

MATCHING EXTERNAL WITH INTERNAL COMPLEXITY

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ABSTRACT

The management literature is in a constant quest to offer new ideas and unfold innovative business practices. In fact, management, throughout these years, has accumulated ideas from nearly all scientific areas. A theory stemming from biology, namely complexity theory emerges as the value adding perspective of the present study. The dynamic nature of internal capabilities will create the link to the environmental complexity. In brief, the authors apply complexity theory to business strategy, which in many cases is considered as static in the relevant literature. Following a qualitative approach, through case studies, the authors investigated three shipping companies and three Universities, revealing several aspects of their presence in the market landscape. The conclusion is that nowadays companies are aware of the complexity they face, thus seeking for more dynamic ways to confront it.

PURPOSE OF THE STUDY

Nowadays, dramatic changes occur in the structure and operational scope of business, governmental and non-profit organisations. These changes are originated in both the external environment of the company (globalisation, intensive competition, etc.) and the internal one (empowerment, the role of human resources, certified quality, business process reengineering, balanced scorecard, benchmarking, etc.). Moreover, organisational entities are being created and dissolved at increasing rates. All these factors have opened the boundaries of the traditional organisation, extending its limits to areas that we have not explored or even thought of before (Cohen, 1999).

The fundamental question in the field of strategic management is how firms achieve and sustain competitive advantage (Rumelt *et al.*, 1994). Andrews' (1971) influential model of corporate strategy suggests that firms obtain sustained competitive advantage by implementing strategies which exploit their internal strengths, respond to environmental opportunities, avoiding external threats and improving internal weaknesses.

Each company can be regarded *internally* as a pool of resources which, autonomously or combined, lead to the development of internal complexity. Alternatively, it is regarded *externally* as a strategic position in the market, which is altered in various ways to confront external complexity. However, a company is a single entity, so there must be clearly a link between the two approaches. Chaffee (1985, pages 89-90)

argues that ‘a basic premise of thinking about strategy concerns the inseparability of organization and environment... the organization uses strategy to deal with changing environments’. In the same vein, Barney (2001a, 2001b) argues that it is important to analyse sustainable competitive advantage in a dynamic fashion.

The aims of the present study are twofold. First, we use complexity theory to develop a new conceptualisation of the linkages between the complexity of the external environment and the internal complexity of the organisation. Our second aim is to test that framework using initial empirical findings from case studies in two industries of the services sector. The existing literature on complexity is almost entirely theoretical, presenting only a few empirical results. We develop research questions derived from two perspectives: firstly an empirical approach and secondly a match between external and internal complexity, explicating their interrelations. The importance of the study is clearly indicated in the statement of Teece *et al.* (1997, page 530): “Researchers in the field of strategy need to join forces... if they are to unlock the riddles that lie behind corporate as well as national competitive advantage. There could hardly be a more ambitious research agenda in the social sciences today”.

LITERATURE ON COMPLEXITY

Cohen (1999) notes that there is no unified, theoretically coherent account of complexity yet, and current attempts in the literature to give precise measurable definitions of complexity are not fully satisfactory. He argues that so far the organisation theory community explores and consequently appraises the strengths and weaknesses of the complexity approach.

Complexity Definitions

In order to define properly what complexity means, we have to refer to the definition of Axelrod and Cohen (2000, page 7). They define a *complex* system as a system where ‘there are strong interactions among its elements, so that current events heavily influence the probabilities of many kinds of later events’. In contrast to this, they define *complicated* as comprising many elements within the system. Thus, the difference rests with interdependencies and the possibility of future events. Moreover, complex and complicated systems work in different ways, because interdependence leads to specific consequences, due to unpredictability of effects and non-linearity.

Another term that will be used in this study is *emergence*. Its definition can be found in Holland’s work (1998): ‘much coming from little’. Its cornerstone is that local agents interact with each other. The interdependencies formed by their emergent interaction constitute the properties of the superior system, namely the one the agents belong to.

Finally, *self-organised criticality* (Bak, 1996; Back and Creutz, 1994; Back *et al.*, 1987) is the point that a system is no longer stable and it turns into an unstable condition. Before turning to unstable, the whole system was stable, but the last addition, even by a small or unimportant proportion, made the system unstable. Moreover, the sizes of these avalanches obey a power law distribution of the form of $y=\beta x^{\alpha}$ (Robertson, 2004). All the systems, which are governed by these power laws, are called systems ‘on the edge of chaos’. However, chaos theory does not explain the

behaviour of these systems and this is one of the reasons why complexity theorists regard their research efforts as separate from those of chaos theorists.

Complexity Theory Building

In one of the efforts, the anonymous author (1999) presents four cast-iron principles of the science of complexity, which are relevant to strategy.

1. *Stable equilibrium equals death*
2. *Self-organisation and emergent complexity.* A breakthrough can initiate changes of increasing complexity, leading to final outcomes that could not be predicted. Cohen (1999) presents a similar point
3. *Edge of chaos.* Nothing new will be generated both by systems with high degrees of order and stability and by completely chaotic systems. Generative complexity takes place when surfing the edge of chaos
4. *Disturbing a living system.* Any intervention can lead to abnormal effects and harm the overall procedure and outcome of the system.

However, one cannot understand the behaviour of an individual in isolation, without taking into account the context and web of relationships and interdependencies. This is in line with Jackson (2005), who argues that collective characteristics of groups, organisations and societies cannot be understood solely as the sum of the properties of individuals.

Due to the adaptation of organisations and the reshaping of their plans, the managerial role has to change as well, in a way that emergent patterns will be allowed to show up (Lewin, 1999). This way is created by actions taken regarding both the external and the internal environment of the company. Emergent strategies, structures and practices will be originated in and helped by the competitive environment, as well as by the internal, as expressed by the structure, the competencies, the value chain and every other approach or theoretical perspective.

Fitness Landscapes

A fitness landscape is the topography of the payoff surface for alternative actions open to actors in a given system (Levinthal and Warglien, 1999). If the payoff (also called fitness) of one alternative is clearly higher than all others, then the landscape is said to be 'single-peaked'; while a multiple-peaked or 'rugged' landscape indicates many alternatives which have broadly equal payoffs. Within the class of single-payoff landscapes, landscapes may be single- or multi-peak, depending on the specification of the interdependence among individuals. However, the situation in multiple payoff landscapes is different. If conflicting interests and incentive alignment is introduced, then multiple payoff structures arise, framed in terms of coupled landscapes (Levinthal and Warglien, 1999).

However, there is a fundamental challenge in complex, adaptive processes. Organisations should either *exploit* past experience and current wisdom, or *explore* alternative bases of action (March, 1991). The dilemma of exploration or adaptation is resolved in a single-peaked world by local, incremental adaptation. However, in a rugged landscape, this procedure will lead only to the local peak closest to the starting point. This implies strong path dependence and, on average, modest performance. One mechanism to overcome such competency traps (Levitt & March, 1988) is to engage in long jumps: random exploration of more distant portions of the landscape.

However, as experience is acquired, random search risks wasting search effort and, perhaps more importantly, risks foregoing the benefits of known, attractive sets of behaviour.

In spite of the presentation of the arguments above, the dilemma remains: how to reap the benefits of exploration without losing the advantages of exploiting acquired knowledge (March, 1991). An at least partial resolution of this dilemma lies in search strategies that recombine elements of existing ‘solutions’ (Cohen, 1981). A recombination is a shift in position that exploits existing knowledge without being trapped by this knowledge. A search process that can simultaneously explore and exploit is created by cross-functional teams, which build on the diverse knowledge of their members.

Concluding, we will focus on the complexity of the external environment, both micro and macro. We view the market as a fitness landscape, where various actors exist. These actors move on their own, but they also move as a reaction to the movements of other actors, which deform the landscape. For this reason, the company is affected by all these ‘distortions’ occurring in the landscape and it responds in order to confront its external complexity. Its behaviour can be both proactive and reactive, based on the internal complexity it presents.

CONCEPTUAL FRAMEWORK

The unit of analysis is the organization as a whole, and our framework is based on the idea that organisations develop internal ways to respond to the complexity of the external environment. A graphical representation and analysis of the conceptual framework of the present research effort is shown in figure 1.

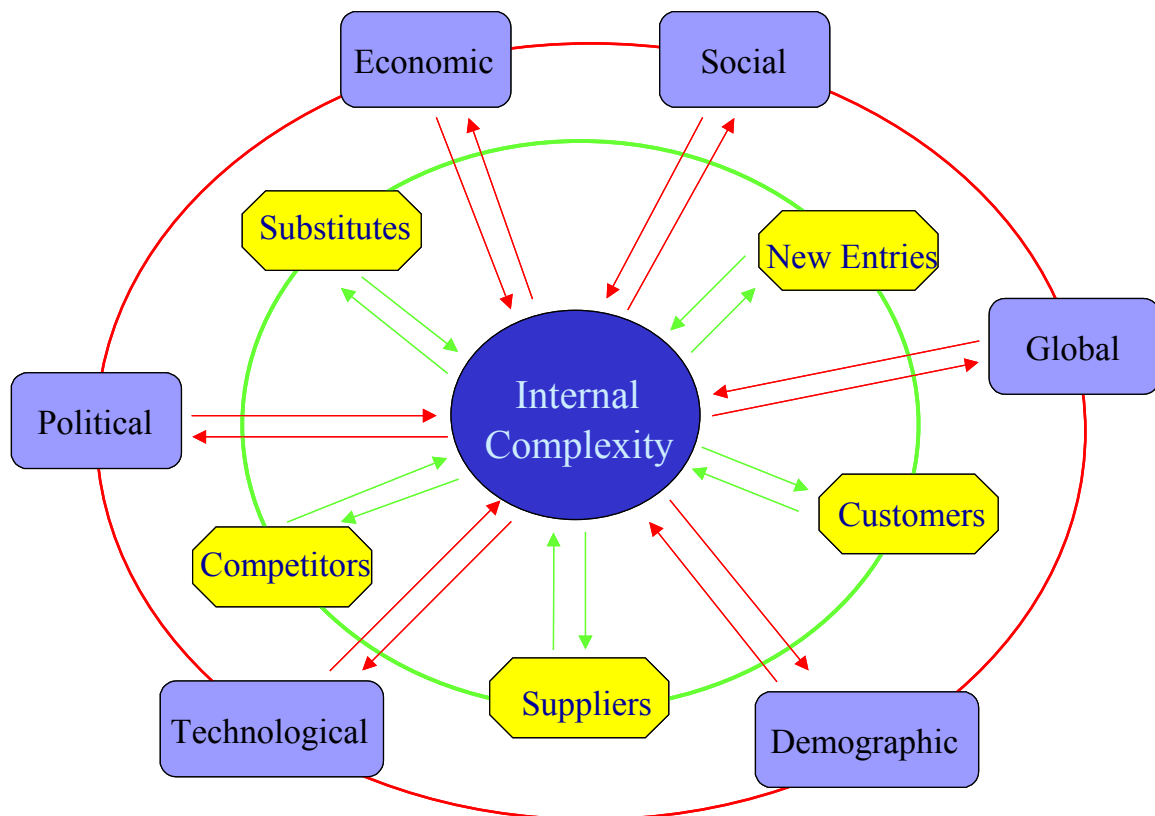


Figure 1: Conceptual Framework

The inner circle (blue) named ‘Internal Complexity’ represents the internal environment of the company. The outer circle (red) represents the PESTLEDG analysis, namely an analysis covering the Political, Economic, Social, Technological, Legal, Environmental, Demographic and Global aspects of the external macro-environment of the organisation. Finally, the circle in between the two (green) represents the competitive environment of the organisation, being affected by Porter’s (1980) five forces. The competitive forces model views the essence of competitive strategy formulation as relating a company to its environment (Tece *et al.*, 1997). The model can be used to help the firm find a position in an industry from which it can best defend itself against competitive forces or influence them in its favour (Porter, 1980), which presents many similarities with the notion of fitness landscapes presented earlier (Levinthal and Warglien, 1999). The red and green arrows represent the interrelations between each of factors and forces in the macro and micro external environment of the company respectively and the internal one. However, each of these forces does not act in the landscape on its own. There are various interdependencies (Levinthal and Warglien, 1999) between the actors in a given landscape. Thus, each of these forces affects and is affected by all the other players in the landscape. In turn, each movement of these players and also the cumulative effect of all the movements in the landscape, affect the internal environment of the company and its complexity.

According to some authors, ‘the resource perspective complements the industry analysis framework’ (Amit and Schoemaker, 1993, page 35). It is suggested that there

is not only one framework that has value. Indeed, complex problems are likely to benefit from insights obtained from all of the paradigms we have identified plus more (Teece *et al.*, 1997). Consequently, the conceptual framework presented above provides an even more in depth and complete view of the co-existence of the organisation and its environment. The following part of the analysis elaborates more on the conceptual framework, providing simultaneously the link to the research propositions.

LINKING CONCEPTUAL FRAMEWORK TO RESEARCH PROPOSITIONS

There are three levels of complexity analysis in the present study. Namely, we will identify, categorise, explore, describe and analyse the complexity existing in both the internal environment of the company and the external one, which (the latter) consists of the macro-external environment and the micro-external environment.

Complexity of the macro-external environment will be revealed through a PESTLEDG analysis of the external macro-environment. In this effort, secondary data will be used, so as to present the characteristics of the markets, industries and economies that the companies operate in. Additionally, we will use data from pilot studies and from interviews with peripheral informants, thus triangulating our existing information even more. Moreover, data collected from interviews with senior managers of each company will add information to the secondary data, shedding light to more specific issues faced by each company.

Complexity of the micro-external environment will be revealed mainly through the pilot studies, the interviews with the peripheral informants and the data collected from the interviews. The micro-external environment is actually the competitive one, thus the most accurate and representative view will be given by the managers of the companies, who act on the specific landscape. Moreover, secondary data will be used, which will provide information on the power distribution in each market.

Finally, the internal complexity will be revealed by the main interviews. However, some secondary data, such as brochures and reports of the company will contribute to a better understanding of the internal environment of each company.

Both internal and external complexity can be represented as a continuum from high to low. Consequently, we can create a diagram, where we will use two axes, one for each type of complexity (figure 2).

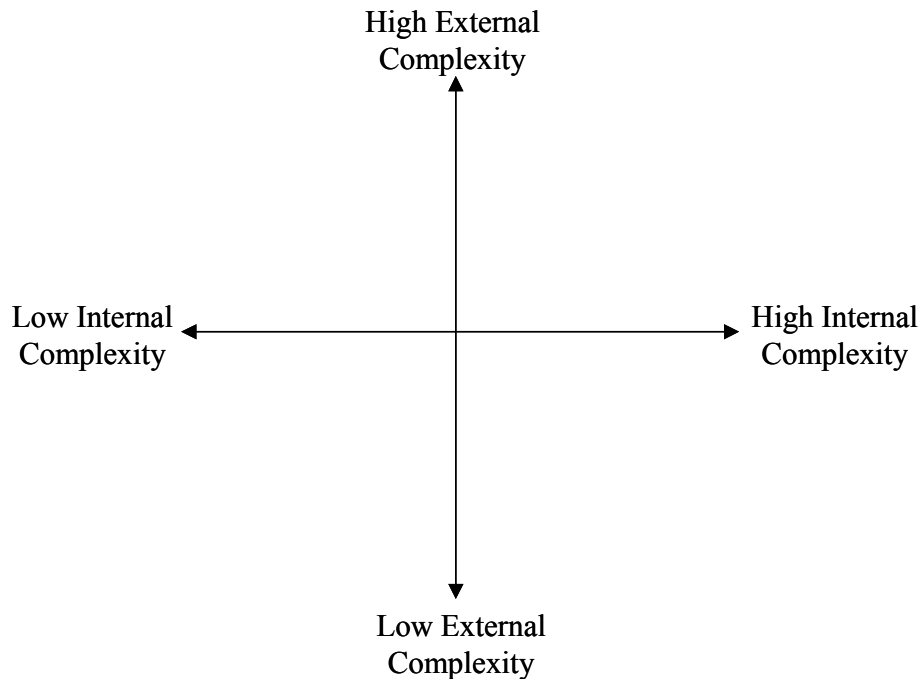


Figure 2: Complexity Represented in Two Axes

We will firstly use secondary data to initially assess the different positions of each industry in the landscape. Then, based on the data collection and the case study analysis, we will assess the levels of internal complexity presented by the organisations in each industry, since they may or may not vary accordingly. In this way, we will position each organisation in one of the four quadrants presented above.

Operationalising Complexity

Before proceeding further, we should resolve another issue, that of operationalising complexity. In the analysis presented above, we used terms like high or low, internal or external complexity. This terminology presupposes the operationalisation of complexity. However, the existing literature does not contain much empirical evidence on complexity and suggested methods are scarce to find.

In order to resolve that issue, we will use the formula used by Kauffman (1993), in his research effort on complexity and fitness landscapes, which was the initial step to this new approach. Kauffman (1993) characterises fitness landscapes with essentially two structural variables, N , the number of elements that characterise the entity (genes in the context of Kauffman's work, actions or policy choices in the context of organisations), and K , the number of elements of N with which a given attribute interacts. In biology, the notion that the fitness contribution of genes has such interdependence is referred to as epistatic interactions (Smith, 1989). Actors attempting to climb a given landscape may find that the landscape shifts and deforms, as the result of two factors: a) the adaptive efforts of other actors with whom they are linked, and b) their own actions, like the creation of new knowledge. Landscapes may also be coupled as a result of processes of mutual adaptation. Formally, the idea of coupled landscapes is captured by Kauffman's $NK(C)$ model (Kauffman, 1993). The

parameter C refers to the number of the N elements that are linked across entities, in contrast to the parameter K, which indicates the degree of interrelatedness within a single entity. Coupled landscapes result in quite complex dynamics as movement by one actor shifts the landscape topography for other actors. Actors are engaged in hill climbing, but climbing a continually shifting landscape.

The NK(C) model can be used as an operationalisation of both internal and external complexity. We will use the number of elements in the internal or external environment of an organisation respectively (e.g. Externally: number of competitors, suppliers, professional bodies, etc. Internally: the number of capabilities possessed by the organisation) and the number of elements with which a given attribute interacts, namely the degree of interrelatedness within a single entity (e.g. Externally: competitors interrelated to each other, namely forming alliances in order to attack the market leader or another competitor. Internally: the interrelations presented between capabilities within a single department of the organisation). Then we will also add to that consideration the number of elements that are linked across entities (e.g. Externally: competitors of an organisation forming alliances with suppliers of that organisation. Internally: the interrelations presented between capabilities across different departments of the organisation). The final outcome will constitute a concrete operationalisation of both external and internal complexity, which can be used in order to make the appropriate categorisations of complexity.

Macro-External Environment

The unit of analysis of the present research effort is the organisation. However, we can group various companies in industries, so as to follow a replication logic in each industry. In order to select the industries, we will use the PESTLEDG analysis, so as to comment on the external complexity that each industry faces and place each one of them in a specific position on the continuum between high and low external complexity. Our selection is justified by the fact that we need to comment on the complexity of the macro external environment of the organisation. However, the macro external environment of the organisation is actually the external environment of the industry. Namely, the political, economic, social, technological, legal, environmental, demographic and global environment, affecting an organisation, has almost the same form, type and impact on the industry as a whole. Consequently, performing an analysis on the macro external environment of the organisation, we produce the analysis of the external environment of the industry and its complexity.

Eisenhardt (1989), in an influential paper on case study research, comments on the number of case studies used in a research, arguing that a possibly sufficient number may vary between four and ten. In order for our study to reside within these limits, but also to follow the replication logic of using at least two companies per industry, we decided to investigate three organisations in two different industries, thus collecting data of six case studies in total. The question though still remains: which industries? Since our study is exploratory and is performed on a notion which is not properly empirically tested yet, we would derive useful and managerially applicable information if we could find industries along different positions on the external complexity continuum. Ideally, we should find one industry presenting high external complexity and one presenting a relatively low one, thus presenting and analysing the extremes.

High External Complexity

High external complexity is usually found in the high technology sector globally. However, in Greece that technology is not developed so much and we cannot derive valuable data from Greek companies. Such an effort would be fruitful in countries like the USA or Great Britain, which host companies on the technological edge.

However, Greece is the pioneer in another sector, namely shipping. Greece is the global power in shipping for decades now. Coincidentally though, shipping is a highly complex industry, as well. There are thousands of ship owning companies in Greece, which denotes a high N, in terms of the NK(C) model. Normally, each company owns one ship only. However, several companies (and consequently many ships) may belong to the same person. This happens mainly for tax purposes. Moreover, there are various other actors in the market landscape, like the international bodies, ministries, charterers, brokers, ship managers, crew managers, crew manning companies, seafarers, etc., which indicate once again a high N. They all participate in the industry and they all play an equally important role. Moreover, the interdependencies between each other (K) and between them and the ship owners or any other forces (C) are numerous and highly complex. Additionally, emergent situations, which deform the landscape, occur in shipping almost every minute. There are plenty of factors, which can lead to surprising, unpredicted and abnormal situations, and these situations can threaten even the existence of a whole company. Finally, the world trade is predominantly made through shipping.

In order to adapt to such an environment, especially when following a totally globalised procedure, even a small shipping company has to develop highly complex internal ways to respond. All shipping companies have formed flexible structures, so as to be able to handle any emergent situations.

Research Proposition 1: Organisations facing high external complexity will tend to explore more than exploit the opportunities presented in the external environment, since they constantly need something new in such circumstances, so as to be always ahead of their competitors

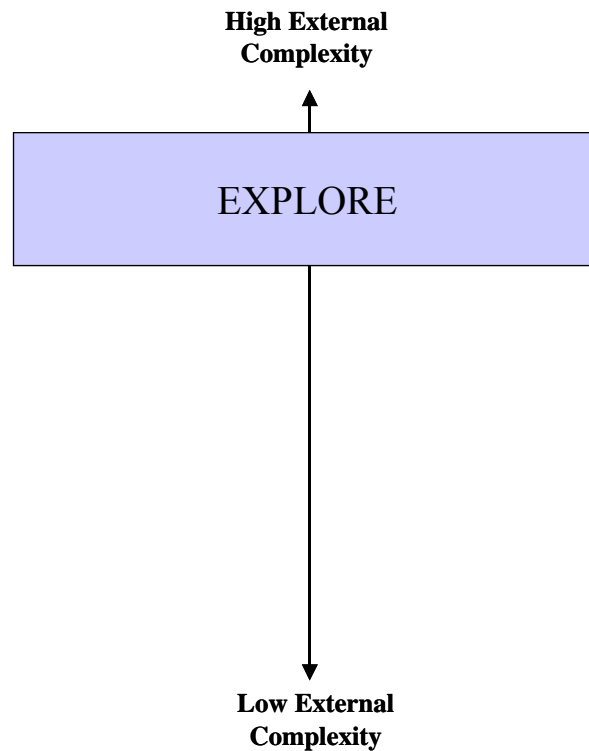


Figure 3: Research Proposition 1

Low External Complexity

This part of the research effort is perhaps the most difficult one, but it is quite interesting. The selection of an industry was made and the outcome of it is education. More specifically, we have chosen to focus on higher education, namely Greek Universities. The difficulty of the decision rests with the nature of the service offered. Education is quite different from other services. Thus, it is difficult to justify the selection of the industry.

However, Universities in Greece operate in a totally different environment, which makes the selection justifiable, fruitful and important. First of all, Greek Universities are public. There are private institutions, offering undergraduate and postgraduate (not PhD) degrees, especially through partnerships with British Universities (of low quality most of the times). However, these private institutions are not recognised by the Greek state as Universities and their graduates do not enjoy the benefits of a University graduate (thus leading to low N, limited number of recognised Universities). Despite that fact, some of the private institutions have a good reputation in the market and good rates of employability by private firms.

The landscape for Greek Universities is relatively smooth. They all obey to the rules of the Ministry of Education, without having any power to develop internal mechanisms and capabilities on their own. They are obliged to follow the guidelines imposed by the Ministry (low K and C). The Universities do not have any authority on their programmes, structure, courses, etc., since all these have to be approved by

the Ministry. They may of course express their opinion, but it is up to the Ministry to decide. Moreover, the same rules and procedures in Greek Universities exist for decades now.

Research Proposition 2: Organisations facing low external complexity will tend to exploit more than explore the opportunities presented in the external environment, because the relative stability allows them to do so

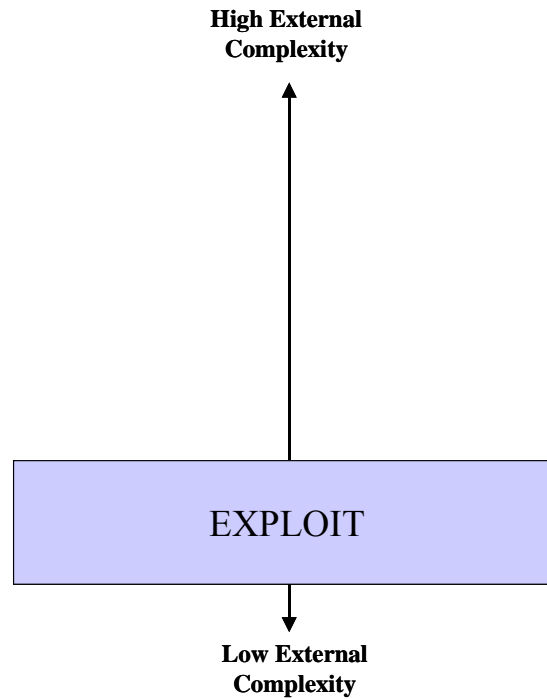


Figure 4: Research Proposition 2

External complexity stays at low levels mainly due to politics, even though there are various stakeholders in the Greek society. Greek families spend more than any other European family per capita on education for their children. The biggest percentage of Greek students enter a University, a Polytechnic (called TEI) or a private institution in Greece, and most of the remaining students go abroad to study. Thus, there are plenty of families expecting the best service from Greek Universities. However, the Ministry is imposing the rules to Universities, and these rules are not always the best way to cope with problems. Politics are closely related to education in Greece, using inappropriate tactics and policies from time to time.

The most important factor though, for the selection of higher education as the industry of our research effort, is the change which is about to begin. As it is well known, European Union has more power than its countries-members and it imposes its regulations. Thus, in education, the Bologna declaration has led to various changes in the educational systems of all countries. In Greece, the direct effect was the need to assess Universities and their Faculty, and also the Greek state must recognise private Universities. The Greek government has already announced that the constitution will change in 2008 and private Universities will be recognised (increase in N, K and C).

Consequently, some of the current private institutions, offering undergraduate and master's degrees, will become the first private Universities in Greece (higher N). This will deform the landscape for Greek public Universities a lot. Competition will arise (higher K) and the public Universities will have to adapt to the new circumstances quite fast. The private Universities will try to gain reputation and market share, using state-of-the-art technology, advanced techniques, innovative facilities and experienced faculty. Moreover, Greek Universities (both public and private) will be assessed on a number of factors and this will reveal any differences between the two types of University (higher C).

Judging from the above, Greek public Universities will face a tremendous change in their external environment, which was static and they were actually a monopoly in the market. Competition will be fierce and new regulations will be required. As it is rational to believe, public Universities will have to change and they will change internally, as well, developing new capabilities, abandoning inertia and increasing internal complexity. This is the reason why education in figure 5 is represented by an arrow pointing up, and not by a circle. In a few years time, education may reside in another position, representing much more complexity, because of the changes that will occur.

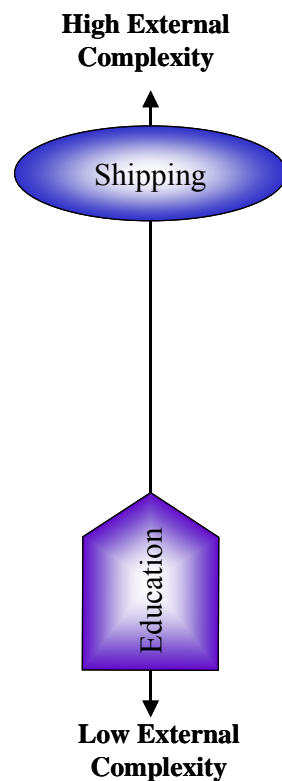


Figure 5: External Complexity of the Shipping and the Higher Education Industry

Micro-External Environment

Having already selected the industries, which can make our contribution even stronger, we have to select the specific organisations in each industry. For this reason, we will use the five forces model (Porter, 1980), since it is a model of analysing

competition in any given industry. Thus, it is perfectly applicable to this stage, since we have selected the industry and we now choose the companies in the industry.

In order to triangulate our data, increasing the internal validity, but also to substantiate our data analysis even more, we will select companies in each industry using at least one of the five forces each time, so as to have included all different forces in total. We will also use the sixth one, which is the supplementary products.

In shipping, the triangulation logic imposes us to investigate two companies which are suppliers and customers of each other and vice versa. Thus, we will investigate two ship owning companies and one crew management company. The ship owning company leaves the management of their ships in the hands of the crew management companies, thus they are their suppliers.

In higher education, we will choose a public University and two of the private institutions, which will be recognised as private Universities in a few years. These organisations are actually substitutes now, because a high school graduate who could not get high marks so as to enter the public University, will choose one of these private institutions so as to get a degree, even if this is not officially recognised by the Greek state. However, the private institution will soon be considered as a new entrant, since it will be recognised by the Greek state as equal to the public ones. Thus, the high school graduates will have a choice between equals (regarding the recognition, not the quality of service offered).

Internal Environment

Having selected the specific companies as well, we have to deal with the remaining issue of which managers to interview. We will interview those managers who are directly related to the market, so as for them to be able to comment on the external complexity of their organisations. Thus, they will actually contribute to the analysis of the external environment. However, they will have also to be relevant to each other and in this way the data collected from their interviews, when jointly analysed, will bring together all the pieces of both the internal and the external environment and its complexity.

Consequently, in shipping we will interview the CEO, the operations manager, but also we will interview the insurance claims manager and the chartering manager of the ship owning company, because these two functions actually constitute a supplementary service of the service provided by the crew management company.

In education we will interview the Dean and the Vice Chancellor of the University and the private institutions, and we will also interview the Heads of one undergraduate and one postgraduate programme.

Complexity Landscape

Figure 1 can be represented as a fitness landscape. The two-dimensional surface is the flat surface of the landscape and each organisation is positioned on that. However, the 3-D axis represents the rents, namely the rewards received by the organisation from adapting properly to its environment. The higher the adaptability, the higher the rents (Levinthal and Warglien, 1999) and, consequently, the higher the position in the landscape that the organisation will climb at. However, movements of other actors in

the landscape will deform it in a way that current hills may become smoother or may even become valleys. Thus, organisations have to adapt in a constantly changing landscape and adapt their internal complexity to the complexity presented by the external environment.

Ashmos *et al.* (1996) in their paper, which is one of the few with empirical results, distinguish two types of complexity: the internal complexity (derived from within the company) and the external one (derived from the environment). Buckley (1968, page 495) states: ‘the variety within a system must be at least as great as the environmental variety against which it is attempting to regulate itself. Put more succinctly, only variety can regulate variety’ (see also Boisot, 2000). This is known in cybernetics as the law of requisite variety (Ashby, 1956). According to the aforementioned law, internal complexity should match the external one. This is also similar to what Boisot (2000) implied.

Research Proposition 3: Organisations with high external and low internal complexity and vice versa do not exist or they are not effective. The only effective parts are these having equal external and internal complexity

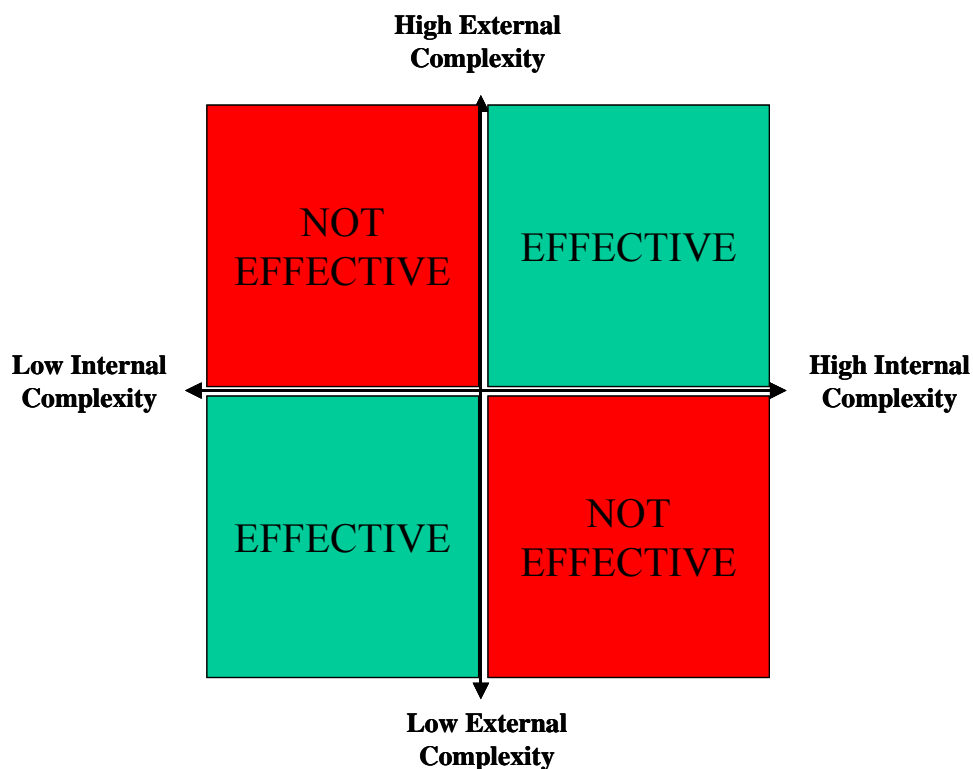


Figure 6: Research Proposition 3

Judging from above, companies should reside only in quadrants representing similar complexity, namely high external – high internal and low external – low internal. Quadrants representing high external – low internal and low external – high internal are not the best choices available for organisations, since they will not be able to regulate variety in the desirable and appropriate way, according to the law of requisite

variety. Thus, organisations residing in these two quadrants will not be effective or will not exist at all, since all organisations will strive to be positioned in the other two quadrants. The only available option for companies residing in the two less effective quadrants is to move towards the other two, effective quadrants, by exploiting the dynamic nature of their co-evolutionary processes.

Which of the two effective quadrants though is the most desirable one? The answer to this question will constitute another contribution to the existing literature, since the law of requisite variety is not confined to high or low complexity. It just refers to the equal quantity of external and internal complexity. Thus, if we can draw concrete conclusions from our case study analysis with regard to the most desirable of the three spaces, we will have contributed a bit more to the existing literature. According to the literature review presented above, high external complexity will lead to rugged landscapes, where organisations will engage in long jumps in order to achieve the maximum benefit, namely the global maximum. They will do that because the global maximum is not obvious from every position in the landscape. The only obvious awards are the local maxima, which however may lead to lower levels of effectiveness for the organisation. Thus, the starting point may not be near the global maximum, so in order for the organisations to explore the area faster and more efficiently, they will have to make long jumps in the landscape (Levinthal and Warglien, 1999). In order to achieve their target, they will also have to increase their internal complexity. On the other hand, low external complexity will lead to a smoother landscape, where the global maximum is more obvious and towards a specific direction. Once again, the literature does not contain explicit information on whether the global maximum in the above two cases (high or low external complexity) is higher than in the other. Thus, we cannot comment on whether the global maximum of a fitness landscape presenting high external complexity will be higher or lower than the global maximum of a fitness landscape presenting low external complexity, based on the existing literature. However, combining the first with the third research proposition, we reach the fourth one. The most effective quadrant is the upper right one, since it is one of the two effective quadrants, but it also allows organisations to explore new opportunities and find new ways to be even more effective and take advantage of both internal and external complexity.

Research Proposition 4: Organisations which reside in other than the high external – high internal quadrant will tend to move towards that quadrant

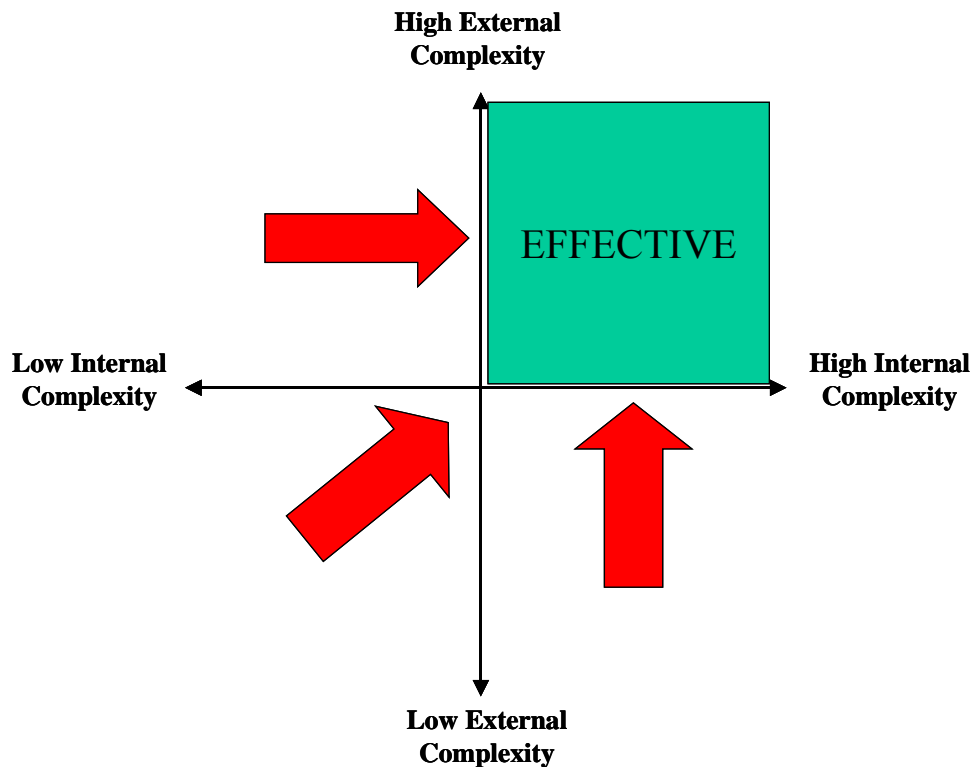


Figure 7: Research Proposition 4

METHODOLOGY

Our study is empirical since it employs techniques for analysing gathered data. Moreover, it is exploratory since it seems to be, to the best of the researchers' knowledge, the first research trying to get an initial practical insight in a novel research-wise phenomenon. The notion of complexity is relatively new and there are only a few research efforts in this area, which are derived from actual data in business practice. Since little is known about our research problem, it seems more appropriate to begin with an exploratory approach. However, it may just be an initial step, followed by a descriptive one.

Method

Some of the available methods of deriving data are surveys, case studies, participatory observation, ethnography, etc. In the present research effort, the authors use case studies as the method of obtaining actual business data. According to Yin (1994), the case study is defined not as a research method or merely a design framework alone, but rather as a comprehensive research strategy. A combination of multiple methods such as interviews, documentations, observation, empirical materials and perspectives are usually used to increase rigor, depth and breadth to the investigation (Yin, 1994). Consequently, we will gather, categorise and analyse secondary data. Secondary data are information gathered by others for purposes which can be other than ours (Ghauri *et al.*, 1995).

Concluding, there are times when little is known about a phenomenon, current perspectives seem inadequate because they have little empirical substantiation, or they conflict with each other or with common sense. Or, sometimes, serendipitous findings in a theory-testing study suggest the need for a new perspective. In these situations, theory building from case study research (Eisenhardt, 1989) is particularly appropriate because theory building from case studies does not rely on previous literature or prior empirical evidence.

Country – Industries – Companies – Interviewees

As it is rational to assume, the Greek nationality of one of the authors is playing an important role on his decision of the country. He will probably know the industries and the market in general better than any other national market globally, so as to provide an in-depth analysis of the selection process of cases and present the environment in which these companies operate. Additionally, we must not overlook the factor of accessibility to the companies. Finally, the choice is justified by the fact that these two industries that will be examined in the study present an increasing interest in the Greek market, because of recent developments, conflicts, new entrants and the changes in the way of doing business in general.

In this kind of efforts, the availability of resources is limited and the time is constrained. While there is no ideal number of cases, a number of four to ten can be regarded as appropriate (Eisenhardt, 1989). In general, the procedure requires researchers to start collecting data from their cases (companies) and stop adding cases when theoretical saturation is reached. However, there must be a planning process, because of the limitations described above. Thus, for the present study, six companies in total are regarded as adequate. We aimed at the top-10 (regarding market share) companies in each industry. This selection is made because these companies will more probably face harsh competition and be greatly affected by their environmental factors. Thus, the environmental complexity that they have to deal with will probably be higher. Moreover, these companies will have the ability to respond to their external environment manipulating their internal one, because they have the size, the resources and the power to do that more easily and efficiently.

Many of the methodological issues and procedures followed were analysed in the previous part of our study. In the following part of the methodology, we will present and elaborate more on the details of the data collection phase.

In order to have a fair view of the company's external and internal environment and its complexity, we aimed at the top management of each company, namely the CEO, using open-ended questions so as to investigate almost unknown or unfamiliar situations. Moreover, other employees belong in top management. These employees are the first-line managers, namely managers just below the CEO. The obvious reason for this choice is that these managers are in constant contact with environmental factors that affect the company, so as to make the appropriate decisions.

As mentioned before, three companies were included in the shipping industry and three institutions in the higher education. In shipping, two of the companies were ship owners and one of them ship managers. In higher education, we had a case of a public University and two private institutions, of differing quality. In each of the six

organisations, four top managers – members of faculty were interviewed, namely the CEO or Dean and three divisional managers or Vice Chancellors or Heads of Undergraduate and Postgraduate Programmes. The interviews were done using an open-ended questionnaire and the length of the interview varied from 45 minutes to one and a half hour. Thus, there were six cases in total and 24 interviewees of the top management of each of the organisations. If we add the two pilot studies and the two peripheral informants, we reach 28 interviewees in the highest positions within the organisations.

All these interviews were done while keeping a case study protocol (Yin, 1994) and a confidentiality agreement was made with all the interviewees. When transcribed, the interviews were translated and back translation was used. Finally, the transcribed and translated interviews were sent back to the interviewees, so as for them to comment on the content of the interview and make any modifications they deemed necessary. Both the initial and the modified data were used, assessed and analysed accordingly in our paper.

Pilot Studies

We had firstly conducted exploratory pilot case studies, the aim of which was to get an initial insight of managers' perceptions on how they perceive both external and internal complexity, which are the factors affecting them and the linkages between them. We did interviews with a CEO of a modern and respectful shipping company and with a Professor of a well-known and established private College in Greece, who had teaching experience in one of the biggest Universities in the UK, as well.

Peripheral Informants

In order to present a more accurate image of the two industries, and also to triangulate the empirical findings of the interviews, we also did two interviews with two peripheral informants, namely two interviewees in senior positions in organisations and bodies, which are closely related to the industries in question. The peripheral informant of the higher education industry is the President of a European research body and the peripheral informant of the shipping industry is the Vice President of a major multinational organisation, which is closely related to shipping.

Case Study Analysis

The overall idea is to become intimately familiar with each case as a stand-alone entity. This process allows the unique patterns of each case to emerge before investigators push to generalise patterns across cases. In addition, it gives investigators a rich familiarity with each case, which, in turn, accelerates cross-case comparison (Eisenhardt, 1989).

After having described and analysed each case properly, we will make cross-case comparisons. The tactic that will be followed here is to select groups of cases (companies in each industry) and then to list the similarities and differences between each group. The juxtaposition of seemingly similar cases by a researcher looking for differences can break simplistic frames. In the same way, the search for similarities in a seemingly different group can also lead to a more sophisticated understanding. The result of these forced comparisons can be new categories and concepts, which the investigators did not anticipate, going beyond initial impressions (Eisenhardt, 1989).

CASE STUDY FINDINGS

The empirical findings of the present study will be divided into three parts. Firstly, we will present the findings related to the external environment of the case studies. Then, we will analyse the data regarding the internal environment of the organisations. Finally, we will verify or not the research propositions posed earlier, based on the findings presented.

External Environment

Based on the operationalisation of complexity presented earlier, we will use the Kauffman's $NK(C)$ model in order to present and analyse the external complexity in both industries. In both Shipping and Higher Education we distinguish between external complexities derived from global stakeholders (more applicable in shipping), by their country specific stakeholders, by their industry specific stakeholders, by their organisation specific stakeholders and finally by the interrelations that these stakeholders have developed, within each category or between different categories. In this analysis, N denotes the different categories of stakeholders, K the interrelations developed within each of the categories, and C the interrelations developed between different categories.

Shipping Industry

The shipping companies face a tremendous external complexity, mainly because they operate in a global environment. As it was clearly stated by all the interviewees in all three cases, shipping companies are not only affected by their direct stakeholders or the industry or the country in which they operate. They also have to deal with global stakeholders, which increases all N , K and C a lot. They all characterised their external environment as of very high complexity and one of the few which are purely dynamic.

The *global stakeholders* are different for each type of companies. Both ship owners and crew managers have to deal with the governments of the countries that the vessels visit. Moreover, they have to face the regulations of the countries that their seamen come from, regarding their employment, their certifications, their training, their safety, their visas, etc. Additionally, both of them have to conform with the rules and regulations of the international maritime bodies, like the International Maritime Organization (IMO), the International Labour Organisation (ILO), etc. All these global stakeholders have interrelations with each other and members of Ministries of countries may be members of the international bodies, or members of one body are also members of the other, etc. The regulations of these bodies and governments are strict and they must be followed by the companies, which have no alternative.

The *country-specific stakeholders* are once again many, mainly because shipping is of utmost importance for the Greek economy and Greece in general. Greek shipping companies are affected by the Ministry of Shipping, the Ministry of Employment, the Ministry of Economy and the Ministry of Development. They are also affected by the Seamen's Unions and the public opinion, which is not very positive about them and the money they earn. The Ministries are interrelated and often affected by the views of the public and the protests of seamen.

The *industry-specific stakeholders* include a lot of categories. Firstly, the shipping companies are more than a thousand. One ship owner may possess e.g. 10 ships, but he establishes 10 different companies and each of them possesses one ship only. This is mostly done for financial reasons. Thus, there are thousands of competitors. However, these competitors are not closely related to each other and they do not monitor each other. Shipping companies try to be effective in the market by taking advantage of their own capabilities and especially their network. In the same industry, there are many other forces, like seamen, who can be Greek (mainly officers), Philippino, Russian, Egyptian, Ukrainian, etc. All these different nationalities and backgrounds are on board, thus making their management even more demanding. Moreover, a ship owner outsources various processes, like the crew management, crew manning, chartering, brokering, etc. to other companies, thus making the landscape even more rugged because of these interrelations. A single owner may outsource his ships to more than one agents and a crew manager for example may manage the vessels of 20, 40, or even more ship owners. This is actually a web of relations.

Finally, the *organisation-specific stakeholders* are once again a lot. Shipping companies employ people in their offices (worldwide) and they work on projects with Universities. They also offer vocational training to students, accept them for their Master's Thesis, etc. Moreover, some of the ship owners outsource the above-mentioned procedures, but others develop them in-house, establishing different departments to deal with these specific issues. Additionally, ship managers and crew managers may have a few or lots of different principals to deal with, their agents and their outsourcing companies. Consequently, the external environment for ship and crew managers may be even more complex than for ship owners.

Higher Education

Higher Education in Greece is somewhat problematic in nature. The *global stakeholders* should be the international academic community, in terms of research. However, most of the public Universities and almost all of the private institutions are not research oriented and most of the times (especially in the private institutions) they do not publish any paper in academic journals and do not present or even attend conferences! Consequently, we could say, with the exception of the public University (PU) that was our first case, the private institution (PI1) that was our second case and only a few others, that Universities and institutions in Greece ignore their global stakeholders.

When it comes to the *country-specific stakeholders*, all actors are more concerned. The public opinion and the students' parents are the main stakeholders, which Universities in general should take into account. However, in the case of Greece, the main stakeholder is the Ministry of Education. The Ministry is the one which decides almost everything and imposes these decisions to the public Universities. The Ministry decides on issues like the programmes offered, the reading materials, the number of students to be accepted, etc. Even if the Ministry does not decide on these, it is the one which will verify the decision of the University. Private institutions are not affected by the Ministry, but they are affected by the fact that they are not recognised by the Greek state. In this way, they do not attract the best students and of course they cannot target foreign students' markets.

Regarding the *industry-specific stakeholders*, Universities and private institutions do not analyse and benchmark themselves against their competitors. There is no evaluation of the Greek Universities and institutions and because of the educational system in Greece, organisations in higher education are not that affected by their competitors. The power distribution and reputation is somewhat made, and organisations enjoy what is already given to them. However, the most important stakeholders are the companies which operate in Greece. These companies constitute stakeholders of the Greek Universities and private institutions in many ways. Public or private companies in Greece employ the graduates of these organisations (public companies do not recognise the degree of the private institutions though). They also offer funding to private institutions (not to public ones). Moreover, companies need consulting by faculty members. Finally, companies send their managers for executive training (mainly for executive M.B.A. programmes). In this way, we can say that the industry specific environment includes forces that are more interrelated to each other and form a more complex landscape.

On the *organisation level*, public Universities are a monopoly, since they are the only recognised by the Greek state institutions to offer a degree. Students, the major stakeholder, when leaving High School, give exams to enter the University. In order to enter the high quality and class Universities in Greece, it is extremely difficult and students have to ace their exams, having an average mark of 18 and 19 per 20 in all 9 courses they give exams in. When they enter the University, they usually learn a wide range of different things regarding their area, and learn them in-depth as well. However, many problems occur, like protesting and occupying Schools. The students are not also offered the contemporary knowledge of the academic community, mainly because their Professors do not deal with these issues anymore. Students who fail to enter a University, or one that they like, have to register in a private institution or go abroad, mainly to British Universities.

As it can be inferred from the analysis performed above, there is a relatively low complexity in the external environment of Universities and private institutions. However, the reason for including such organisations in our research is the future changes. In a few years, as it was officially announced by the Greek government, private Universities will be recognised by the Greek state. That change will severely affect all actors in the landscape, which will be substantially deformed. Private institutions will gain legitimacy and they will be able to attract better and more students and faculty members. Public Universities will have to stop their inertial and arrogant attitude and adapt to the new circumstances, because they may lose their dominant position in the Greek market. However, the negative aspect of that change is that no one is informed yet about what will happen, how and when. All actors are completely in the dark, awaiting for the government's decisions. It is rational to assume though that if the Ministry wants to impose rules and regulations on the autonomous and flexible private institutions (like it does with the public Universities), in order to recognise them, almost all of them will deny the recognition. In general though, all N, K and C are expected to increase in the following years in higher education, because of that change.

Internal Environment

As mentioned earlier, organisations seek ways to match their external complexity with the internal one. They develop dynamic ways to confront the complexity derived from

their external environment. These dynamic ways may be internal to the company or external ones (Eisenhardt & Martin, 2000). Internally, they are either tangible or intangible, depending on their nature. There are tangible characteristics which are dynamic and thus assist the company in adapting to changing environments, but most of them are intangible, in order to be more flexible and adaptive. The intangible ones are further categorised in country, industry and organisation specific characteristics. Some of these are similar in both industries, some others are quite different due to their distinctive nature. Not all elements are dynamic though. Consequently, we will present and elaborate on the dynamic characteristics in each of the industries, for each of the cases separately, since the internal environment of each of the organisations is quite or totally different.

Shipping Industry

The shipping companies that we examined possess many dynamic characteristics, so as to confront the high external complexity they face. However, these characteristics are quite different in each of the companies, so the analysis will be performed regarding each of them separately.

- **Dynamic Characteristics of SO1**

SO1 is an old company, characterised as a traditional ship owner. It operates in a global environment, which is characterised by high complexity. According to the law of requisite variety (Ashby, 1956), it should match the external complexity with the internal one. However, this case study is revealing an important exception to the rule.

SO1 has a relatively big size in the market it operates, a specific type of ships. It has also built an excellent reputation in the market throughout these decades. According to Dierickxx and Cool (1989), that reputation is not readily tradeable, so we can characterise it as a dynamic characteristic of the company. Their historical path has given them the technical expertise in the market and the experience in doing the job. Moreover, they have the financial ability to order new ships if they want to. For the time being though, they are not willing to invest in new ships. This happens mainly because they will not be able to manage a bigger fleet, due to its complex nature. They have also developed a family ethos in the company and they recruit people only if they are relatives of the existing employees. This strengthens the company's culture, but it places restrictions on the abilities of the potential employees.

However, the most important point is that half of their ships are chartered in the open market, namely they do not time charter their vessels. This increases complexity even more, because they are not able to control the prices and their earnings. When shipping is doing well, they will benefit, but when there is a decline in the industry, they will lose money. Moreover, they need additional skills and capabilities in order to play the game effectively and find cargos on time and at good prices. What they have developed, in order to match that complexity, is only the network that they have developed globally with other partners in the same industry. They liaise with other companies and bodies, which can be charterers, brokers, international regulatory bodies, etc. and in this way they are able to adapt to the demanding and changing environment. However, they could be more effective if they developed more dynamic advantages, but they do not wish to. They enjoy their present position in the market and since they are profitable as they are, they are not willing to change.

- **Dynamic Characteristics of SO2**

SO2 is a new and modern ship-owning company in Greece. A few years earlier it possessed only a few ships, however the CEO, who is in his late 20's, decided to invest in a totally new area within the shipping industry. They bought almost 30 ships gradually within two years, which represents a huge rate of growth. The company entered the NYSE, which brought additional funding and additional obligations. All these ships are now time chartered, mainly because the CEO wants to be quite relaxed and not be affected by the fluctuations of demand. "I want to sleep at night", he argued. Moreover, the investors in NYSE request that, because they feel insecure in the open market.

His initial decision to invest in a totally new and unknown to him market can be characterised as complexity absorption, because he was dealing with the complexity of his internal environment, by developing his own dynamic advantages internally. However, his decision to time charter his vessels can be characterised as complexity reduction, because he is not willing to play in the open market and absorb its complexity. Consequently, we are witnesses of another important finding: there are companies, in complex environments, which follow one of the two choices under some circumstances and then change to the second option under new circumstances. They may even follow both of them simultaneously, but in different aspects of the environment.

The CEO's decision was based mostly on his intuition; we can conceptualise it as a 'long jump' from one region of a rugged fitness landscape to a quite different part of the landscape in order to find a higher global maximum (Levinthal and Warglien, 1999). Following March & Simon's (1958) analysis of bounded rationality, managers in such a global and complex environment should use heuristics like these in making decisions about improving performance. The market sensing that the CEO used is considered a dynamic advantage, associated with 'outside-in' processes (Day, 1994). "I was able to 'smell' the changes", as he said. That dynamic characteristic helped his company to be rather proactive than reactive, so as to pro-actively create and control its environment (McGuinness and Morgan, 2000).

Having finished his strategic move, he now possesses 10% of the world fleet in the specific market. This means that when someone needs the services of an owner of the specific vessels, they have to contact SO2 first, because they are the global leaders by far. However, these strategic moves require irreversible commitments, as well. The moves in question will have no effect if they can be costlessly undone (Teece *et al.*, 1997). A firm's current position is often shaped by the path it has travelled. Thus, a firm's previous investments and its repertoire of routines constrain its future behaviour (Teece *et al.*, 1997). Consequently, there are huge barriers which prevent SO2 from leaving that niche market.

A question regarding the acquisition or the development of these dynamic attributes remains though: when investing in a diversified area, having no experience or expertise in that, how can you possibly manage the new situation? As Shuen (1994) stated, if the source of economic profits is the control over scarce resources, then issues like skill acquisition, the management of knowledge and know-how and

learning become fundamental strategic issues. That was exactly what SO2's CEO did: he recruited the best managers in that particular area from competitors worldwide. They brought their experience and technical and managerial expertise. However, they also brought their corporate culture. The CEO was assertive: he asked them to analyse the elements of their culture and they had a few meetings with all the top management. The decision was to keep the best parts of each of the cultures and thus create a new one. "Our company is so flexible that this was implemented in no time", he said.

In order to implement that huge change of direction, they were assisted by a few dynamic elements more. First of all, the change itself shows a hands-on approach to the market and a quick response to the market needs. This is not the case with all ship owners, because the majority of them are traditional companies, which do not invest time, effort and money in discovering opportunities.

A powerful capability was information technology. They invest in IT and seek ways to be involved in new approaches on how to use it for the benefit of the company. All their ships are equipped with state-of-the-art technology and their team has developed dynamic software in order to meet the demands of the environment regarding software and information dissemination.

Additionally, they have a well-respected reputation, which was mainly established through the NYSE. That reputation allows them to establish a huge network around the world, comprising of other ship owners, charterers, brokers, etc. That network provides information, offers protection and create opportunities for the company, especially in periods of change or uncertainty.

Finally, they have developed a dynamic advantage, which was proved to be extremely useful during the changes, which they implemented. They are outsourcing the ship and crew management services to other agents. They have created a pool of five different agents, in three different parts of the world, who constantly compete with each other in terms of price, quality, speed, etc., in order to be SO2's partners. However, they do not sign long-term contracts. They assign projects to all of them over time, based on the evaluation made on their services. In this way, they are able to find services of high quality, at better prices, fast and consequently gain competitive advantage in the market.

- **Dynamic Characteristics of CM1**

CM1 is a big, well-established crew management company, in the top-10 worldwide. It has more than 30 years presence in the market and is characterised by very high complexity, both internal and external. Its external environment comprises many stakeholders, especially since it deals with the human factor, namely seamen, which is unpredictable. There are various interdependencies between seamen, regulatory international bodies, charterers, principals, etc. They all interact with each other, creating a complex external environment that changes daily. The top management of the company is well aware of that and is investing heavily in developing dynamic ways in order to have the competitive edge.

The main dynamic characteristic of CM1 is the development of web accounts, an online intranet, which allows the customers of the company to log in and have access to information regarding their ships, the seamen on board, their certificates, information which can be downloaded at any time. That system also creates reports and analyses, while providing up to date information regarding all shipping issues worldwide. They receive information when it happens, they analyse it fast and send it to their customers instantly, so as to keep them informed. That system is built in the company, which employs nine programmers – a huge number in that industry – who developed that software and they constantly monitor and improve it. This is in line with Makadok (2001), who argued that dynamic assets are built rather than bought in the market, and they are embedded in the organisation.

These web accounts are not developed to be static though. There is an ongoing procedure of improving and transforming them, in order to be always one step ahead of competition, which imitates them. In rapidly changing environments, there is obviously value in the ability to sense the need to reconfigure the firm's asset structure, and to accomplish the necessary internal and external transformation (Amit and Schoemaker, 1993). This requires constant surveillance of markets and technologies and the willingness to adopt best practice. The capacity to reconfigure and transform is itself a learned organisational skill. The more frequently practiced, the easier accomplished (Teece *et al.*, 1997). This is exactly the case with CM1, which reconfigures not only its web accounts, but also its dynamic characteristics in general. That strategic decision to constantly transform has led to the development of another dynamic advantage: that of being able to change easily, efficiently and fast.

CM1 is a family company and its top management preserve that characteristic very carefully. That family ethos was not threatened even when they grew a lot bigger. The founder's and CEO's sons are ready to take over, thus signalling to the market that they are here to stay and they will invest even more. That increases their reputation in the market and makes them even more trustworthy. Reputational assets, according to Teece *et al.* (1997), are best viewed as an intangible asset that enables firms to achieve various goals. Its main value is external, since reputation is a kind of summary statistic about the firm's current assets and position, and its likely future behaviour.

It should be noted here though, that one distinctive characteristic of the specific industry is the reputation of both the company and the owner. Actually, the owner's reputation is more valuable in the market, and it is a dynamic asset that assists the company in turbulent times (Dierickx and Cool, 1989). As the CEO said: "Our customers say that they are relaxed because they have trusted their ships to me personally, not to my company".

CM1 has offices – branches in different parts of the world. The main ones are in The Philippines, Ukraine and Russia, because these are the pools where they can find seamen. They have well trained human resources worldwide, they invest a lot in training their people, and they have valuable technical expertise. Their experience in the market is immense, being one of the oldest companies. However, in order to strengthen the links to their offices and train their employees even better, they transfer knowledge on the job. This means that managers from the headquarters in Greece visit the offices in Ukraine or The Philippines, and work there for one to six months,

so as to understand the problems of the employees there and transfer the best practices from the headquarters. Then, managers from the offices visit the headquarters so as to get that experience in turn. This is in line with Teece *et al.* (1997), who argue that replication involves transferring or redeploying competences from one concrete economic setting to another. However, since productive knowledge is embodied, this cannot be accomplished by simply transmitting information. Replication and transfer are often impossible absent the transfer of people.

Its presence worldwide has created many problems, but also led to the development of additional capabilities. Regulatory systems, laws, the system of higher education, and the national culture are also part of the environment. There are significant national differences, which is just one of the reasons geographical location matters. Such assets may not be entirely firm specific; firms of different national and regional origin may have quite different institutional assets to call upon because their institutional/policy settings are so different (Teece *et al.*, 1997). However, CM1 has achieved to unify its branches worldwide, mainly through information technology and knowledge transfer by managers visiting the offices and staying there to work.

A similar point can be made regarding national culture, which can be both a dynamic advantage and a dynamic disadvantage in periods of change. For example, Greeks have the entrepreneurial flair and intuition, which is essential in shipping, but they also have the 'curse of the nation', as they call it, trying to destroy the efforts of a Greek competitor, instead of building on these efforts or trying to become better themselves. In the same vein, the Philipinos are peaceful and obedient people who work well with Greek officers on board, but they need time in order to understand the procedures and be effective in what they do.

Speaking of dynamic disadvantages, namely obstacles in adapting to volatile environments, CM1 has two of them. The first one is the old managers, as it happens with other companies, as well. Some of the employees in CM1 are old, which deters them from using technology as needed. However, these employees possess valuable experience, which is proven advantageous in other cases. However, when the rate of change is increasing, these old managers are not adapting as fast.

The second dynamic disadvantage is not an actual one, it should be rather considered as a reputational asset, but it is not. Some of its competitors in the market, the low quality ones, bribe the managers of their customers in order to get the contract. Unfortunately, sometimes they succeed and CM1 is losing potential new customers. However, it is a rigid policy of the company never to adopt such an attitude towards the market. That type of disadvantage is also mentioned by Teece *et al.* (1997), who argue that companies with the best products will not always win, as chance events may cause 'lock-in' on inferior technologies.

Going back to dynamic advantages again, CM1 has established a huge network globally, and that network consists of their customers, other agents in the market, international regulatory bodies and governments. They exploit their network only when there is a crisis or when a change is about to take place. In normal periods, they do not use their network for taking action, but mostly for receiving information, which is crucial in their industry. Consequently, that collaborations could be the means for new organisational learning (Doz and Shuen, 1990; Mody, 1993).

The final dynamic attribute possessed by CM1 is relative to its structure, namely the cross functional teams that it has developed. These teams – workgroups contribute in the flexibility and quick response of the company to the market, while they are essential in order to meet the demands of the volatile external environment. CM1 has developed teams and each of the teams deals with one fleet of ships only. In this way, they gain expertise in the ships, the owners and the seamen on board. The team comprises captains, managers, etc., namely each team has a full set of capabilities and skills. This resembles to a matrix structure, but it goes beyond that. However, if specialised information is needed, there could be some ‘ad-hoc’ teams, which deal with a specific project or emergent situation.

The teams described above are the answer to the dilemma presented by March (1991), namely how to reap the benefits of exploration without losing the advantages of exploitation. As Cohen (1981) argued, search strategies should be implemented, so as to recombine elements of existing solutions. A recombination is a shift in position that exploits existing knowledge without being trapped by this knowledge. A search process that can simultaneously explore and exploit is created by cross-functional teams, which build on the diverse knowledge of their members. Consequently, another way for CM1 to confront its high environmental complexity is to invest in these teams in all of its offices, so as to benefit from the diversity they present.

CM1 is characterised as a ‘high flex’ company (Teece *et al.*, 1997), because it follows a decentralised structure, enabling local autonomy, so as to reconfigure and transform the company ahead of competition. Earlier strategy frameworks that assigned strategy formulation roles to corporate management, and operational roles to line managers are inappropriate in turbulent environments. Leaving entrepreneurial discovery to top management could turn out to be myopic (Subbanarasimha, 2001). All employees of CM1 contribute to the strategic direction of their company.

Higher Education

The organisations in Higher Education were facing a relatively static and predetermined environment. Consequently, they have not developed many dynamic characteristics, because they were not obliged to do that by the external environment. However, a huge change is about to take place in the industry in question, thus forcing both public and private institutions to develop dynamic attributes in order to adapt to the new circumstances effectively. The new situation though affects each of these actors differently, mainly because they aspire to be in different positions of the landscape. That is why the analysis that will follow will be separate for each of the cases.

- **Dynamic Characteristics of PU**

PU is a relatively small and specialised University in Athens. It is extremely reputable in Greece and very successful in terms of employment of its graduates. Being small, it can also be flexible in its strategic approach.

However, public Universities in Greece suffer from many dynamic disadvantages, since they operate in a rather ‘protected’ environment. The Greek Ministry of

Education is imposing procedures, decisions, even programmes to public Universities. Thus, PU could not avoid the general rule. Consequently, PU is not deciding on its own regarding its strategic moves and actions, which causes several problems to its operation. One of the consequences is that PU is not a research driven University, but rather a teaching one. This means that its faculty is more concerned with teaching, but also consulting, so as to have additional earnings. However, they do not pay the appropriate attention to the research they produce.

Another internal consequence of PU's environment, which hinders potential ability to change, is that there are no linkages at all between departments of the University. It all depends on the willingness of individuals to share the information and knowledge they produce. There are no formal procedures and meetings, so as to disseminate information and adopt best practices within the organisation. The strategic direction of each of the departments is actually a one man show, usually being the Head of the department. The only way to share information across departments is when individuals have developed good relations to each other or they work together in other programmes.

However, PU is regarded as the best or one of the best Universities in Greece and it attracts students of the highest quality. A consequence of that fact is that it recruits the best Greek academics, from all over the world, since when they want to go back to Greece, PU is their first choice. That is why it employs the most well known Greek professors. Its faculty members are well experienced and highly reputable in the Greek society. The fact that two of the Ministers are professors in the University highlights the importance of the organisation for the Greek society in general.

The Ministry, as said earlier, is reducing complexity for PU, since it is the one which makes the decisions. However, it also provides funding to the University, thus PU does not have to seek ways to receive funding. PU has its own budget and they run the organisation on that basis. It is true though that sometimes they need additional funding for specific reasons, but they do not always get it.

Its main dynamic advantage though is its alumni. Graduates of PU are almost everywhere in the Greek market, in almost every company, occupying the highest positions in the hierarchy. Moreover, there is a sense of belonging in that organisation and its graduates help new graduates. However, this is not a formal procedure, it happens only when new graduates send their CVs to companies where an older graduate is working. That capability is a path dependent routine (Eisenhardt and Martin, 2000) and as such, it cannot be imitated by other institutions. Despite the fact though that the alumni is PU's dynamic asset, which affects the decision of many potential students, the University completely ignores it, doing nothing to establish a network among its graduates. Consequently, the power of the alumni rests once again with the individuals, who may want to help.

In general, PU possesses a portfolio of dynamic advantages, which could be valuable for other institutions, especially the private ones, but that portfolio stays inactive. That inertia is caused mainly by the fact that external complexity is reduced by the regulatory role of the Ministry of Education.

- **Dynamic Characteristics of PI1**

PI1 is a small private institution in Greece, perhaps the most respected one, offering equal quality with the public Universities. Its faculty believes that they are even better, mainly because of the fact that they are a research driven institution. However, they are not recognised by the Greek state as a University and this places some constraints on their strategic decisions.

PI1's intention is to offer programmes not to Greek students only, but to expand its market to the Balkans, Middle East and even China and India. They think that there is no particular reason for these students to study in British or American institutions, while there is a programme in Greece, which offers a high quality service. The main obstacle in that direction is the recognition. Students would not trust an institution which is not recognised by its own state.

According to Teece *et al.* (1997, pages 524-525), emulation occurs when firms discover alternative ways of achieving the same functionality. PI1 is not recognised, but it found alternative ways of achieving the same respect and reputation in the market. PI1 has developed links to the international academic community, in order to get the recognition required for their aims. They will also be accredited by international academic bodies and institutions, so the recognition of the Greek state is less important. Thus, its reputation is becoming even better. Reputational assets are best viewed as an intangible asset that enables firms to achieve various goals in the market. Its main value is external, since what is critical about reputation is that it is a kind of summary statistic about the firm's current assets and position, and its likely future behaviour (Teece *et al.*, 1997, page 521).

Faculty members in PI1 are well-known and they have established strong bonds with the academia internationally. Even the younger ones are highly promising research wise. They have developed the academic expertise so as to provide high quality programmes. Moreover, they have no departments, which makes them flexible. They have regular meetings with each other and during these meetings they discuss about potential improvements, but also they present their research to the other members of faculty. Thus, they all know the areas of research of their colleagues and they can establish more links and synergies in their teaching and research efforts.

Researchers (Doz and Shuen, 1990; Mody, 1993) have pointed out that collaborations and partnerships can be a vehicle for new organisational learning, helping firms to recognise dysfunctional routines, and preventing strategic blindspots. PI1 has developed strong links to the business world, as well. Most of the biggest multinational and local companies are collaborating with the institution in many ways. They also send their managers to be trained in its programmes. PI1 is committed to the companies and their needs, since it is their main target market. In this way, they offer only specialised programmes for managers, which can be considered as a complexity reduction, because they do not offer a wide range of programmes.

Finally, another link that they have developed to companies is the grants and endowments that they accept from them, in order to be able to develop their programmes, since they do not receive any government or other funding. These links increase the interdependencies and in turn increase both the internal and the external complexity of the institution.

- **Dynamic Characteristics of PI2**

The second private institution (PI2) that we examined in our research was a well known one, offering many undergraduate and postgraduate degrees. They have established a partnership (Doz and Shuen, 1990; Mody, 1993) with a British University, which is of relatively low quality. However, according to the Dean, students seem to value the brand name of PI2 more than that of the British University, even though it is important for them to get a degree from a foreign University.

Their dynamic disadvantage is that faculty members have no communication and exchange of knowledge at all with each other, so they do not co-evolve as academics. Moreover, PI2 is not a non-profit organisation. This means that there is an owner, namely an entrepreneur, whose goal is to make profit. In this effort, they neglect basic things which are quintessential for an academic organisation.

Its dynamic advantages are not a lot, however they assist PI2 in dealing with its external environment. Since the external environment is expected to increase in complexity, all interviewees in PI2 believe that they should increase their internal complexity, as well, by strengthening their existing dynamic attributes even more.

PI2 was the pioneer in offering specialised Master's programmes in some industries. No other institution, not even the public Universities, were offering these programmes, so PI2 has already gained expertise in these fields. There are some private and public institutions which followed PI2, offering the same programmes, but they do not possess the technical knowledge in order to be competitive.

The partnership with the British University is also a dynamic asset, because they have developed or adopted programmes in various areas, establishing a standard quality in the courses offered. However, they are now well established in Greece and their brand name is highly recognisable by their potential students. Consequently, students value the name of PI2 more than that of the British University.

Moreover, PI2 is very flexible regarding the programmes offered. They offer the same courses in English and Greek, in the morning, afternoon or even evening, full time or part time, etc. In this way, they meet the needs of their customers, who are students with differing demands. A capability related to this is that they have segmented the market successfully and they know exactly the profile and the characteristics of their target group. This may sound obvious, but it is not the case with organisations in higher education. PI2 is targeting specific segments of the market, advertising and promoting its reputation to these segments only, so they do not waste their money without any positive effect. Now that the recognition will take place, their marketing strategy will become even more successful and effective. That is why their ability to segment the market is characterised as a dynamic one in this case.

Finally, PI2 has three campuses in three different areas of Athens, which is considered as an important dynamic asset, in terms of the change that will occur. Students do want to be registered in a School next to them, so geographical proximity really matters, according to their market research. When private institutions are recognised, the different campuses will offer a substantial competitive advantage to PI2.

Research Propositions

In this final part of the data analysis, we will consider whether or not our research propositions are verified. The verification process of course will be based on the data analysis performed above and its outcomes.

Research Proposition 1: Organisations facing high external complexity will tend to explore more than exploit the opportunities presented in the external environment, since they constantly need something new in such circumstances, so as to be always ahead of their competitors

The first research proposition is verified by the shipping companies, which face high external complexity. These companies, as it was shown in the above analysis, have no option but to constantly innovate and search for something new. Consequently, they explore (March, 1991) the opportunities offered, so as to be always one step ahead of their competitors. In the given landscape, they engage in long jumps (Levinthal and Warglien, 1999), in order to locate the global maximum and reach it. These long jumps are made by exploiting their dynamic characteristics. Their ordinary capabilities, even the core ones, cannot assist them in making these long jumps and explore distant parts of the landscape.

Research Proposition 2: Organisations facing low external complexity will tend to exploit more than explore the opportunities presented in the external environment, because the relative stability allows them to do so

On the other hand, the second research proposition is also verified. Organisations facing low external complexity are mainly public Universities, while the private institutions face a relatively moderate one. Universities face a low external complexity mainly because the Ministry of Education imposes rules, regulations and procedures to them, thus reducing the complexity of a 'free' environment. These organisations do not explore the opportunities offered by the environment. On the contrary, they almost ignore them, while exploiting (March, 1991) what they have already earned because of their historical path. The relatively static environment allows them to be inert, and they take advantage of the reputation they have and the fact that they are recognised by the Greek state.

Research Proposition 3: Organisations with high external and low internal complexity and vice versa do not exist or they are not effective. The only effective parts are these having equal external and internal complexity

Research Proposition 4: Organisations which reside in other than the high external – high internal quadrant will tend to move towards that quadrant

The following two propositions are closely related to each other, since if the third is verified, then ineffective companies will move towards a more effective quadrant, namely the upper right one. However, propositions 3 and 4 are not verified and the reason is the same: ship owner 1 (SO1). SO1 faces high external complexity, especially by being in the open market for their vessels, while having a low internal complexity. They possess only a few dynamic advantages, namely the reputation and

the networking, which are the “mandatory” ones in shipping. By exploiting these two, they can be effective and profitable, while being in the upper left quadrant. Moreover, they are not willing to head towards the upper right one, even though they could be even more profitable there. They value other aims more than profit and their strategic decision is to stay where they are now. In terms of fitness landscapes, they have found a local maximum and they do not wish to engage in long jumps (Levitt & March, 1988) in order to reach the global maximum.

CONCLUSION

The authors believe that there are some fruitful ideas in the analysis and this topic is highly promising. The data derived from the interviews are rich and their usefulness to make these notions more practical is important. Assessing the analysis presented above, both in terms of the research propositions and in terms of the general information it provides regarding the issues in question, we come to specific conclusions.

The first one is regarding the shipping industry, which is a quite distinctive industry and presents many peculiarities. The complexity grid which was presented earlier can now be filled with the four companies (three cases and a pilot study), which take their position in the landscape.

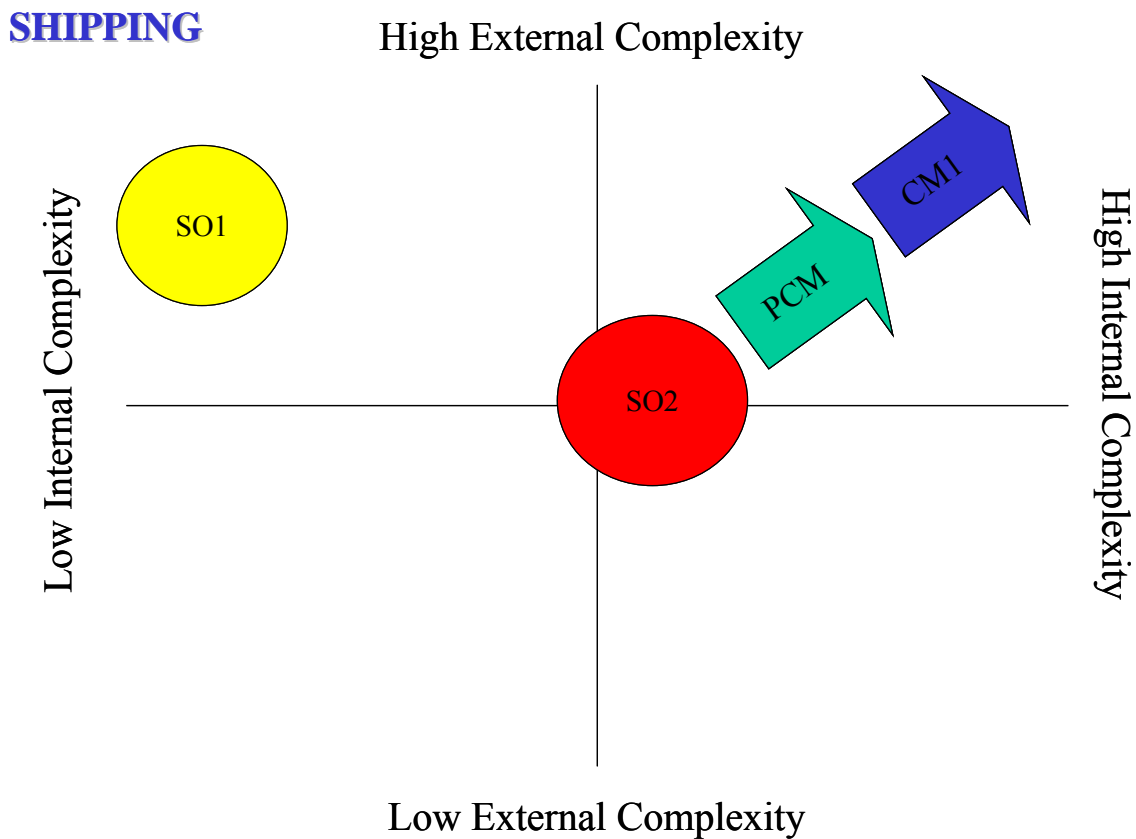


Figure 8: Complexity Grid in Shipping

As we can see above in figure 8, the two ship owners do not reside in the same quadrant and they have distant positions from each other. SO1 is the traditional ship owner and it faces relatively high external complexity, but maintains a low internal one. On the other hand, SO2 is the modern ship owner, facing less external complexity and having moderate internal complexity, thus being almost at the point where the two axes meet. The pilot company (PCM – crew management and manning) and the third case (CM1 – crew management company) are represented by arrows, because they want to increase both their external and their internal complexity. CM1 is ahead of PCM, because it possesses more dynamic characteristics and it faces more complexity externally.

However, some important conclusions that could be drawn are regarding the two ship owners. Both of them belong to different positions in the landscape, but they are both satisfied and successful. What is even more interesting is that SO1 is successful, ‘ignoring’ the law of requisite variety. SO1 maintains low levels of internal complexity, without any ‘scientific’ management techniques and what they do possess is only networking and reputation. These two dynamic advantages are enough for them to confront the huge external complexity they face in such a globalised activity, consisting of lots of stakeholders. Thus, SO1 does not attempt to head towards the upper right quadrant, namely that of high both external and internal complexity, because they think they are doing well in the present position and there is no reason to change. In terms of fitness landscapes, we could say that they have found a local maximum and they do not wish to reach the global maximum. Their attitude cannot be

easily explained and justified. However, if we take into consideration that the fitness landscape in shipping is a coupled one, we can explain it. A coupled landscape, as mentioned earlier, shifts and deforms by an action of an actor or its competitors. As it is rational to assume, if a huge and well-known shipping company like SO1 decides to move towards another peak, the whole landscape will deform, because of the action taken by SO1. Thus, SO1 may not actually go towards a higher peak, but towards a lower one, because of the new situation created by its own strategic moves. This will happen mainly because SO1 competes in the open market for some of its vessels, so the market will be affected by that change. Consequently, SO1 decided not to move from that local maximum, where they are positioned now, since they are effective and profitable. The managerial implication of that decision is that organisations may not want to reach the global maximum. They may be fairly satisfied by climbing at a local maximum, which presents rewards for specific goals that may be of interest for the specific organisation. SO1 could perhaps be more profitable in the upper right quadrant, but its first priority is not profit, consequently they choose not to go there.

A similar attitude is presented by SO2. That company initially absorbed complexity by investing in a totally new market, namely in vessels that they knew nothing about. They were obliged to increase their internal complexity and recruit experienced managers from other companies, so as to gain expertise in that market instantly. When they were established in that market as the market leader, they decided to have all their ships time chartered, which denotes a complexity reduction. They have no ship in the open market, thus not heading for higher profits by taking advantage of increasing prices. As the CEO of the company mentioned: 'I want to sleep at night'. They absorbed their external complexity in the early steps and now they reduce it, because they have the size required to be successful and moreover they also do not wish to make more profits. Consequently, SO2 presents another 'peculiarity': it uses both complexity absorption and reduction, depending on the timing and the strategic decisions they have to make.

Crew managers are almost the fifth wheel in that industry, even though their importance in the market is significant. That is why they are absorbing their external complexity, mainly because they do not possess the required power to reduce it. However, as it was shown in the analysis earlier, they can also affect their environment sometimes, by using their dynamic characteristics in order to be proactive.

Consequently, we have to assess our research propositions, not only on the basis of the quadrant that actors are in, but also on the basis of the direction that they have. If companies are heading towards different positions, their decisions may differ from those of companies which are static in the same quadrant. Moreover, there are levels of complexity absorption or reduction, because of differing characteristics in each industry or in each organisation.

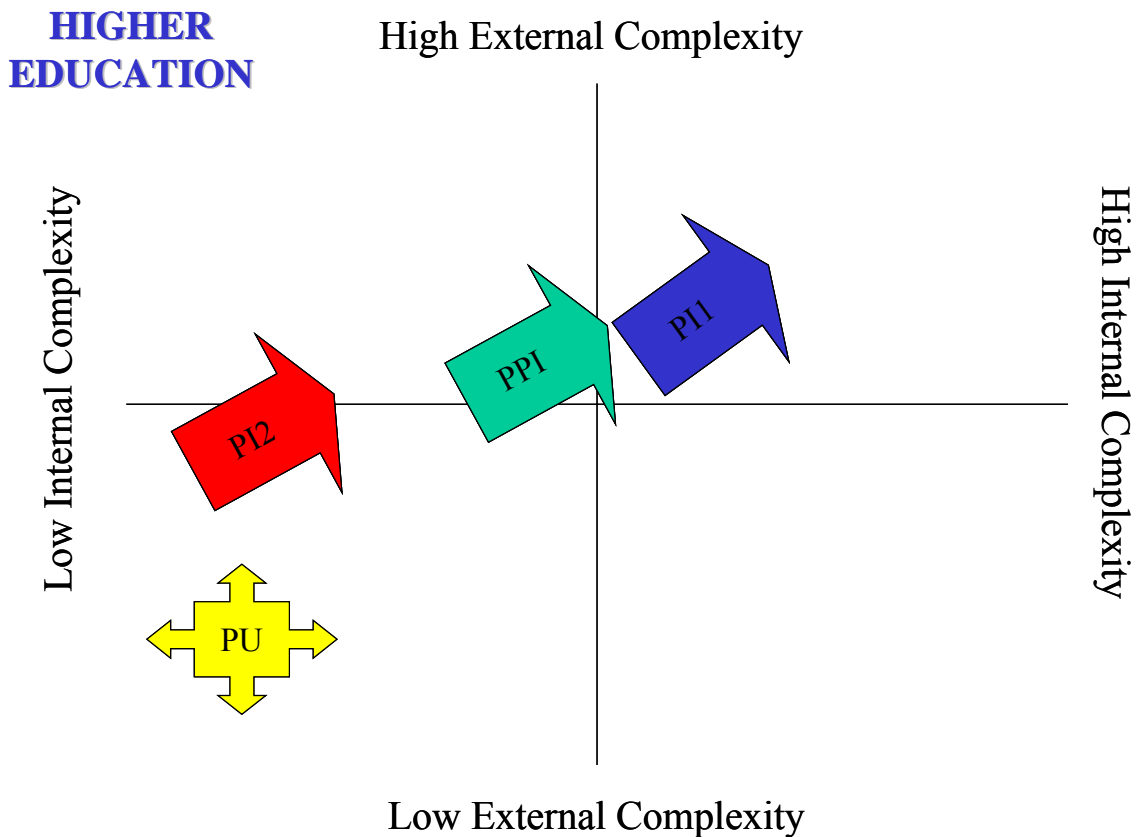


Figure 9: Complexity Grid in Higher Education

The conclusions that could be drawn in Higher Education are also important. PU, the Public University, accepts what it is imposed by the Greek Ministry of Education. In the present period of change, PU is waiting for the outcome of the change and the new regulations. This is why they do not know which direction they will follow and they are represented by four arrows pointing to all directions. If the Ministry sets them free, public Universities will move relatively fast towards the upper right quadrant. However, they were 'protected' by the Ministry for many decades now, and it is really doubtful whether they will be able to reach the global maximum (or even a local one after a certain period of time).

On the other hand, things are easier for private institutions, according to how they perceive their environment. They will be the ones to be recognised as private Universities and they will develop a significant dynamic characteristic by that recognition: that of legitimacy. Legitimacy will assist private Universities in adapting to change, growing bigger, targeting new markets and addressing to new students. However, not all private institutions belong to the same 'league'. There are at least two or three 'leagues': the first one consists of the high quality institutions (which are only a few), the second one the average quality ones and the last one the low quality institutions (the majority of them belong here). Depending on their 'league', they will occupy different positions in the landscape presented in figure 9, actually climbing on local maxima. Only a few institutions, either public or private, are able to head towards the global maximum, but the landscape will be initially deformed so much, that it will be difficult for any actor to locate the highest reward. The path dependency (Eisenhardt & Martin, 2000) though of their dynamic characteristics will be even

stronger, because their decisions now will affect them a lot in the future, mostly through reputation and academic achievement.

A final comment is that managers and faculty members give a different meaning to complexity than that used in the academic literature. As Axelrod and Cohen (2000) argued, a complex system is different than the complicated one. A system which consists of many elements is a complicated one. In order to be complex, there should be many interrelations, between elements of either a single entity or different entities. This is in line with the NK(C) model presented by Kauffman (1993), where N are the elements, K the interrelations within a single entity and C the interrelations between different entities. However, managers' perceptions affect their behaviour, as well, so we have to comment on these perceptions. The interviewees believed that a complex system is the one having many elements (namely the complicated one). If a system has many interrelations, then they call it dynamic. A comment directly related to this is that they value C more than K and K in turn more than N, when making their strategic decisions. For example, having many competitors may be ignored by some organisations. But if these competitors have developed networks with each other, or with other forces in their external environment, then the organisations are more alerted.

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