maritime cluster types comparison
Stavroulakis and Papadimitriou 2016	Strategic factor topology	Grouping of strategic factors for maritime cluster formulation and competitiveness
Zagkas and Lyridis	Benchmarking framework	Framework for model development and benchmarking
Zhang and Lam 2013	Typology for cluster evolution	Maritime cluster classification and evolution
Zhang and Lam 2017	Typology for cluster evolution	Empirical investigation of maritime cluster evolution

Since the theory of industrial clusters is inherent with paradox, the elaboration on typologies can facilitate the disengagement of obscurity within scholarly research, and managerial practice. By doing so, both strategy and policy will be warranted with an effective ally, that may provide a complementary level of analytical clarity for the case at hand. From a structured literature review in the matter of generic cluster typologies and maritime cluster typologies, one may conclude that on the one hand, the topic is rich and filled with potential and on the other, that maritime cluster research may be considered as situated at its germination phase. Therefore, the domain of maritime studies may benefit substantially from the formulation of constructs that facilitate the extraction of typologies, for effective strategic management and business /

cluster policy. Towards this aim, the present work relinquishes a novel instrument for the extraction of maritime cluster typologies, that may prove effective in generic strategic policy applications as well. The extended versatility required for effective application within the maritime domain, is acquired through the ad hoc selection of the categorical variables that will compile the construct. Through this process, this work pertains to a pure framework, as the analysis at its planning phase, is completely free to select and scrutinize any matter of relative impact, without any methodological constraint imposed by the framework itself. At a subsequent step, the variables selected, will be statistically treated to investigate causality of the latter, with the application of statistical decision tests. With this formulation, the unhindered selection of the variables is then processed with robust techniques, in a way that the analytical results may be compared, assessed, and employed. Therefore, it would not be unwarranted to assess that the resonating impact of the methodology may spill-over to and interlock with, maritime cluster requirements.

3 Formulation of maritime cluster typologies

3.1 Devising the framework

The methodological construct presented herein will initiate with the selection of two categorical dichotomous variables, pertinent to the strategic policy case of the maritime cluster. These variables can be selected on a case-by-case basis and/or can be accessed within the pool of strategic factors that accentuate competitiveness, per maritime cluster literature (Stavroulakis and Papadimitriou 2016). The objective is to compile a simple two-by-two contingency table. If the first categorical variable was to be designated as 'Y' and the second as 'X,' then the cross-tabulation of these variables would render the contingency table of Figure 1.

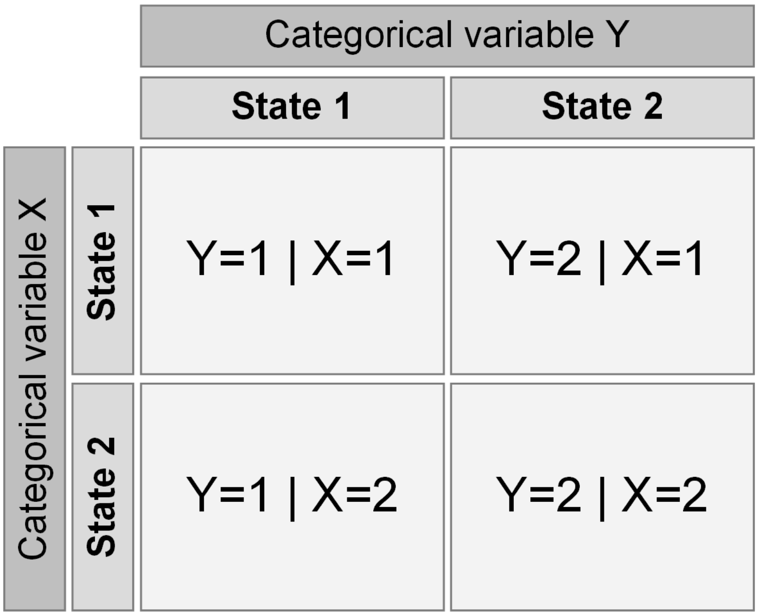

Figure 1. *The formulation of the contingency table (source: authors, Visio™ output).*

The four states of the contingency table will include all possible combinations of the variables, in states 'one' and 'two,' respectively. The first state will find categorical variable 'Y' in state 'one' and categorical variable 'X' in state 'one' (Y=1 | X=1); the second state will have categorical variable 'Y' in state 'two' and categorical variable 'X' in state 'one' (Y=2 | X=1); the third state will include categorical variable 'Y' in state 'one' and categorical variable 'X' in state 'two' (Y=1 | X=2); whereas the fourth will access categorical variable 'Y' in state 'two' and categorical variable 'X' in state 'two' (Y=2 | X=2).

Through this simple contingency table and the cases of each possible state within, statistical hypothesis tests and measures of association may be extracted. A designation as to the relationship of the samples can be accorded, as paired (dependent samples) or unpaired (independent samples), to proceed with statistical hypothesis testing. This will investigate causality (dependence) between the two categorical variables and therefore widen the analytical scope, as causality is an important aspect with many lateral implications to both policy and strategy. For a given significance level, with McNemar's test (for paired samples), the null hypothesis will pertain to the equality of the marginal probabilities, per H_0: P (Y=2 | X=1) = P (Y=1 | X=2). If the samples were considered unpaired, Pearson's chi-squared test would render the null hypothesis of H_0: P (X=i, Y=j) = P (X=i) P (Y=j). Let (Ω, F, P) pertain to the probability space, wherein results are designated with 'Ω,' events with 'F,' and the probability function with P: F → [0, 1]. Per Kolmogorov's definition, the conditional probability of the 'i' event, given that the 'j' event has occurred, is P (i | j) = P (i ∩ j)/P (j), if P (j) > 0. Per Bayes theorem, P (X | Y) = P(X) P (Y | X) / P(Y); thus, the initial null hypothesis of Pearson's chi-squared test is rendered to H_0: P (j = 1 | i = 1) = P (j = 2 | i = 2), essentially comparing two conditional probabilities.

These statistical decision tests will facilitate the investigation of internal causality of the variables and by extension, can provide relevant insight. Since binary causality has been investigated, the analysis may proceed to the calculation of measures of association. For example, one may consider the risk ratio that begins with an attack rate calculation, for each state of the categorical variable. For variable 'X,' two attack rates are calculated. For state 'one,' the attack rate would be calculated as 'Y=1 | X=1' / ('Y=1 | X=1' + 'Y=2 | X=1'), whereas for state 'two,' the attack rate would be extracted as 'Y=1 | X=2' / ('Y=1 | X=2' + 'Y=2 | X=2'). The division of these two attack rates, results in the risk ratio. The attack rate for state 'one,' would pertain to the cases in state 'one' for variable 'Y' given that they are in state 'one' for variable 'X' as well, to the total 'population' in state 'one' of variable 'X.' This would signify the tenacity of the 'Y' cases, that are included in the state of variable 'X.'

Accordingly, the remaining attack rate will portray the same concept, but for the cases contained within state 'two,' of the categorical variable 'X.' It would be calculated as the cases of state 'one' of categorical variable 'Y,' given that they are within state ‘two’ of variable ‘X,’ to the total number of cases of state ‘two,’ within variable ‘X.’ The division of these two attack rates will render the risk ratio, that as a measure of association, will present itself as the risk of state ‘one,’ to the risk of state ‘two’, within variable ‘X.’ By selecting a threshold, and depending upon where the measure of association will fall within the latter, typologies can be created. A simple typology of three categories is portrayed in Figure 2. The symmetrical region around the threshold (α) is designated as neutral and pertains to Type I; this region’s extent is selected depending on the analytical requirements of the case. A value greater than the threshold plus half the neutral region will give Type III, whereas a result less than the threshold minus half the neutral region will refer to Type II.

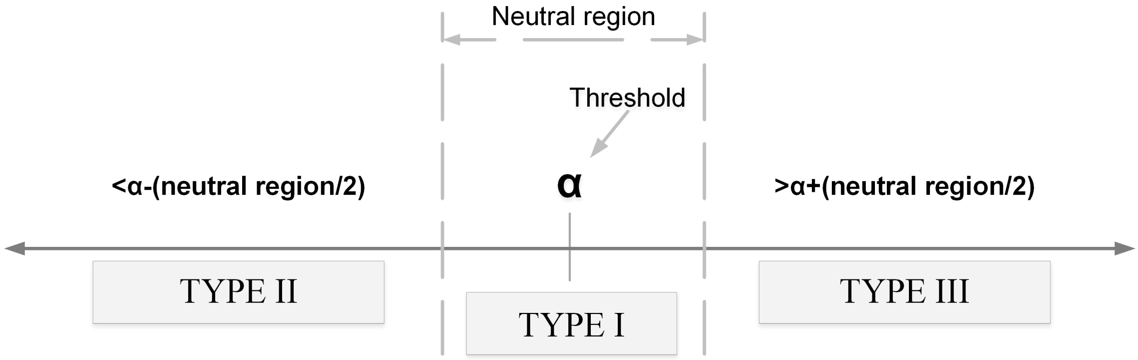

Figure 2. *A typology with tree regions (source: authors, Visio™ output).*

Adjacent to the attack rate and risk ratio calculations, the odds ratio (‘Y=1 | X=1’ / ‘Y=1 | X=2’) / (‘Y=2 | X=1’ / ‘Y=2 | X=2’) can be extracted, as well. This will calculate the odds of state ‘one’ of ‘X’ and ‘Y,’ to state ‘one’ of ‘Y’ and state ‘two’ of ‘X,’ to the odds of state ‘two’ of ‘Y’ and state ‘one’ of ‘X,’ to state ‘two’ of ‘Y’ and state ‘two’ of ‘X.’ The odds ratio will designate the likelihood that one variable’s state has been affected by the other variable. Therefore, the analytical aspect is granted with two measures that can effectively portray the extent of association between the two categorical variables. Attention should be directed to the confidence intervals of each measure; the approximation of risk for each variable must be treated accordingly, so as not to deliver the analysis to unfounded conclusions.

The framework generated pertains to three tiers. The first is relinquished with the selection of the variables and the compilation of the contingency table, including its marginal, joint, and conditional probabilities. The second tier includes statistical hypothesis testing, that ensues with the calculation of measures of association - the third tier. By way of a discrete calculation, a marker may be assigned to the degree of the effect and this outcome may be included within a classification of a typology, that has been extracted through the selection of a pertinent threshold and suitable regions; these will signify the different categories within the typology. The framework presented herein does not restrict the selection of any number of regions, as they can extend symmetrically from the threshold, to any value required. A three-region typology has already been presented in Figure 2, whereas a five-category typology is included in Figure 3. A mid-region has been included, that introduces two more categories in the typology. In this manner, the regions may be selected and tailored, according to the analytical depth and diversity required.

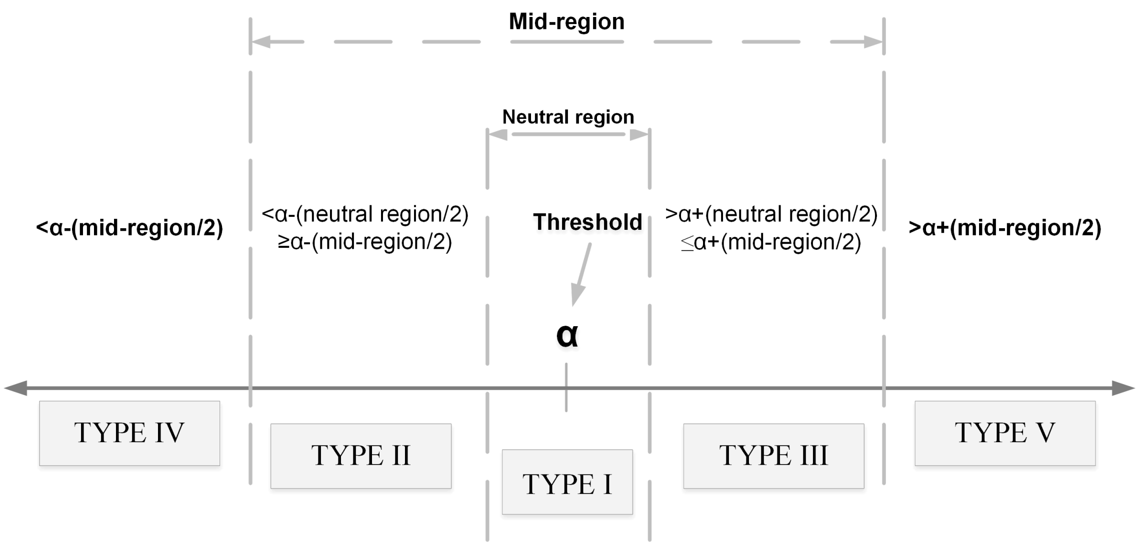

Figure 3. *A typology with five regions (source: authors, Visio™ output).*

Through the inclusion of the result within a typology, effective and educated strategic and policy directions may be drafted; in addition, the case may be monitored over time and assessed within a longitudinal perspective. At the same time, different cases may be considered and compared. Since the categorical variables are not fixed, but selected for each case, ranges of typologies may be generated, each with a specified portrayal, that may assist the management of strategy and the formulation of policy, within a maritime cluster. The instrument aims at including scientific robustness within a simple and functional construct and in this respect, it may have succeeded.

3.2 Demonstration of the framework

A demonstration of the framework's functionality is as follows. To initiate the analysis, two categorical variables are selected. For an indicative example, the first ('Y'), could be the variable of 'sustainable innovation.' This variable may hold specific metrics to extract its presence or absence, based on (including but not limited to) a firm's track record, the internal processes that lead to knowledge creation, the output with respect to innovative products and services, etc. The question to be answered, is how much the dichotomous variable of proximity with the cluster's members ('cluster proximity' = 'X'), may stand to affect the variable of sustainable innovation (= 'Y'). Within the literature, there are many instances where innovation has been documented to play a crucial role within cluster dynamics. Innovation itself may relate to different manifestations and characteristics, but somehow, it seems to be always pertaining to a major cluster component. But within this cluster constant, one may wish to calculate exactly how much cluster proximity may affect the existence of innovation. The instrument formulated herein can model this process and (for a given significance level) provide conclusive answers with respect to the variables' causality. In addition, the typology formulated may pertain to (indicatively) three possible states of the maritime cluster, per the extraction of the risk and odds ratios, and the selection of a relevant threshold (herein, the value of $\alpha = 1$).

A result close to the threshold may deem the cluster as neutral, whereas a result higher than the threshold will portray the cluster as relating to 'volatile innovation;' a result lower than 'one' will signify 'uncorrelated innovation.' The latter will represent the (interesting, but regrettable) state of a cluster, that is hampering the innovation of its members; an instance that would deem an unhealthy, or inefficient, maritime cluster; an occurrence not impossible, as cluster pitfalls have already been documented (Held 1996; Hutton 2004; Martin and Sunley 2003). The typology may have a linear portrayal, as in Figure 4. A region within the proximity of the threshold must be selected to designate when the result will pertain to cluster neutrality; this can be left up to the analytical sensitivity required.

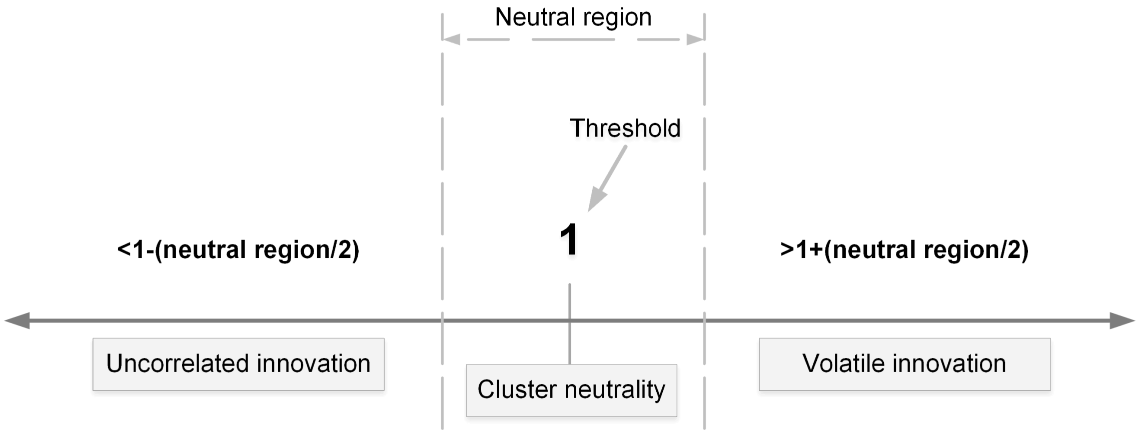

Figure 4. *The maritime cluster typology (source: authors, Visio™ output).*

After the selection of the categorical variables, one must move to document the cases within each of the four categories of the contingency table. The methodology of documentation and extraction of the cases must be specific, following a predetermined protocol, so that the analysis can be valid and reliable. After the extraction of the categorical variables and the formulation of the framework for the rudimentary contingency table, the cases are collected and summed, per study protocol. For the example that is presented herein, the initial number of cases portrayed derive from a random number generator, solely for the purposes of demonstrating the methodology. Though the initial values are randomly generated, the methodological application remains factual.

The cases of this example are presented in Table 3, along with the marginal, conditional, and joint probabilities of the contingency table. Per the framework, the four potential cases signify the possible states within the Table. The 'Y=1 | X=1' state shows sustainable innovation, given cluster proximity. State 'Y=2 | X=1' represents the absence of sustainable innovation, given cluster proximity. State 'Y=1 | X=2' signifies sustainable innovation without cluster proximity and state 'Y=2 | X=2' portrays the absence of sustainable innovation without cluster proximity. Since the crosstab has been compiled, the analysis can proceed to the tiers of statistical hypothesis testing and the calculation of measures of association.

Table 3. *'Cluster proximity' and 'Volatile innovation' crosstabulation (source: authors, SPSS™ output).*

Tier 1 Crosstabulation			**Volatile innovation**		**Total**
			yes	**no**	
Cluster proximity	**yes**	**Cases**	**135**	**18**	153
		% within Proximity	88.2%	11.8%	100.0%
		% within Innovation	71.8%	17.3%	52.4%
		% of Total	46.2%	6.2%	52.4%
	no	**Cases**	**53**	**86**	139
		% within Proximity	38.1%	61.9%	100.0%
		% within Innovation	28.2%	82.7%	47.6%
		% of Total	18.2%	29.5%	47.6%
Total		Count	188	104	292
		% within Proximity	64.4%	35.6%	100.0%
		% within Innovation	100.0%	100.0%	100.0%
		% of Total	64.4%	35.6%	100.0%

Per statistical hypothesis tests, McNemar's test (for paired samples) and Pearson's chi-squared test (for unpaired samples), will provide the results presented in Table 4. This process pertains to the investigation of the variables' internal causality, the second tier of the framework. Both statistical hypothesis tests have revealed that, for a significance level of 5%, the null hypothesis of the variables' independence, is rejected. Therefore, for the given case, cluster proximity is statistically correlated with innovation. From this preliminary, yet statistically significant find, the analysis can proceed to the formulation of typologies, through the calculation of measures of association. These will quantify said correlation and portray an exact numerical designation as to the degree of the variables' causality. Through this methodology, the binary result of the statistical hypothesis testing is normalized within the elaborate setting of a typology. The process may be interestingly considered to resemble digital-to-analog conversion, as the binary result of 'reject' or 'fail to reject,' is enriched with specific metrics that range within a typology drafted for the specific case.

Table 4. *Statistical hypothesis tests for the devised case (source: authors, SPSS™ output).*

Tier 2 **Statistical hypothesis tests**	Value	Asymptotic significance	Exact significance
Pearson Chi-Square	79.740	0.000	
McNemar Test			0.000

Notwithstanding, the third tier of the framework can be extracted, even if there is no statistical significance from the preceding statistical hypothesis testing. The rejection of the null hypothesis can lead to the conclusion of statistical significance, that translates into variables' dependence. If the null hypothesis cannot be rejected, then it would be critical to provide more insight as to the variables' intrinsic dynamics; one that the measures of association are able to provide. With this rationale, the third tier of the instrument may act as a backup calculation for the cases wherein the analysis has failed to reject the null hypothesis. For the devised case, the odds ratio compares the odds of exposure to the cluster within the innovative cases, to the odds of exposure to the cluster, within the non-innovative ones. It is calculated as equal to 12.17 (Table 5), thus portraying that the odds exhibiting the fact that the innovative firms will be proximate to the cluster, are more than twelve times the odds that the innovative firms will not be proximate to the maritime cluster.

Table 5. *Measures of association for the devised case (source: authors, SPSS™ output).*

Tier 3 Measures of association	Value	95% Confidence Interval	
		Lower	Upper
Odds ratio	12.17	6.68	22.16
Risk ratio	2.31	1.86	2.88

For the risk ratio calculation, the attack rate for variable ‘X’ and state ‘Yes,’ is extracted as equal to 135 / (135+18) = 0.88 and the attack rate for variable ‘X’ and state ‘No,’ is equal to 53 / (53 + 86) = 0.38. Thus, the risk ratio (referring to a taxonomically similar, yet conceptually divergent interpretation to that of the odds ratio), with respect to ‘cluster proximity’ and ‘sustainable innovation’, will be equal to 0.88/0.38 = 2.31 (Table 5). A risk ratio such as this, will signify that a firm exposed to cluster proximity, has 2.31 times higher chance (probability) to engage in sustainable innovation, exactly because of its proximity to the cluster. Therefore, due to the results of the measures of association, the maritime cluster’s classification within the typology, is deemed as ‘volatile innovation.’ Both measures of association may be portrayed in the linear representation of the typology, as in Figure 5, where a neutral region of two tenths (1/10 bilaterally) around the threshold ($\alpha = 1$) has been selected.

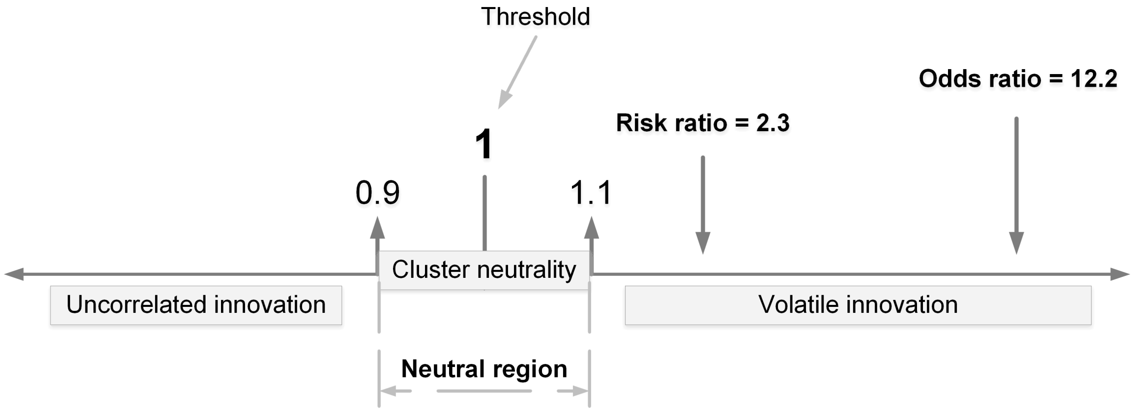

Figure 5. *The risk and odds ratios within the maritime cluster typology (source: authors, Visio™ output).*

Calculations such as the above may be conducted in fixed points in the future, to monitor their results within a temporal perspective and draft strategic policy directions accordingly. These sets of metrics portray cluster health, so they may pertain to the monitoring mechanism that can inform per the implementation necessity of mitigative strategies and/or invasive policy. Other strategic groups of dichotomous categorical variables may be selected, to assemble a monitoring array of strategic indicators for the maritime cluster. This collection of indicators can be used to compare typologies between different maritime clusters, as well. The framework presented can provide analytical clarity and insight, that may, extensively and cost-effectively, facilitate the process of strategic management and policy formulation for a maritime cluster.

4. Conclusions

Clusters of industry form cases of proximate agglomeration that are considered to pertain to sustainable competitive advantages for their respective regions. Within these constructs, strategic management and policy, find a dynamic arena of applicability, with a definite potential for the generation and assessment of novel models and frameworks. Clusters that are formulated with a central aspect akin to the maritime industry, demonstrate resilient instances of strategic might, since the maritime sector revolves around an economy of near-perfect competition, wherein networks of trust can lead to sustainable innovation and prosperity-designating competitiveness. From a maritime cluster's vantage point, the domains of strategic management, policy, and governance benefit from the formulation of typologies, for documenting, assessing, and monitoring an array of aspects. The work herein pertains to this field of interest.

A framework for the generation of typologies is presented, that provides the autonomy to select two categorical variables, in accordance to the strategic policy interest of the case at hand. Since the methodology is flexible and does not prerequire a determined set of variables, it can be applied within a wide array of cases. After the dichotomous categorical variables are selected, their case count is included within a two-by-two contingency table. Through this table, statistical hypothesis tests and measures of association may be calculated, that render the case within a given typology. From the extraction of typologies, the case may be observed in a longitudinal perspective, assisting the process of strategy and policy formulation; in addition, it may be compared to other maritime cluster cases. The methodology is limited from the validity and reliability of the protocol followed. Its effectiveness is based on the validation of the raw data acquired and respective caution is advised with reference to its robustness. Nevertheless, the model is considered particularly relevant to the maritime sector due to the breadth of business entities participating in maritime clusters. The flexibility of the framework provides an inclusive methodology for the diversity, heterogeneity, spatial, and temporal focus of maritime clusters.

From an academic viewpoint, the domain of frameworks and models for the strategic policy of maritime clusters, may stand enriched. Subsequent research can focus on the collection of data from factual shipping and maritime firms' active within clusters and relinquish novel typologies based on predefined sets of categorical variables. Through this process, the value of the typology generating methodology that is presented herein, may manifest itself in a practical perspective. From this standpoint, the analytical approach proposed, enhances current literature by effectively documenting, assessing, and monitoring different strategic and policy attributes that maritime clusters entail. The focal point of the analysis enables greater variability compared to traditional models, as it pertains to an inclusive methodology to be utilized by either individual cluster members, or the entire cluster itself. This top-down perspective, in contrast to any bottom-up approaches, complements more effectively previous methodologies in analysing cluster governance, strategy development, and policy formulation.

A practical contribution of this research is that this framework effectively documents causality among two categorical variables, that are not set a priori by the methodology, but are selected on an ad hoc, per case basis. The framework's applicability is mirrored within its capacity to measure and assess different sets of variables and to monitor these within a temporal perspective. Maritime clusters exhibit a high level of competitive and cooperative dynamics within; therefore, they may be able to utilize this framework to unlock further aspects of regional competitiveness that guide regional dynamics into collective prosperity. In addition, the framework is relatively simple and straightforward in its application, yet it is backed up by proven analytical methods, such as crosstabulation, statistical hypothesis testing, and measures of association; all considered benchmarks of best practice in their respective domains. To this extent, its robustness can ensure its applicability to heterogenous maritime clusters, such as port, shipbuilding, services, and tourism clusters, to name but a few.

The instrument is expected to facilitate strategy and policy for maritime clusters and help them enter new frontiers of competitiveness. The proposed framework is based on a conceptual outset and has been piloted within a sanitized context; however, it holds the likelihood to be of interest and practical feasibility for many cluster types. In addition, the framework should not be considered as a static construct, for it bears the potential to be further enriched and developed. From this viewpoint, the work presented herein aspires to be the first step towards the formulation of a subset of instruments for strategic policy of maritime clusters, that have derived from this initial design.

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