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M.Sc. IN ENTRPRISE RISK MANAGEMENT

MASTER THESIS

A RISK ANALYSIS ON A DIFFERENTIATION IN THE PRODUCTION PROCESS OF AGGREGATES FOR CONCRETE

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Abstract

This dissertation has to do with the risk that may arise from a differentiation in the production process of concrete aggregates. The essay is divided into two major categories.

In the first part an alternative method of concrete production is presented and analyzed. This proposed method will reduce the environmental waste of one of the raw materials (aggregate sand) that is used in the design of concrete mix, while at the same time the cost of the final product will be decreased as well. This will be presented in the following pages through a techno-economic study that will describe the current state of concrete sand production. Questions like how much it costs to the concrete company to buy the sand today , and how much the sand would cost if the process of producing it would change as this thesis proposing will be answered. This is amplified with the presentation of a concrete strength study that indicates that the mix design of concrete with the two different sands (the one used today and the one we suggest to use) has the same results. This is to prove that the quality of the final product is the same in both of the mix designs.

In the second part of the thesis a comprehensive risk assessment will be made based on change of the production of sand used to produce concrete. However, for this change to take place, among other threats, a change in the legislation of the Republic of Cyprus is also required. Starting with the identification of stakeholders, which are numerous and cover a large part of the society of Cyprus (Citizens, Owners of sandstone, Limestone and Diabase quarries, Quarries association, Owners of concrete factories, Cement factory, Technical services of the Ministry of Interior Environment Department of Cyprus, Water supply of Famagusta area/Farmers, Mines service, Sovereign Base Areas -U.K). Following that a qualitative Risk identification will be presented choosing tools from the bibliography in order a Risk analysis of both threats and opportunities that may arise from the change of the production process to developed. The risk assessment will follow the basic stepwise process (Risk identification-Risk analysis-Risk treatment) At the end of the risk analysis process, for the risks that will be calculated as important the work will present a thorough risk treatment to mitigate as much as possible the threats and to exploit to the maximum the opportunities.

1.Introduction

The 1960s saw the development of environmental economics in the Western countries as an expression of emerging "green thinking" and the environmental movement. During this time, the term "Environmentalism" was spread around the globe. Of course, we should not forget that Environmental Economic is a branch of Economics, the Development of which dates to the 19th century *(Zagorianakos 2002).* During the 1990s, environmental social scientists developed the concept of ecological modernization to capture the changing intellectual and institutional context of environmental policymaking in economically advanced nation *(Cohen 2006).* At international conferences, efforts are made to redefine development and action, and changes in production processes and consumption patterns are planned, especially in developed countries. Today, the proposals to the member states of the United Nations (UN) focus on the sustainable development of the environment and in the sense of balanced development, in which all aspects will be considered and not only the economic ones. Sustainable development is based more on the prediction of environmental problems. (*Spyropoulou, Kontaxaki 2005).*

The increase in urbanization and industrialization leads depletion of natural resources *(Mehta and Meryman 2009; Nanthagopalan and Santhanam 2010; Behera et al. 2014).*

In this field of prevention this thesis will primarily focus on. More specifically, alternative methods of concrete production will be analyzed which will reduce the environmental waste of the raw materials of the concrete in the quarries, while at the same time the cost of the final product will be reduced.

Experimental methods of concrete production are not something new in the scientific world., especially in the 21st century there are many studies on this subject. There are examples in the Mediterranean countries with siliceous and limestone additions, obtained by fine grinding of dune sand and sieving aggregate crushing waste, respectively. Both additions are added by substitution to the cement content. To model the influence of cement content and the dosages of these additions on the properties of high-performance concrete, *(R. Zaitri 2014),* or in other areas of the planet they are experimenting with the Utilization of limestone powder as an activator for early- age strength improvement of slag concrete *(Chenzhi Li 2018)* Using mineral slags to replace a portion of cement is a promising way to reduce carbon emissions from concrete production. However, slag

concrete suffers from low early-age strength and large dry shrinkage. To address this issue, limestone powder was utilized as an activator for slag concrete
The valorized materials are mineral additions:

2.Description of the current situation - and the problem

In this case will be analyze how a change in the production process of concrete can lead to a reduction in costs in the final product of the consumer which will result from the production process of aggregates. Aggregates are a granular material used in construction. Aggregates are sand, gravel (including marine aggregates), crushed rock, recycled and manufactured aggregates. Aggregates are produced from natural sources extracted from quarries and from sand and gravel extraction sites in some countries from sea-dredged materials (marine aggregates). Recycled aggregates derive from reprocessed materials previously used in construction, including construction and demolition residues. Manufactured aggregates are sourced from industrial processes, for example from blast or electric furnace slags or china clay residues.

Specifically, if we differentiate the product of production, this composition of sand (in terms of its granulometry) and how it will affect the final cost without altering in any case the quality of the concrete. In the presentation of the different compositions, a typical concrete composition that is currently used in the Cypriot concrete production plants will be presented, as well as an alternative that will have a different composition in terms of its granulometry.

The reference quarry from which the data are received is KAOS. while regarding concrete we will use information from Tsikos concrete company. This will be the first part of the master thesis

The second part of the thesis will be focused on his risk analysis on how this differentiation in the production process of concrete aggregates could affect the stakeholders.

First the stakeholders and their points of view will be identified, using the appropriate tool from the literature (it will be a combination of pestle, porters five forces and the ISO standards that are used for management systems). After that we will proceed with a thorough recognition of the risks. Starting qualitatively and following the basic stepwise process by Identifying which are the risks. After that, the analyze of them will take place depending on the priority of each risk (the priority will be calculated depending the likelihood x impact). When the threats and opportunities are

analyzed, they will be categorized based on the priority that should be addressed. Finally a thorough risk treatment will be presented in order first to avoid , reduce and compensate each risk.

3. Quarries in Cyprus

The quarrying industry of Cyprus is intensely activated. There are about 200 quarries that produce various rocks and industrial minerals. From these quarries 45 are in the final stage of their operation and the restoration of the area.

For inland use the following are produced:

- Havas's for embankments and roads subbase.

- Aggregates mainly from limestone and diabase for the needs of the building industry and other constructions (roads etc).

- Limestone, clay, and gypsum as raw material for the production of cement.

- Limestone to produce lime.

- Clay for bricks and tiles.

- Gypsum to produce plasters.

- Sandstone to produce building stone.

The country is considered self-sufficient regarding raw material for buildings, roads, harbors, dams and other constructional works. *(Cyprus Mines Services 2020)*

3.1 KAOS Quarries

The quarry produces limestone products is based in Xylophagous and supplies aggregates to the Larnaca, Famagusta and Paralimni areas.

The idea behind this thesis came from a study carried out by the quarry itself and concerned various experimental concrete compositions, and had in essence 3 objectives,

1) To reduce its production costs, since with the existing production process the produced sand must first be washed to meet the requirements of Regulatory Act 164/2011 which we will see in detail below

2) To reduce the waste generated from the production process (mud) that has an environmental impact on the quarry and the wider area.

3) To calculate the cost of concrete in the way it is produced today, and in the way it will be produced through this.

3.2 Concrete factory Tsikos

This is a company located very close to the quarry under study and will be the plant that will be studied in relation to the production of concrete. In this case we list 3 different types of concrete with three different concrete compositions which in turn will give us specification results. In other words, we will show concrete compositions for the category C25, C30 and C37 (describe what each one is and include bibliography) The factory has existed in the area since 1973 in Derynia in the province of the Free Zone of Famagusta. Since 1990 the company has acquired an automated ready-mixed concrete production unit which has been installed in the area in a privately owned space. This unit is maintained to this day in excellent condition and has a service capacity of up to 500m3 per eight hours.

4. Consistent quality of the final product

4. 1 The European Standard 12620: 2002

This is a European standard prepared from CEN/TC 154 "Aggregates". It is specifying the properties by processing natural manufactured or recycled materials and mixtures of those aggregates for use in concrete. It covers aggregate having an oven dried particle density greater than 2,00 Mg/m for all concrete, including the concrete that conforms with the EN206-1 (European Standard for manufacturing concrete). It also specifies that a quality control system is in place in the factory production control and it provides for the evaluation of conformity of the products to this European standard. *(CEN 2002)*

As fines or filler, according to the European standard EN 12620 is defined the graduated fine inert material with a maximum grain of 2 mm, and which passes at a rate of 70 - 100% through the sieve 0.063 mm. *(Taylor 2002).* The fines content is determined in accordance with EN 933-1, are declared according with the relevant category according with the table below

Aggregate	0,063mm sieve Percentage passing by mass	Category f
Fine aggregate	< 3	f_3
	<10	f_{10}
	<16	f_{16}
	<22	f_{22}
	No requirement	f_{NR}

Table 1 – Categories form maximum values of fines content

4.2 The restriction of Legislation of 164/2011

Annex				
EN 12620: Aggregate for concrete				
Paragraph	Test	Limits		
		Coarse aggregate	All in Aggregate	Fine aggregate
4.6	Fines Content			Max Category f10

Table 2 – Restriction of Legislation

The limitation that comes from the technical services of Cyprus is the percentage that you allow the final product of the sand to have in its composition the fines. That is, the state comes to restrict the use of fines only in one category only in f10.

4.3 Description of the process

At this stage of the dissertation α comparison of the results will be made, with the experimental mix design carried out by the limestone quarry that contains fines in percentage 15% and the mix design that is used with the limitations placed from the Cyprus government . Once more we should emphasize in the fact that the sand with a percentage of 15% is allowed by the standard EN 12620: 2002 while it is forbidden by the legislation Regulatory Act 164/2011. There are several analyzes and experimental concrete compositions in this study, but we will deal with the two mixtures whose results are consistent and have substantial differences.

Mix Design for C35- 1st Specimen. Combination of limestone sand and sandstone. It is the mix design used today in the concrete factory

Data	Kg
Cement – CEM II /A-L 42,5	340
Limestone sand 0-4	573
Sandstone 0-4	196
Aggregates 8-20mm	578
Aggregates 4-10mm	296
Water	211
Admixture	1

Table 3 - Mix design for specimen 1

Mix Design for C35- 2nd Specimen with the unwashed sand of 15% fine.

Data	Kg
Cement – CEM II /A-L 42,5	340
Limestone sand 0-4	795
Sandstone 0-4	0
Aggregates 8-20mm	540
Aggregates 4-10mm	277
Water	221
Admixture	1

Table 4 - Mix design for specimen 2

The procedure for mixing the concrete complies with the requirements of *EN 123501-1*. After the manufacturer of the concrete is completed the specimens are cured and maintained in the mold for 48 hours at a temperature that was between 20-25oC *(5.5.1, EN 12390-2).* After removing from the mold, the specimens were placed in water at a temperature of 20oC *(5.5.2, EN 12390-2).* The nominal size of the cube (specimen) was according to the relative European standard EN 12390-1

The important thing of this process is to observe that with different compositions, concrete as a final product gives us the same quality results in both mix designs.

In all the cases of the concrete compositions from its production΄ (until the calculation of breaking strength) they were used the same and followed the requirements of European Standard that are mentioned above.

Concrete Grade C35	Crushing strength	
	7 days N/mm^2	28 days N/mm^2
1st Mix	27.7	
	27.3	
		34.4
		35.0
2nd Mix	27.9	
	27.7	
		33.8
		33.5

Table 5 - Crushing strength for both mix designs

It is obvious that the results in both cases are fulfilling the requirements of the standards and the comparative results for both mix designs are the same.

Based on the Information given from the GM of N. Odysseos Tsikos, the cost of the raw material of the 1st mix design are the following

Raw material	Type	From	Cost
Cement	II AL-42,5	Vassiliko Cement Factory	23.12 /ton
Aggregates	4-10mm	Mosfiloti quarries	6.86 /ton
Aggregates	8-20mm	Mosfiloti quarries	6.86 /ton
Aggregate Limestone	0-4mm Sand f_9	Kaos Quarries	6.40/ ton
Aggregate Limestone	0-4mm Sand f_{15}	Kaos Quarries	5.60/ton
Aggregate silica sandstone	0-4mm sand f_9	Latouros quarries	11/ton
Admixture	Frinics retarted	Frinics Chemical ltd	0.45/lit

Table 6 - Source and characteristics of raw materials

Those prices are the exact amount paid from the concrete factory at October of 2020.

Going back to our two-now mix design we can apply the prices of the raw material into the two different types of mixtures

1st Mix design			
Data	Kg	Price/Quantity	Cost per m^3
Cement – CEM II /A-L 42,5	340	23.12 /ton	23.12
Aggregate Limestone f9 0-4	573	6.86 /ton	6.4
Aggregate Sand Silica f9 0-4	196	6.86 /ton	11
Aggregates Limestone 8-20mm	578	6.40/ ton	6.86
Aggregates Limestone 4-10mm	296	11/ton	6.86
Water	211		
Admixture	1 (lt)	0.45/lit	0.45
Sum cost of raw materials			20.13

Table 7- cost of raw materials per m^3 1st mix design

2nd Mix design			
Data	Kg	Price/Quantity	Cost per m^3
Cement – CEM II /A-L 42,5	340	23.12 /ton	23.12
Aggregate Limestone f15 0-4	795	6.86 /ton	5.6
Aggregates 8-20mm	540	6.40/ ton	6.86
Aggregates 4-10mm	277	11/ton	6.86
Water	211		
Admixture	1 (lt)	0.45/lit	0.45
Sum cost of raw materials			18.36

Table 8- cost of raw materials per m^3 2nd mix design

By observing the result of the total costing of producing 1 m^3 concrete one can easily conclude that there is a significant reduction in the cost for the two different mix design. Today the mix design regarding only the price of raw materials is 20,13 euro/m3 while the experimental mix design costing only 18,36 euro/m^3. That is, by simply changing the sand in the concrete composition, the producer has a reduction that reaches almost 10%. Perhaps more interesting is if we compare only the parts that changes in the mix design.

Data	Kg	Sum	Price/Quantity	Cost per m^3	Cost of 0-4	Sum
1st mix design						
Aggregate Limestone f15 0-4	795	795	6.86 /ton	5.6	4.45	4.45
2nd Mix design						
Aggregate Limestone f9 0-4	573	769	6.86 /ton	6.4	3.667	5.8232
Aggregate Sand Silica f9 0-4	196		6.86 /ton	11	2.156	

Table 9 - Cost of raw materials per m^3 2nd mix design

Comparing the costing only for the sands, the combination in the first mix design of limestone and sandstone we observe that the cost is 5.8232 euro per m^3 , while in the second case (experimental mix design) the cost is 4.45 euro per m^3 , meaning that a cost reduction of 25% can be achieved.

5.Identification of stakeholders

A stakeholder is a person or organization that can affect, be affected by, or perceive themselves to be affected by a decision or activity (ISO 31000). Stakeholders should have the opportunity to provide their perspective and have it considered even though it may not align with that of the organization. External stakeholders can include shareholders who expect a return on their investment and ongoing performance of results.

- customers who are affected by the quality of products and services.
- suppliers and partners who expect an enduring and reliable relationship.
- government (national and local levels), unions, non-governmental organizations; and,
- the public, who depend on the organization's economic and environmental performance, its reputation, and compliance with legal and regulatory obligations.

Internal stakeholders include employees, all levels of management, and others involved in the effective management of risk. Specific responsibilities include:

- being aware of and fulfilling their responsibilities as defined by the risk management framework.
- providing input into risk management activities.
- participating in risk management procedures and processes to identify and analyze risk;
- ensuring treatments for risks are effective within their area of accountability.
- reporting risks; and,
- following policies and procedures to ensure compliance.

After the costing analysis of the raw materials of concrete, the case study will focus on the analysis of the risk that such a progress might have. *(ISO 31000 Handbook)*

The stakeholders, their interest and their points of view are presented in the matrix below as they extruded from the bibliography on the subject. The main stakeholder groups are of course the citizens, the government, the owners of the quarries, the owners of the concrete factories the Environment Department, Mines service, the quarries association of Cyprus, the Sovereign Base Areas -U.K. of Cyprus, Water supply board of Famagusta and the Technical services of the Ministry of Interior.

Stakeholders, Points of view and interests
Citizens
The first interested party or stakeholder are the people of Famagusta area or the general population. This is a category of stakeholders which will be affected in the primary by the reduction of the final product, not the new sand that will be made, but the concrete that as we have already shown will be cheaper. So as ordinary consumers they will see it positively since based on its principle of consumer surplus, the maximum amount any buyer in the market is willing to pay for a unit by the demand price for the unit of the good (economic value) and the market price the consumer must pay *(Thomas 2013, Menegaki 2020).*

Owners of sandstone quarries:
This is a complicated situation. That is because as we demonstrated in the previous part of this dissertation in the mix design if the limestone sand (product of KAOS quarry) is not washed then the concrete factory does not to buy any sandstone (which is more expensive in relation with the limestone sand) since the workability properties it would give to the mix design, they are no longer needed due to the already increased dust that the composition already has sandstone (that is more expensive than the limestone sand) this is a change that will not be in favor of the interest of the managers of sandstones quarries . But on the other hand, this means that their own sand will be produced cheaper, that is, if it is done established that sand will not be washed, then their cost will be reduced as well. So, it seems that there is a threat that can be developed in the oligopolies in that built at the same time there is also an opportunity. In this case the managers should aim to Nash equilibrium meaning that a set of actions for which all managers of sandstone quarries choosing their best actions given the actions chosen by those of limestones (*Thomas 2013)*
Owners of limestone quarries
There are many different opportunities on their part, obviously they will benefit in many levels. They will produce a product that will not follow the sand removal with a turbine but with air, which will thus reduce its production costs to a significant degree. At the same time, the volume of environmental waste of the fine-grained product will be reduced. Furthermore, the lifetime of the quarries will be significantly increased. This is the stakeholder that obviously will benefit the most if this change will be applied.
Owners of Diabase quarries
They do not seem to be affected directly in the first place, but the fact that their competitors will be able to offer a product at a lower price, even for a while, will pose a threat depending on the size and location of each quarry. Although these quarries do not sell sand in the area of Famagusta because it is far from them it is unprofitable to transport them due to logistics. The other area that has limestone quarries in Cyprus is located in the west part of the island in Polis Chrusochou, an area that also the diabase quarries does not sell their sand for the same reason we said before.

Quarries association
Some members will benefit, while others will not. Although some categories of quarries will probably one way or another may lose some market share. This will may cause problems in the quarries association and they may have to treat it as a systemic threat for them that could even Disturb their wellbeing . It can even result in tactics that are used in oligopolies as tic-for tat (a situation in which you do something to harm someone who has done something harmful to you) between the different quarries.
Owners of concrete factories
With this change the factories will be called upon to decide. In any case, they will know, that the product they will be buying now on will be a lot cheaper to be produced by the quarries , so they will expect to buy it cheaper than they used to . So, it's a great opportunity in the long run for them as they will benefit economically.
Cement factory
In Cyprus we have the case that all the cement is manufactured and delivered by a single factory (Vassiliko Cement company), so here we have a monopolist company (a firm that produces a good for which there are no close substitutes in a market that other firms are prevented from entering because of a barrier to entry Tomas 2013.). The involvement of cement in our case comes from the fact that there are several studies that promote and claim that by adding different fine-grained materials you can partially reduce the addition of cement (*Venkatesen 2020 , Vindhyan 2020)* Nevertheless the reduction (if any) of the proposition of the cement will not be so big in ordered to alert the cement factory.
Technical services of the Ministry of Interior
The ministry will be, as one might imagine, negative from the beginning, since it is it that has issued the legislation for the increased percentage of gravel in the sand under production. In addition, it will not take kindly to the fact that he will be challenged, while it will be afraid of other similar studies for other construction products in which he has set prices that are stricter with the harmonized standards. This here may be the biggest threat to the project we are studying

Environmental Department of Cyprus
t is a development that will be duly appreciated by the specific department since on the one hand they will consider that the environmental waste will be reduced firstly while they will see it as an opportunity for actions in the other quarries as well. Also in this way the quarries will operate for more years (even a few) so that there is no need to open quarries in other areas of Cyprus *(Good practice-code No. 263/2007).*
Forestry department of Cyprus
This department although has a small role in this risk assessment, nevertheless, is still a stakeholder. Its role in the quarries is to oversee the restoration of the natural landscape in the areas where the extraction / quarrying of the material has been completed. The restoration success in quarry depends on backfilling material characteristics *(Gentili 2020).* A possible change in the production process also means a change in its waste, which will positively affect the flora of the quarries.
Water supply of Famagusta area/Farmers
There was a conflict as we said in the past with these two categories of industry, although now the problem between the construction industry and the farmers in the area has been solved, ie they get water from the higher treatment recycled water from the unit that supplies water to the province of Famagusta. As the science of water resources management progresses you do not anticipate a problem in the future as the quantities of recycled water will increase *(Tofa 2013).*
Mines service
A possible change of the production process is a development that most likely will be considered positively but at the same time may be treated with suspicion by some of the department's officials. On the one hand we have already said that it is a development that will extend the lifetime of the quarries, on the other hand the current legislation shows that such a change in the production process will put the product out of standards resulting in concern in the department.

Co-owners of the Three quarries in the area
In the description of the KAOS quarry, which is also our study quarry, we have previously stated that in fact it borders with two other quarries which today are competitors since I sell essentially the same product. In such a case, however, all three quarries will benefit and this will be considered as an opportunity for their survival. A good opportunity would be to strengthen their relationship towards this common goal.
Sovereign Base Areas -U.K.
The entire area where the quarry is located belongs to the U.K. that is, it is in the sphere of influence of the English Bases. The area's quarries had asked the sovereign bases a work permission to expand to find more mining material so they can operate for more years. But this request rejected several times from the sovereign. If the change in the production process proceeds, it will be a great opportunity for the relations between the two sides, it will be something that they will see with a positive eye.

6. Methodology of risk assessment

After the end of the identification of the interested parties, a framework must be selected as the most appropriate so we can proceed to the risk assessment. The main options regarding the frameworks for risk assessment can be summarized in the following four.

6.1 Risk Governance framework of the IRGC.

First there is the methodology based on the is because the Council has already an interactive framework of risk based on the concept of risk governance *(IRGC 2005).* This framework covers a comprehensive means of integrating risk pre- assessment, appraisal, and management. In this process communication is a affects all phases of addressing risks and is itself a cyclical nature.

When referring to risk management one might think mostly organizations and companies When the term governance is used, is to refer to a risk that is a risk that affect society in general. In this case we more than a few risks that although some affect the community, there are others that would respond better to other frameworks.

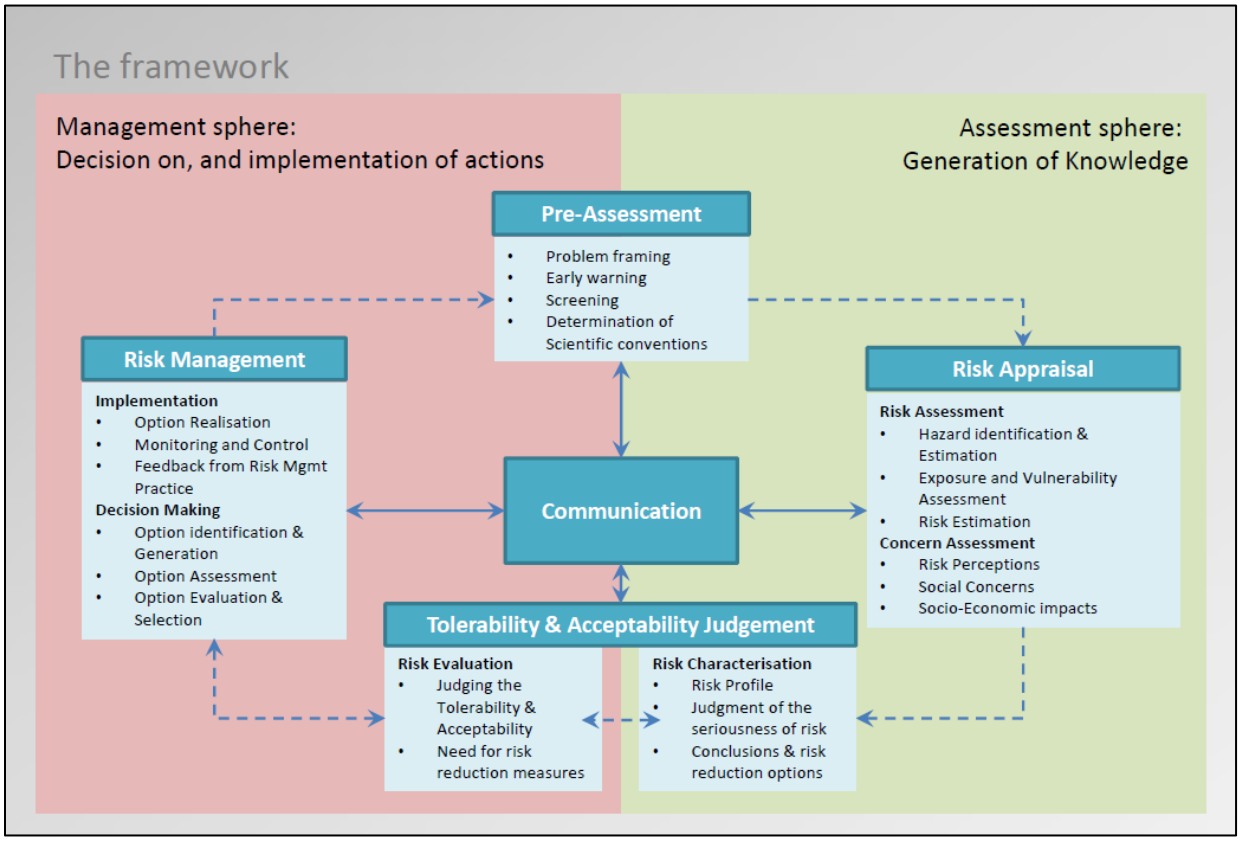

Figure 1 - The IRGC risk governance process (adapted from IRGC 2005)

6.2 COSO's framework

COSO, s framework is an approach to risk management, focused tightly on organizational risk management. This is a framework designed focused in the three key organizational dimensions. Those are the Organizational objectives, grouped as Strategic, Operational, Reporting, and Compliance related. The risk Management components, for example the procedural elements of risk management, and the organizational entities within which risk management is applied. With this in mind the COSO framework is easier visualized as a cube, whereby the three dimensions serve as coordinates. By focusing on range of each dimension, it is possible to pin down 'precisely' the context and setting whereby risk management is applied in a particular organization. This multidimensional view can help with the flexibility to the implementation of risk management, which is more consistent with organization-chart-like perspectives of organizations.

The COSO 'cube' is illustrated below.

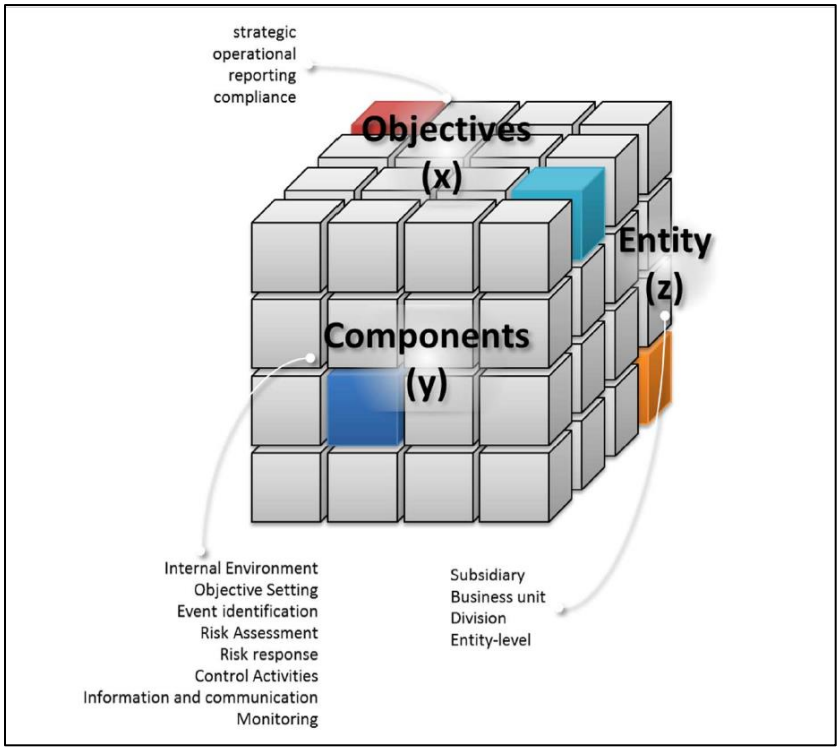

Figure 2 -The COSO framework (Objectives, Entities, Components)

This is not a standard for communities, the level of entities on the other hands is very good for large organizations *(Luzzi 2012).* Very good for multisite companies, it can also allow you to use the 2-way matrix approach of organization in a company *(Daft 2018)*. The multiple entities and the multilevel goal setting are crucial for companies. It is not also the best solution for the case we are studying, since COSO needs stability. COSO will handle All problem in one company**.** *(Moeller (2011) Ch. 4, Ch5)* This is a standard that is for Risk management for a lot of different risks (that can be applicable in this case) but is used for one company, and not in different organization as in our case.

6.3 ISO 31000:2009

Is an international standard on risk management, issued by the International Standards Organization, (ISO 2009). This is a management standard that considers organizational risk management as the interaction between three main components. Those are the principles, the framework, and the process.

The principles can provide a governance ‘template’ for practicing an effective of risk management within the organization. That is, risk management can create value and is an integral part of the process in an organization. Is part of decision making and also can address uncertainty when it is systematic, structured and timely. Is Based on the best available information and it is tailored while it takes human and cultural factors into account while it is also transparent, inclusive, dynamic, iterative and responsive to change

Finally, it facilitates continual improvement and enhancement of the organization. The risk management framework provides a blueprint for organizational arrangement that allows the integration of risk management with other organizational functions, as a separable function. The ISO 31000 frameworks is illustrated below.

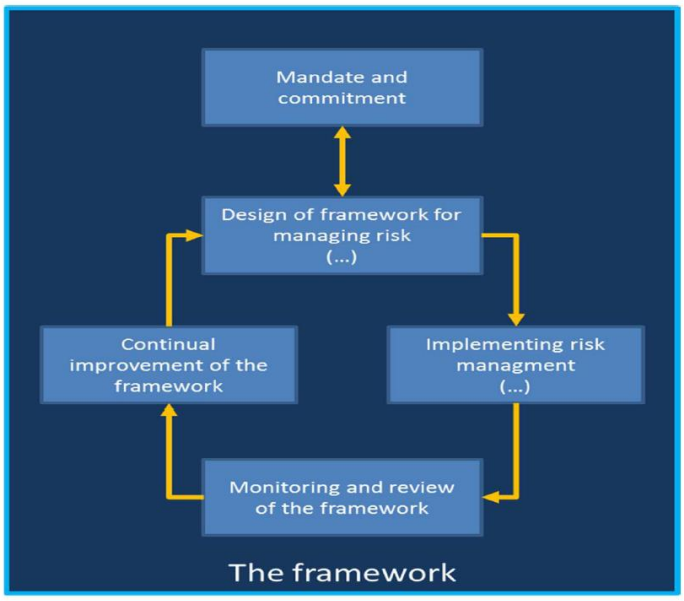

Figure 3 -The ISO 3100 framework (Objectives, Entities, Components)

The risk management process is stepwise approach for hands-on risk management, i.e. dealing with the organization's risks, at all levels of the organization. The ISO 31000 process is illustrated below

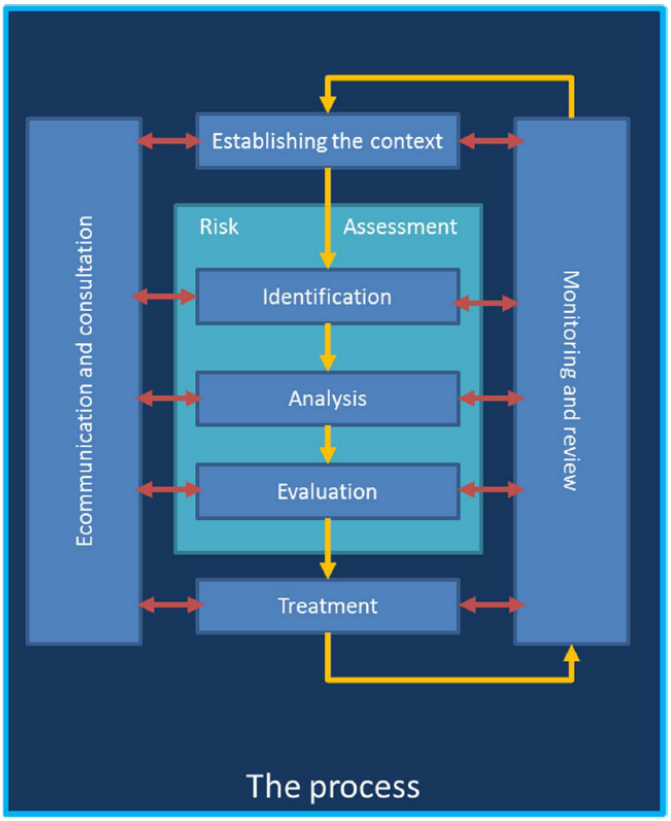

Figure 4 -The ISO 3100 process

ISO 31000 is a generic applicable to all organization standard. This is a benefit of this standard when you do not know what framework is best fitted for your case. But if we had to categorized, we will have to choose that is closer to Risk management, this framework would be the best solution compared with the other two, although in this case it is better to use even a more generic approach as the fourth alternative

7. Basic stepwise process.

For this thesis the framework that is going to be used is the basic stepwise process (Targoutzides 2020) In the first stage the risk will be identified, while in the second stage those risks will be

analyzed in terms of likelihood multiplying with the impact, and then prioritize them (a detailed methodology will be presented). The third and final stage will be the risk treatment (avoid-reduce-compensate).

This framework is chosen because we are dealing with risks that will be for the community, but also risks that have to do with the company as an entity and its competitors.

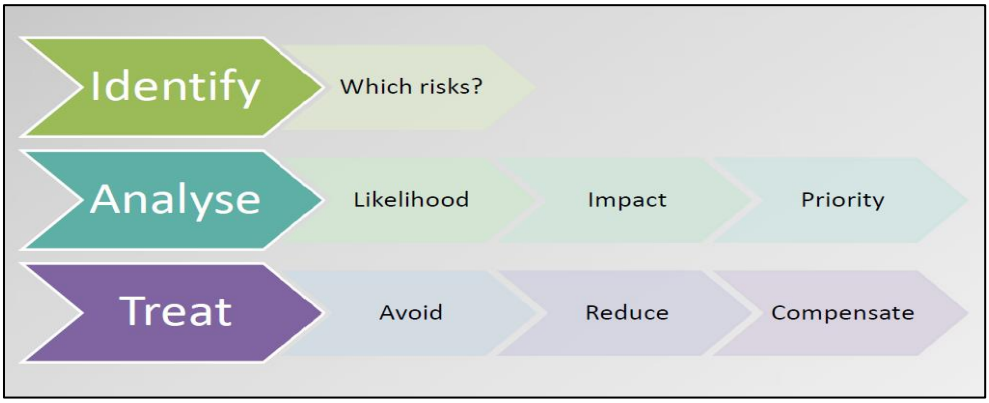

Figure 5 -Basic risk management process

The framework of the basic stepwise process will be used , but tools from other frameworks will be used as well. For example regarding the Methodology of quantitative the threats and opportunities the tool of Consequence Probability matrix of ISO 31010 will be used.

7.1 Identification the main risks – STEP 1

7.1.1 Daft Approach

The first task is to address and identify the stakeholders that affected form the change of the production of aggregates. In order to do that we must define the methodology that is going to be used. In this case was chosen to use the the diagram found in (New Era of Management) *(Daft 2012).*

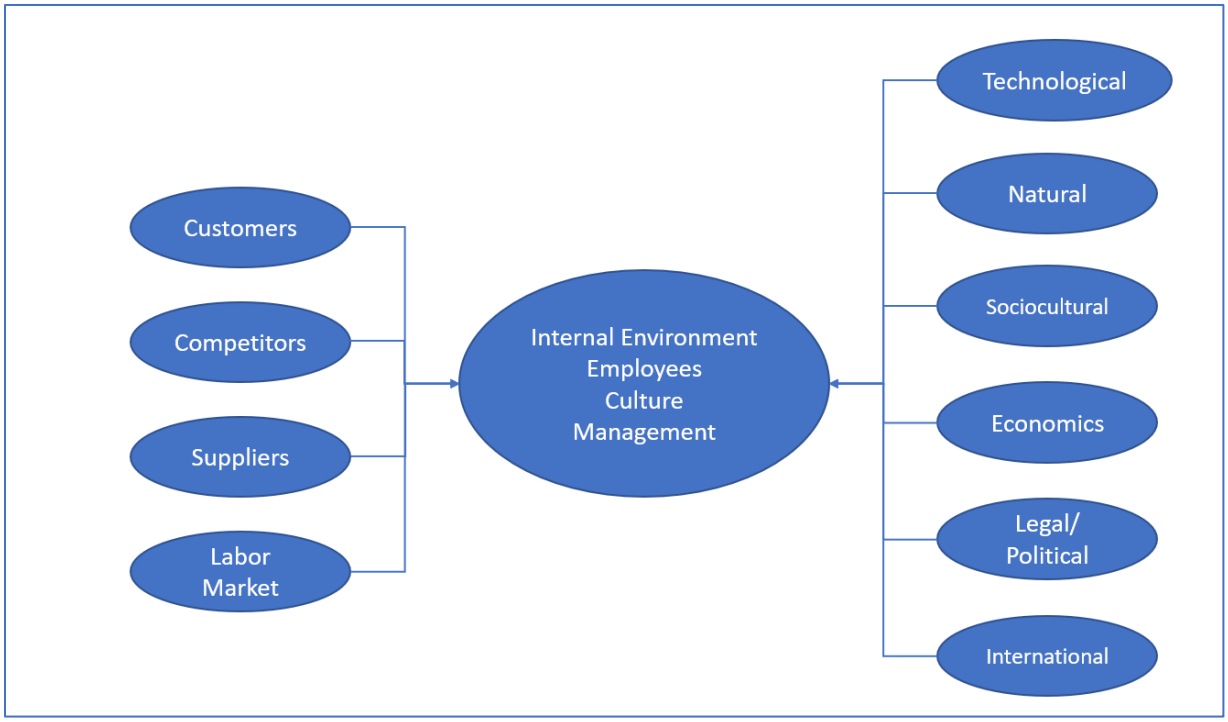

Figure 6 -Daft approach of identifying Stakeholders

This method was preferred because it combines the advantages of PESTLE analysis *(Perera 2017)* with those of Porters five force *(Miller 2011)* and is generally reminiscent of analyzes of international ISO systems management standards *(ISO 2015).*

7.1.2 Pestle Analysis

The PESTLE analysis (*Tacit Intellect 2012*) is the tool that is going to be used to identify the stakeholders. PESTLE is the acronym of Political, Economic, Social, Technological, Legal, and environmental factors which after their identification will lead us to analyze the risks of the company. One of the forms illustrated in the literature in the form of the following shape.

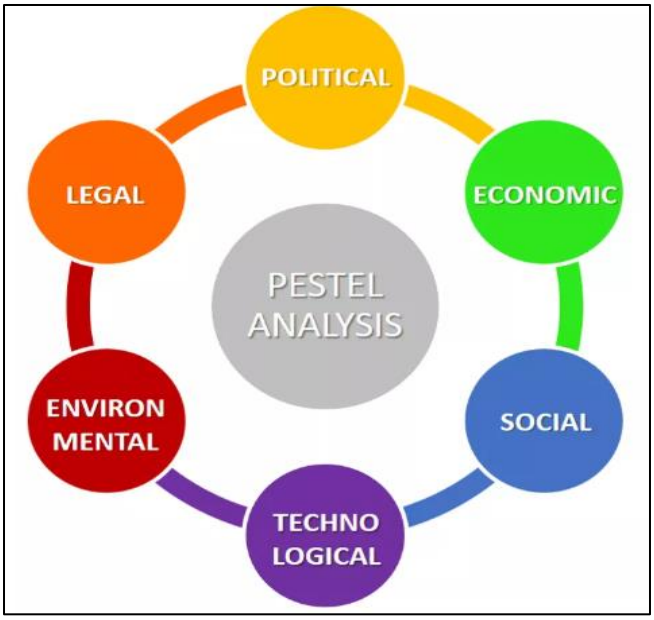

Figure 7 -PESTLE Analysis

7.1.3 Porters five forces

Porters five forces *(Miller 2011)* The tool was created by Harvard Business School professor Michael Porter, to analyze an industry's attractiveness and likely profitability. Since its publication in 1979, it has become one of the most popular and highly regarded business strategy tools. Competitive Rivalry: This looks at the number and strength of a company's competitor and it can help the organizations to understand how many rivals the company has and what the quality of their products and services is. Supplier Power: This is do determined by how easy it is for the suppliers to increase their prices. How many potential suppliers does the organization has. Buyer Power: The company can ask how easy it is for buyers to drive your prices down. How many buyers are there, and how big are their orders Threat of Substitution. This refers to the likelihood of your customers finding a different way of doing what you do. Threat of New Entry: Companies position can be affected by people's ability to enter your market.

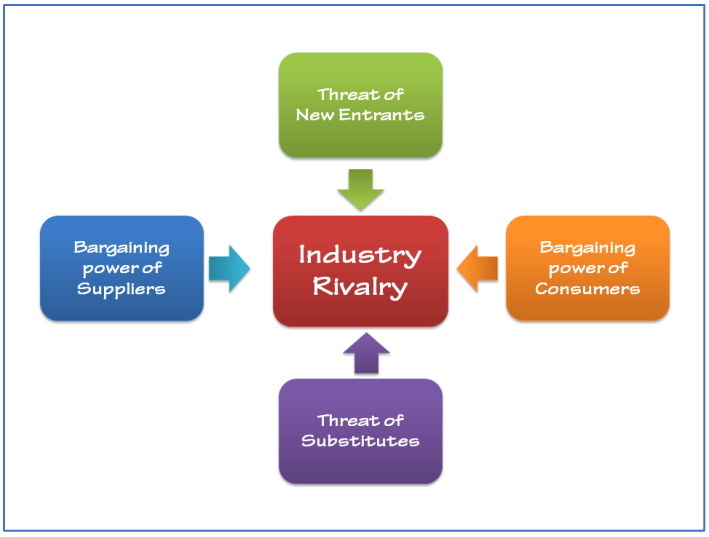

Figure 8 -Porters five forces

This analysis *(Daft 2012)* will be used for identifying and evaluating the main risks as those evolve from the stakeholders, to identify and assess qualitatively the higher threats and opportunities.

*Internal Environment and culture***:**

As internal environment we will name the environment of the companies that will be directly affected and is none other than the environment of the companies of limestone quarries.

This is a great opportunity for them . If the production process changed, the company would gain knowledge from the new technique they would use to remove the fine grain sand, this knowledge would remain in the company, from the new production process,

A thread could be the (initial) cost of replacing the water turbine with an air turbine, but in relation to the long-term profit in the quarries

Employees, Management and Labor Market:

There is an opportunity regarding the employees and the management of the limestones quarries again one can argue that there is the opportunity of keeping the quarries (there are three in the same area) active for more years to come so both the administration and the employees would feel, among other things, a sense of security, which is quite important nowadays.

Legal:

The Legal challenges is one of the biggest threats the change of the process.

There will be extremely difficult to convince the Ministry of Interior to change the decree of governing the production of aggregates. The essence of this proposal is to change the production process and that of course implies a change in legislation. In general, on the one hand, the culture of the public sector is well known that has a great resistance to change especially when they have to admit that there is a different more suitable solution for managing the fine grading product, while at the same time there is a very high probability that they will challenge the result of the new mix design, as not reliable. This threat in the process should be addressed with tools that best fit the IRGC framework as this risk applies to society.

Political:

Someone may think that Political and legal issues is pretty much the same, but this is not the case . There is a big risk also that should be taken special care. Changing the process, that is used today can have unpredictable political dimensions and this can be used by opposition political parties to their advantage, emphasizing and challenging the quality control results.

As in legal, the specific threat must be addressed again in the IRGC framework in terms of treatment. Moreover the information noise is something also that should focus and emphasis

An opportunity regarding the political could be the fact that the relations between the quarries and the English bases will become better (not that they are bad but they will become better) since their expansion may be delayed for some time.

Environmental:

Regarding the environmental factor one can identify many opportunities in this endeavor. First, the fact that a percentage of 15% filler (fines) must remain in the product immediately means that from now on less environmental waste will be generated from the production process. (Today you can have as much as 10%) This fine graining aggregate is removed today and returned to the quarry as waste. if more fine grading sand is used then we will have less waste, which is a very good opportunity in terms of the environmental part of the project.

In case for some reason these changes in the future, the quarry will not be affected since it has already switched to the method of removal with air turbine

Another environmental criterion has to do with the quality of the final product in case as we said for some reason, we should return to conventional methods of washing the aggregates in the quarries in the Famagusta Area. Meaning to have aggregate washing from the underground aquifers. In this case, huge problems have been created in the past since the level of these aquifers is so low , because of which water enters them from the sea. This has had disastrous effects on sand in the past as the percentage of chlorine in it was too high, making the product prohibitive in its use to produce concrete. A problem that we will not face if the way of removing the additional dust is done with the method of air. Furthermore, the possible contribution of dust polluting the area will be significant reduced.

Social:

The society (both of the wider region of Famagusta and of Cyprus in general) will benefit as mentioned in the part of the environment, in many sectors, social groups such as the farmers of the regions will not come to any form of disagreement with the quarries for use of the water. It has also been stated that employees in the area will maintain their work status for longer. Opportunities and threats from social issues are analyzed in the other categories.

Technological:.

For the technological factor there is a threat that should not be passed unnoticed. In case this change is passed, ie it is documented legally with a change of the decree that determines, a cycle of disputes of decrees that determine the construction products may be opened, and while in this case there is a scientific basis with different experimental mix design, they may not exist for all the others, causing chain reactions in the wider construction sector.

The opportunity in the technological part is to promote a technological culture in terms of construction products, especially in the part of experimental design in construction products.

A threat may be the fact that the specific mix design of concrete with new sand, has not been tested for a long time. The tests have been performed as presented in the first part of the dissertation, while there is also a bibliography that allows its use in countries with similar characteristics to

those of Cyprus (countries of the Middle East and North Africa mainly). nevertheless, this is an argument that can be used from someone.

Economical:

The financial part is also what affects almost all the categories that we analyzed above and were analyzed, for this reason we see it last in the analysis. There are clearly more opportunities in the financial sector than threats. Such a change as stated will be an opportunity for the survival of the quarries, the employees will keep their jobs, the end users will theoretically have a cheaper product, etc. The threats in the financial part are clearly less and have to do with possible lost profits from the competitors of the quarries which in this case are the diabase quarries the sandstone quarries and also could be considered the cement factory.

Customers:

The customers of the quarries are the concrete factories. While the end user of this change are the citizens . The owners/managers of the factories will see this change with a positive eye since any reduction will be an opportunity and not a threat, ie either keep their current price stable or pass this discount to their customers the actual end user.

Suppliers :

No major threat is identified regarding the suppliers, the opportunity is the only are the suppliers of the machines that are the crusher, that is, the only change will be the possibility of changing it. hydro turbine with that of air, which cannot even be considered in essence a threat opportunity

Competitors :

This could be a very complex situation that we must see in two different groups The first category are the owners of the limestone quarries that we have already stated that this is actually a great opportunity for their survival. The other quarries owners both sandstone diabase owners will be considered that change both as an opportunity, but also as a threat. This is because despite the fact that the tactic of using more must in the sand of their own products will be an opportunity for them as well, but because today there are no studies on how this does not affect the quality of the final product can be considered a threat.

7.2Analysis of the main risks – Step 2

7.2.1 Methodology of quantitative the threats and opportunities

To make the Risk assessment (identification, analysis and evaluation) and eventually reach the risk treatment, there are tools that can be used from the literature For example

The traffic light model

The risk management framework can also be addressed in the part of decision making with three possible outcomes of the steps: an intolerable situation, a tolerable situation, or an acceptable situation. This is a component of risk governance and it is called the *Traffic Light Model.*

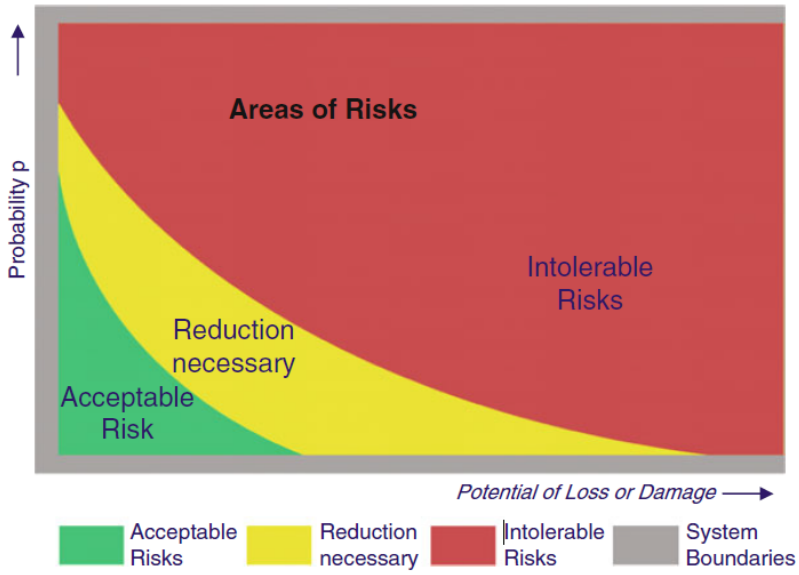

Figure 9- Acceptable, tolerable, and intolerable risks (Traffic Light Model)

7.2.2 Consequence Probability matrix of ISO 31010

Another tool will be used for measuring threats and opportunities *(ISO 31000:2018).* This tool is the Consequence Probability matrix of ISO 31010 (Figure B.15 of the standard) for both the negative and positive effect (*ISO 31010: 2010*)

Probability	Threats					Opportunities				
Very High	L	M	H	H	H	H	H	H	M	L
High	L	M	M	H	H	H	H	M	M	L
Moderate	L	L	M	H	H	H	H	M	L	L
Low	L	L	M	M	H	H	M	M	L	L
Very Low	L	L	L	L	M	M	L	L	L	L
	Very Low	Low	Moderate	High	Very High	Very High	High	Moderate	Low	Very Low
	Negative effect					Positive effect				

H = High Risk requires immediate reaction
M= Medium Risk a reaction might be needed
L= Low Risk no reaction is needed at the time

Degree of Threat = Probability x Severity
Opportunity Significance Degree = Probability x Severity

Matrix 1 - Consequence Probability matrix of ISO 31010:2010 both for threats and opportunities

COLOUR	PRIORITY	SIGNIFICANCE
GREEN	LOW	**ACCEPTABLE** no actions required
ORANGE	MODERATE	**UNACCEPTABLE** unless there are ways to reduce it
RED	HIGH	**UNACCEPTABLE** It should be reduced as much as possible
GOLD	HIGH	**INTERESTING** It should be exploited as much as possible
SILVER	MODERATE	**INTERESTING** usable on a case by case basis
BRONZE	LOW	**NOT INTERESTING** no actions are required

Table 10 – Explanatory Table for Probability matrix for threats and opportunities, regarding the priority and significance for every risk.

The threats and opportunities will then be categorized according to Matrix 1 and Table 10. Depending on the Probability and Likelihood each risk will then be categorized. Each threat will be colored coded in green, orange and red, and for the opportunities gold silver and bronze as shown in the table above.

7.3 Analysis/Evaluation the main risks

It is at this stage of the risk assessment that the classification and categorization of opportunities and threats will take place, following the methodology that was thoroughly described in 3.1. from the qualitative identification of threats and opportunities Starting from the threats the sum of the likelihood and impact will be first be calculated. Then the significance will be determined based of the level of acceptance of each threat (acceptance or unacceptance) and then the determination of the priority will take place (if it is acceptable or non-acceptable).

7.3.1 Threats

1.1 Threat:	Replacing Quarry equipment
Affected party	Limestone Quarries
Description: There will be an initial cost of replacing the water turbine with an air turbine, but in relation to the long-term profit in the quarries. This is actually a low risk. Both impact and severity can be characterized as low risk. The impact of cost of the new air turbine although it is high, can be managed from the profit afterwards and from the various grants that the Ministry of Commerce has for equipment upgrades in industry. Furthermore the likelihood of this process to fail is also low since the air turbines is something that are widely used throughout Europe's quarries.	
Risk evaluation	
Likelihood x Impact	Low x Low
Sum	L= Low Risk no reaction is needed at the time
Significance	Acceptable no actions required
Priority	Low

1.2 Threat:	Change of the legislation Regulatory Act 164/2011
Affected party	Limestone Quarries, Citizens Technical services of the Ministry of Interior,

Description:

The Legal challenges is one of the biggest threats in this proposal. It is probably the biggest of this project, it affects all the interested parties without exception one way or another.

but mainly the technical services of the ministry of interior .In this case ,if the difficulties are not removed and the ministry does not consent to a change of the regulation Regulatory Act 164/2011 that governs the aggregate production in the island then no change can be done.

The likelihood is high since it is extremely difficult to convince the Ministry of Interior to change the decree governing the production of aggregates (it is not very high because in all the positions of the public services there are voices that want to see changes, at least it is receptive to new proposals). The impact is very high since if this threat cannot be managed then the whole proposal collapses. The treatment of this threat will be presented in the third part of risk treatment with tools that best fit the IRGC framework as this risk applies to society.

Risk evaluation	
Likelihood x Impact	High x Very High
Sum	H= High Risk requires immediate reaction
Significance	Unacceptable It should be reduced as much as possible
Priority	High

1.3 Threat:	Political turmoil
Affected party	Limestone Quarries, Diabase quarries , Sandstone quarries Citizens Technical services of the Ministry of Interior,

Description: The political turmoil is also a great threat for the proposed project. Even if the ministry sees the proposed change positively, , there is still a great threat of the political impact such a change will bring. that will create such a move. The political parties that will be opposing the government (any government) will try to get advantage from this, emphasizing and challenging mainly in the quality control.

It is certain that there will be reactions at the political level. For this reason the likelihood is judged as Very high and the impact it depends, but cannot be lower from High.

Risk evaluation	
Likelihood x Impact	Very High x High
Sum	H = High Risk requires immediate reaction
Significance	Unacceptable It should be reduced as much as possible
Priority	High

1.4 Threat:	Quality control of the new product
Affected party	Citizens Technical services of the Ministry of Interior, Concrete factories

Description: Another threat may be the fact that this new proposed mix design of concrete with new sand has not been tested for a long time in Cyprus. But this is a threat that can be characterize as one that can nit have such a great significance as the other two. There is an initial literature for the application of such a design in countries with similar characteristics. concerning quality control of concrete. The likelihood of that to happen is Low, but the impact of such deviation could be High in case of failing of the mix design, but this is something very unlikely to happen.

Risk evaluation	
Likelihood x Impact	Low x High
Sum	M= Medium Risk a reaction might be needed
Significance	Unacceptable

	unless there are ways to reduce it
Priority	Medium

1.5 Threat:	Relationship between competitors
Affected party	Limestone Quarries, Diabase quarries , Sandstone quarries
Description: This is actually something that can be considered both as a threat as well as an opportunity. Although it is a change that can disrupt the existing oligopolistic relations between the three major categories of quarries, and internally within the quarry association itself. But this is unlikely to happen or to be considered as such a great threat. This proposal will be applied to all to all quarries on the one hand and on the other the concrete factories prefer to buy aggregates from the nearest to reduce transportation costs. Both likelihood and impact will be considered Low	
Risk evaluation	
Likelihood x Impact	Low x Low
Sum	L= Low Risk no reaction is needed at the time
Significance	Acceptable no actions required
Priority	Low

7.3.2 Opportunities

Continuing with the classification and categorization of opportunities, following the same methodology that is used for threats, to calculate quantitively the opportunities that have been identified qualitive. The sum of the likelihood and impact will be first be calculated. Then the significance will be determined based of the level of interest of each threat (Interest or not Interesting) and then the determination of the priority will take place.

1.1 Opportunities	Knowledge from the new process
Affected party	Limestone Quarries
Description: By having the production process changed, the company would gain knowledge from the new technique they would use to remove the fine grain sand, this knowledge would remain in the company, from the new production process. This is in fact an opportunity but no a very significant one. Both the positive impact that will have to the company and the likelihood to be exploited by the limestone quarries are low	
Risk evaluation	
Likelihood x Impact	Low x Low
Sum	Low No reaction is needed at the time
Significance	Not Interesting / no actions are required
Priority	Low

1.2 Opportunities	Relation with the UK sovereign base areas
Affected party	Limestone Quarries, UK Sovereign state , Community
Description: An actual opportunity could be arisen regarding the politics in the Famagusta region. The relations between the quarries and the English bases will become better. All three of the region quarries due to limited space they have asked for expansion in order to drill for new raw material, something that was declined for the U.K military bases. With this change the quarries could solve the problem of expansion for some time (not that they are bad but they will become better) since their expansion may be delayed for some time. The likelihood of this opportunity is moderate, and the impact can be characterized as Low, since this could since this could delay the need to expand the quarries, but for a short time.	
Risk evaluation	
Likelihood x Impact	Moderate x Low
Sum	M= Medium Risk a reaction might be needed

Significance	Interesting usable on a case by case basis
Priority	Moderate

1.3 Opportunities	Reduce of Environmental waste
Affected party	Limestone Quarries, UK Sovereign state , Community , Environment Department of Cyprus
Description: This is also a great opportunity since less environmental waste will be generated from the production process. This fine graining aggregate is removed today and returned to the quarry as waste. This waste actually prevents the vegetation of the area to be developed due to both its composition and density. It will be categorized both High in impact and likelihood. With this opportunity great alliances can be made (Environment Department of Cyprus) with the aim of promoting the proposal	
Risk evaluation	
Likelihood x Impact	High x High
Sum	H = High Risk requires immediate reaction
Significance	Interesting usable on a case by case basis
Priority	High

1.4 Opportunities	Water usage
Affected party	Limestone Quarries, UK Sovereign state , Community , Environment Department of Cyprus,
Description: The fact that it is going to be a great saving of water during the production process oit is a big opportunity. Since no more water turbine will be used but the sand will be removed with air, this will result in much less water being used in the production process, Also to have aggregate washing from the underground aquifers. In this case, huge problems have been created in the past since the level of these aquifers is so low *(Water development department 2020)* This is a big problem because the sea water enters them. This has had disastrous effects on sand in the past as the percentage of chlorides in it was too high, making the product prohibitive in its use to produce concrete. A problem that we will not face if the way of removing the additional dust is done with the method of air. High on impact and high for Likelihood. This opportunity alongside with the dust will be treated with the IRGC framework to be exploited it as much as possible.	
Risk evaluation	
Likelihood x Impact	High x High
Sum	H = High Risk requires immediate reaction
Significance	Interesting It should be exploited as much as possible
Priority	High

1.5 Opportunities	Economic savings
Affected party	Contractors, concrete factors, End user/citizens, Employees in the quarries

Description:

Another one opportunity is the economic benefits of this proposition. As we have calculated in the first part of this thesis and also in the qualitive analysis of the opportunities the savings regarding the process can be significant, in a lot of factors. There will be a limitation on the use of water and in the final product since of the use of more fine grading sand as we have also stated before. The sand will be produced cheaper and that will leed to a cheaper production of mortar and concrete. This is also a very good opportunity that can help to the argument of passing the proposal to change the legislation if exploited well. Alongside with the saving on water and the reduced of waste this is also an opportunity that is very interesting and must be prioritized.

Risk evaluation	
Likelihood x Impact	Moderate x Moderate
Sum	H = High Risk requires immediate reaction
Significance	Interesting It should be exploited as much as possible
Priority	High

1.6 Opportunities	Reduce of dust pollution
Affected party	Limestone Quarries, Community, Environment Department of Cyprus

Description:

Studies in the nearby country of Israel showed that there is a possible contribution of dust from a pollution source, such as a limestone quarry *(Bluvshtein 2011).* To be precisely sure about the impact the dust has to the air pollution in the community of Xylophagous a complete research of Mineralogical and chemical analysis of the background accumulated dust to find how much of contribution of the total [pollution of the area comes from the quarries in the region. In the case although the change in the process of manufacturing aggregate sand would have had a rather small change regarding the dust. The 10% difference that the sands will have if the process changed is not a very large percentage to burden so much the load of air pollution. This is

because the sand dust will be deposited in the quarry and from there it will have a rather small addition into the general air pollution load. For this reason. This is not such a great opportunity since. It will be categorized both Low in impact and likelihood	
Risk evaluation	
Likelihood x Impact	Low x Low
Sum	Low No reaction is needed at the time
Significance	Not Interesting / no actions are required
Priority	Low

1.7 Opportunities	Quality of water for washing aggregates
Affected party	Limestone Quarries, Environment Department of Cyprus, Water Department Cyprus
Description: The method used for washing the aggregates in the quarries in the Famagusta Area is through the recycled water from the sewer system of Famagusta Region. A few years ago, and before the recycled water was connected in the quarries, the aggregate washing was from the underground aquifers. When this was the case huge problems have been raised since the level of these aquifers is very low. Seawater intrusion (SWI) occurs when seawater encroaches into the freshwater region of a coastal aquifer, and has long been considered a global issue (Bear et al., 1999). . This as stated before had disastrous effects on sand in the past as the percentage of chlorine in it was too high, making the product prohibitive in its use to produce concrete. However, this problem has now been eliminated since recycled is used. The Cyprus Water Development Department *(WDD 2020),* however, promotes an integrated way of water management in Cyprus, which among other things wants at least two water supply sources for every activity. In this case the first way is to recycle and back up the aquifers (if they ever needed to provide water)	

This is again not such a great opportunity since it is very unlikely to happen any problems in the process of using reclaimed water to the quarries. It will be categorized both Low in impact and likelihood.	
Risk evaluation	
Likelihood x Impact	Low x Low
Sum	Low No reaction is needed at the time
Significance	Not Interesting / no actions are required
Priority	Low

1.8 Opportunities	Flora growth in the Quarry
Affected party	Limestone Quarries, Forestry department.
Description: The change of the production process will bring a partial increase of the flora in the quarry, This is something that will be considered as an opportunity by the forestry and environmental department of Cyprus. In the areas of the quarries where the extraction ends, the landscape must be restored by planting local plants, in the study area the bushes called tamarisk trees are widely used. This will happen after reducing the waste of dust which has the property of making it very difficult to grow any form of fauna due to its fine-grained composition This is again not such a great opportunity since it is very unlikely to happen any problems in the process of using reclaimed water to the quarries. It will be categorized both Low in impact and likelihood.	
Risk evaluation	
Likelihood x Impact	Low x Low
Sum	Low No reaction is needed at the time
Significance	Not Interesting / no actions are required
Priority	Low

The tables below summarize the threats and the opportunities regarding the priority and the significance of each one.

A/A	Threat	Priority	Significance	Color
1	Change of the legislation Regulatory Act 164/2011.	High	Unacceptable	Red
2	Political turmoil	High	Unacceptable	Red
3	Quality control of the new product	Moderate	Unacceptable	Orange
4	Relationship between competitors	Low	Acceptable	Green
5	Replacing Quarry equipment	Low	Acceptable	Green

Table 11 -Categorized threats

A/A	Opportunities	Priority	Significance	Color
1	Reduce of Environmental waste	High	Interesting	Gold
2	Reduce of water usage	High	Interesting	Gold
3	Economic savings	High	Interesting	Gold
4	Relation with the UK sovereign base areas	Moderate	Interesting	Silver
5	Knowledge from the new process	Low	Not interesting	Bronze
6	Reduce of dust pollution	Low	Not interesting	Bronze
7	Quality of water for washing aggregates	Low	Not interesting	Bronze
8	Flora growth in the Quarry	Low	Not interesting	Bronze

Table 12 -Categorized Opportunities

7.4. Risk treatment

After finalized the identification and the analysis of both threats and the final stage of the risk process (the risk treatment) is going to take place. The two tables (11 and 12) show that eight opportunities and five threats have been identified.

The first two threats (Change of legislation, Political turmoil) have characterized as of High priority and that they are unacceptable and there should be reduced as much as possible, one is characterized as moderate (Quality control of the new product) and it is unacceptable unless there are ways to reduce it, and finally the other two are calculated as low regarding priority and there threat can be acceptable (Relationship between competitors, Replacing Quarry equipment)

Three are the opportunities that have high priority and are very interesting and should be exploited as much as possible: The reduce of Environmental waste, the reduce of water usage and the economic savings. The relation with the UK sovereign base areas is a moderate opportunity and is usable on a case-by-case basis, and the last one (Knowledge from the new process) is analyzed as of not interesting opportunity.

The treatment of the risk once more will be split for threats and opportunities as it happened on the two previous stages

7.4.1 Treatment of Threats

As of High priority are considered the threats of Change of legislation and the Political turmoil, the threat regarding the quality control of the new product is categorized as Moderate. It is considered best to treat them together. This is because they are directly connected if it is considered that the is a proposal to change the legislation that governs the construction products. one and one is the natural to have a political turmoil. Regarding the treatment this is something that cannot be avoided, but it can be reduced greatly and eventually compensate. These threats are very complicated and they concern the society. Examples like ours but in various industries can be found around the world like the case of "Listeria in Raw Milk Soft Cheese in the US" *(Knight 2008),* "the Nagara River Estuary Barrage Conflict" *(Okada 2008)* and the "Energy Security for the Baltic Region" *(Warner 2008).* All of these examples has to do with problems that communities are facing, just like in this case. Those threats are better to be handle by using tools for governance and communication both threats

7.4.1.1 Elements for Risk treatment (Threats)

*The Levels of Horizontal and vertical Governance***.**

A component of Governance could be used in this stage could be, the Levels of Horizontal and vertical Governance *(Renn 2008).* For this report and for the risk we can develop the matrix as it seen below.

		Horizontal Levels			
		Governments	Industries	Science & Academia	Civil Society
Vertical levels	Local				
	Regional				
	National	X (1st)	X (2nd)	X (2nd)	X (2nd)
	Supra-National				
	Global				

Matrix 2 - Levels for Horizontal and vertical Governance.

First (1st level) there should be a collaboration between the different stakeholders should be from the Vertical axis the National Level and for the horizontal the Government to address both of the threats. After that for better co-ordination there should be in a second level (2nd) also a co-operation in National level with the Industries, the scientific community in the country and civil societies. This is the first measure that can be taken in order to govern both of the high-risk threats.

The Categorization of risk related knowledge

In order to have a shift in the legislation of aggregates soon for the wellbeing of Cyprus people and industry, and reduce the threat of Political turmoil and the reactions from the ministry of interior a component of the new concept of risk management can be used in that stage. The Categorization of risk related knowledge**.** That is basically a distinction between different stages of knowledge or interpretations between simple, complex, uncertain, and ambiguous. In our case and since. In this case there is a lot of knowledge on how the politician and the public sector will react on the subject. They will be opposing the proposal. This is a problem that is best fitted to the

third category since almost all the actors are involved. And although we have a indication how the stakeholders will react because it is a critical problem it should ne categorized as “Uncertainty”.

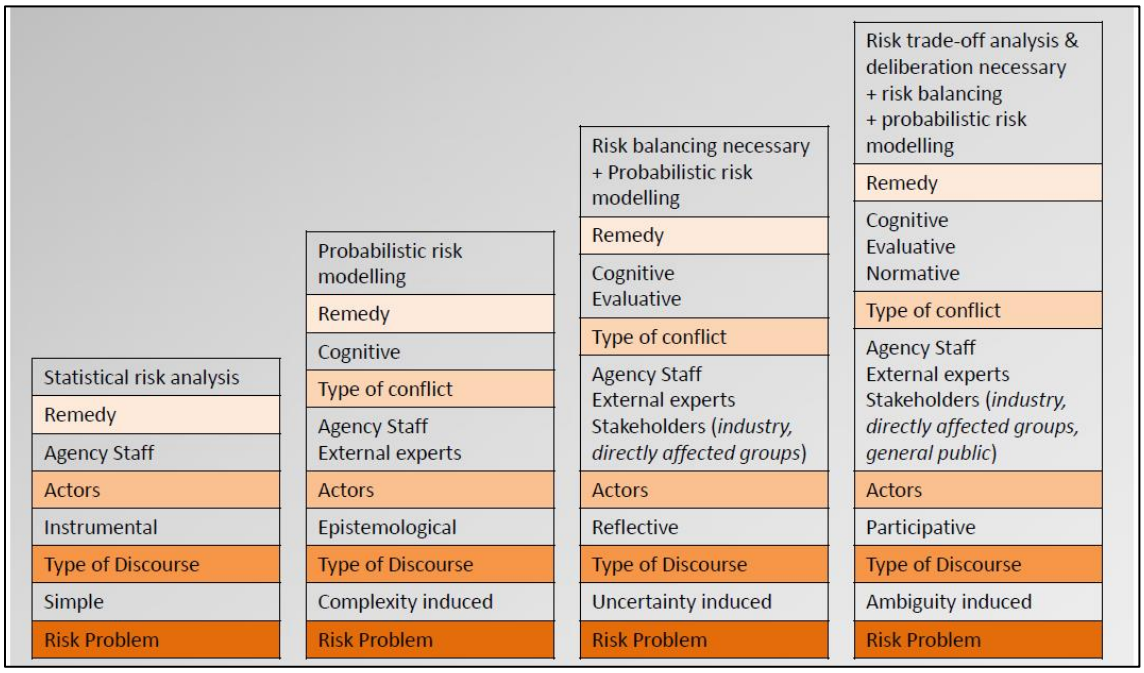

Figure 10 - The risk management escalator and stakeholder involvement

Addressing Different Subcultures in Society

A major help to the risk institutes and communicators is to characterize the audience according to cultural beliefs, different cultural categories need different approach regarding on how to communicate the proposed change. There are five patterns of behaviors that separate the groups, they differ at the degree of the cohesiveness and at the degree of grid *(Aven, Renn 2010).* The five group are, the atomized individuals, the Bureaucrats the Hermit(s), the Entrepreneurs, and the Egalitarians (as they presented in the figure below). The person in charge (risk communicator for example) must use his skills to convince the Bureaucratσ that this is a situation that will benefit all around the country and will be the start of even more changes in the right direction regarding construction products.

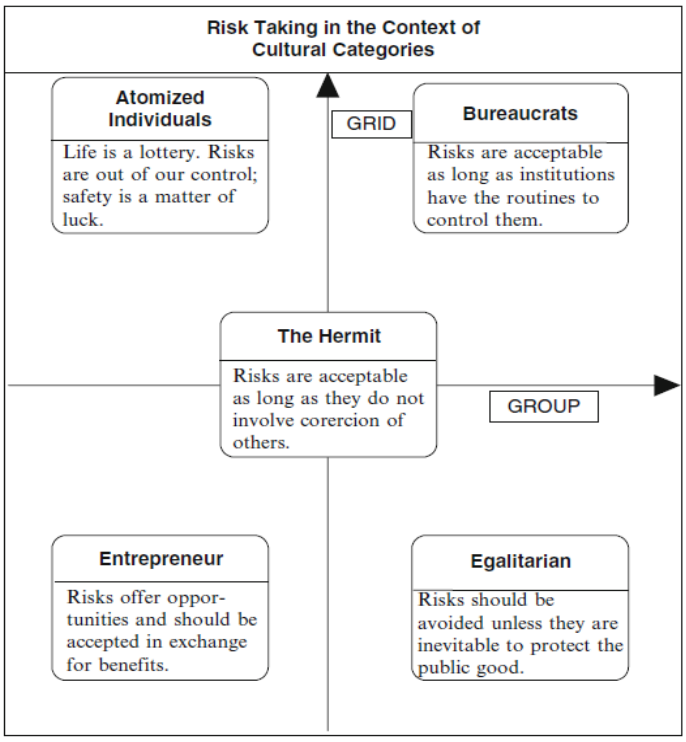

Figure 11 - The cultural prototypes of risk experiences

The three different levels of debates

The three different levels of debates *(Renn and Levine 1991)* This approach requires a good understanding of the audience of people that want to be informed about this legislation change from the manufacturers point of view. The first level of the risk debate is to inform the stakeholders from a technical point of view about the change of the legislation will bring to the industry, The second level has to do with the previous experience of that project. This is a step that can be communicate the most with the stakeholders for those threats (Ministry, Government and Politicians) since there is experience in the European countries about using unwashed sand in the concrete mix design.

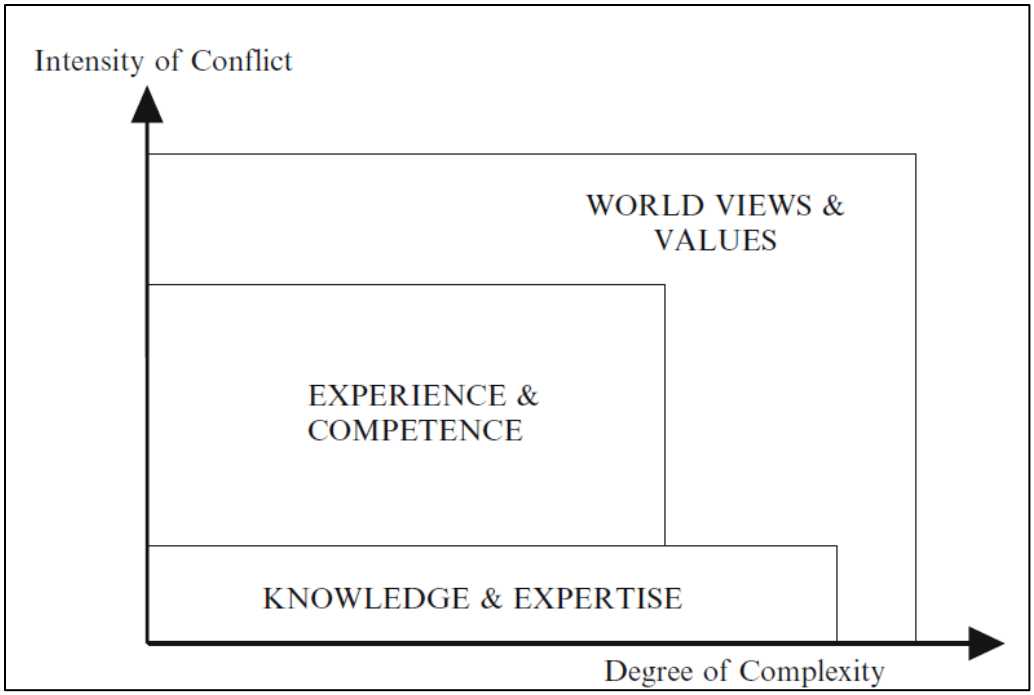

Figure 12 - Levels of concern in risk debates

Reduce of the noise (Communication cycle).

It is very important when we have risk that effect the whole community (in this case a whole country) to be communicated to the stakeholders mentioned above, but the "noise" of others interference should be as reduced as possible. People tend to get abstracted when they hear something, they value more important, for example an economic problem, or a political situation, that a lot of times cannot stay focus to the proposed solution When addressing that kinds of risk to people we must be aware of the “noise”, for both threats and opportunities.

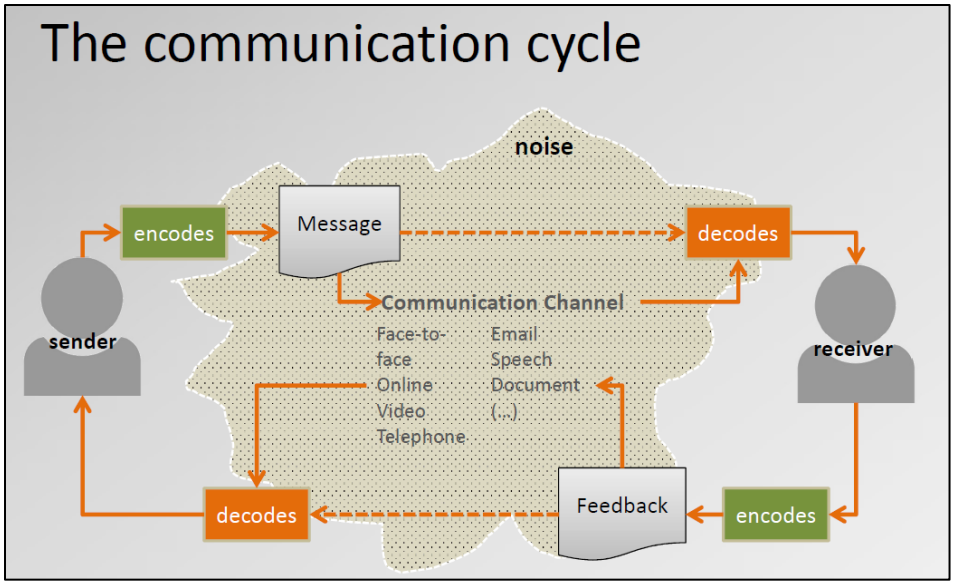

Figure 13 - The Communication Cycle

7.4.1.2. Risk measures for threats

After identifying the elements from the literature that can be applied to the risk method treatment for the three threats, an approach to the treatment could be made of developing teams of individuals with different knowledge backgrounds and characteristics that will handle the threats and there will be coordinated from one or more people , following in a way the *Schraagen Van de Ven (1997*) model at least concerning the idea of task groups.

The first team will be of civil engineers, geologist specialist of the concrete design **(Scientific team).** After identifying all the literature needed to prove that the two mix designs, are of the same quality. Examples must be provided from countries with the same climate as Cyprus and from other EU countries. Furthermore, this group will also have the task to start experimenting with the new product in real conditions, documenting its results before the submission of the proposal begins. This team will have to experiment more with the new product and study even further on to the literature if similar mix designs that uses unwashed sand.

The **Data collectors** will be the second team. Those individuals will be obligated on studying and reporting how the collaboration between the different stakeholders should be from the Vertical axis the National Level and for the horizontal the Government to address both of the threats, also what could be the different levels of debates that can be raised against this proposal, but more

important they should search for other similar case that a legislation regarding construction products change in order to the greater good. The team should be consisting of data analyst, lawyers, and experts in CE Marking Regulations.

The third team will be **the communicators.** After collecting the data from the Data collection team and having all the literature on the specification of the new products (unwashed sand and new concrete mix design) this team will have the task to choose the best way to approach the "receivers" as they described in the communication cycle. The proposal will be communicated differently to the high-ranking technocrats of the ministries (who will view the project with suspicion) and different to the political parties in order their objection to be removed. For the skepticisms regarding the quality of the new final product there must be documented studies of the composition and application of concrete that will not leave room for questioning the quality even in the most difficult. This is a team that could be made up of communicators, perhaps politicians, marketers, and HR experts.

All those teams will be handled by the **Team leader** that will oversee the whole project. He or She or perhaps a small team of people more , would have to have knowledge of all the work that is going to be developed on all three teams. The leader is the one that is going to persuade the politician, the Concrete experts, and the legislators not to stand opposite to the proposed change.

7.4.1.3 Re-Evaluation of the main threats

Implementing the measures mentioned above, the threats after being handled, will be evaluated as follow

1.2 Threat:	**Change of the legislation Regulatory Act 164/2011**
Affected party	Limestone Quarries, Citizens Technical services of the Ministry of Interior,

Description:

The Legal challenges is one of the biggest threats this proposal. It is probably the biggest of this project, it affects all the interested parties without exception one way or another.

but mainly the technical services of the ministry of interior .In this case ,if the difficulties are not removed and the ministry does not consent to a change of the regulation Regulatory Act 164/2011 that governs the aggregate production in the island then no change can be done.

The likelihood is high since it is extremely difficult to convince the Ministry of Interior to change the decree governing the production of aggregates (it is not very high because in all the positions of the public services there are voices that want to see changes, at least it is receptive to new proposals). The impact is very high since if this threat cannot be managed then the whole proposal collapses. The treatment of this threat will be presented in the third part of risk treatment with tools that best fit the IRGC framework as this risk applies to society.

Risk evaluation

Likelihood x Impact	High x Very High
Sum	H= High Risk requires immediate reaction
Significance	Unacceptable It should be reduced as much as possible
Priority	High

Risk Treatment

Measures

- The scientific task group will be ready to present similar mix designs, and how they are applicable in other countries like Cyprus
- The Data collection task group should be ready to present and critical explain and documented similar changes in countries of the European Union or of those of Middle East
- The communication task group lead by the team leader must be ready to use all the information and be ready to communicate the benefit of such change.

Risk Re-valuation (after treatment)

With the implementation of those measurements likelihood but also impact as well can be reduced both as moderate.

Likelihood x Impact	Moderate x Moderate

Sum	M= Medium Risk a reaction might be needed
Significance	Unacceptable unless there are ways to reduce it
Priority	Medium

1.3 Threat:	**Political turmoil**
Affected party	Limestone Quarries, Diabase quarries , Sandstone quarries Citizens Technical services of the Ministry of Interior,
Description: The political turmoil is a great threat for the proposed project. Even if the ministry sees the proposed change positively, , there is still a great threat of the political impact such a change will bring. that will create such a move. The political parties that will be opposing the government (any government) will try to get advantage from this, emphasizing and challenging mainly in the quality control. It is certain that there will be reactions at the political level. For this reason the likelihood is judged as Very high and the impact it depends, but cannot be lower from High.	
Risk evaluation	
Likelihood x Impact	Very High x High
Sum	H = High Risk requires immediate reaction
Significance	Unacceptable It should be reduced as much as possible
Priority	High
Risk Treatment	
Measures	
• The scientific task group will be ready to present similar mix designs, and how they are applicable in other countries like Cyprus • The Data collection task group should be ready to present and critical explain and documented similar changes in countries of the European Union or of those of Middle East • The communication task group lead by the team leader must be ready to use all the information and be ready to communicate the benefit of such change.	

• All parties and their scientific teams should be contacted and informed before any announcement of the proposal.	
Risk Re-valuation (after treatment)	
Applying the above measures the likelihood will be reduced furthermore with the correct scientific documentation the impact will be reduced as well.	
Likelihood x Impact	Moderate x Moderate
Sum	M= Medium Risk a reaction might be needed
Significance	Unacceptable unless there are ways to reduce it
Priority	Medium

1.4 Threat:	Quality control of the new product
Affected party	Citizens Technical services of the Ministry of Interior, Concrete factories
Description: Another threat may be the fact that this new proposed mix design of concrete with new sand has not been tested for a long time in Cyprus. But this is actually a threat that can be characterize as one that can nit have such a great significance as the other two. There is an initial literature for the application of such a design in countries with similar characteristics. concerning quality control of concrete. The likelihood of that to happen is Low, but the impact of such deviation could be High in case of failing of the mix design , but this is something very unlikely to happen.	
Risk evaluation	
Likelihood x Impact	Low x High
Sum	M= Medium Risk a reaction might be needed
Significance	Unacceptable unless there are ways to reduce it
Priority	Medium
Risk Treatment	
Measures	

• The scientific task group will be ready to present similar mix designs , and how they are applicable in other countries similar to Cyprus	
Risk Re-valuation (after treatment)	
With the implementation of those measurements likelihood can be reduced both as Low.	
Likelihood x Impact	Low x Medium
Sum	M= Medium Risk a reaction might be needed
Significance	Unacceptable unless there are ways to reduce it
Priority	Medium

7.4.2 Treatment of Opportunities

As stated previously three are the opportunities that have high priority and are very interesting and should be exploited as much as possible: The reduce of Environmental waste, the reduce of water usage and the economic savings. The relation with the UK sovereign base areas is a moderate opportunity and is usable on a case by case basis, and the last one (Knowledge from the new process) is analyzed as of not interesting opportunity.

Again (as it happened with threats) it is considered best to treat the three opportunities together . This is because their directly connection within the proposal

In the case of opportunities the treatment is going to be focused in the level of how interesting are those opportunities and there for they should be exploited as much as possible In this case the in addition to the threats that aware very complicated the opportunities are easier to be calculated (savings on money, savings on water, less environmental waste from the procedure) and to make an arguments.

7.4.2.1 Elements for Risk treatment (Opportunities)

The same elements that are applied on threats are going to be used for the opportunities. Considering once more the: Levels of Horizontal and vertical Governance., the Categorization of risk related knowledge, the Different Subcultures in Society, the three different levels of debates

and the communication cycle, one concludes that the best approach with the opportunities also the one used for threats.

That is developing teams of individuals with different knowledge backgrounds and characteristics that will handle the opportunities as it happened with the threats there will be coordinated from one or more people , following in a way the *Schraagen Van de Ven (1997*) model at least concerning the idea of task groups.

7.4.2.2. Risk Treatment for opportunities

The first team will be of civil engineers, economist, and logistic managers **(Economics team).** This will be the team that will have the task to calculate exactly and for all the limestone quarries the exact amount of money that will be saved, on the market in general, with the change in the production. For every province, for every quarry (depending on the concrete factories and the production of aggregate that manufactures) will be made a thorough report estimating the years to come regarding the consumption of the produced products in relation to the productions that are expected to be made using the sales data of the concrete factories. Those reports then will be communicated through the communication team and the group leader to champion furthermore the proposal.

The **environmental team** will have a similar task as the economists. Topographers, Mineralogists, Hydrologist, and Environmentalists will make up this team. This should be the team that should calculate in all the quarries (not only in KAOS,) the amount of environmental waste that is going to be reduced, and the quantities of water that could be saved. As with the above category, an in-depth measurement of both the amount of water that will be saved and the environmental waste that will be reduced should be made and ready to be presented to the interested parties. These two groups and their derivatives in the form of reports and measurements will be given to the team of data collectors and to the communicators and eventually reach the team leader. With the creation of the two task groups mentioned above and through the structured recording and calculation of the data we have already mentioned, the opportunities that were considered as of high priority and interesting, will be exploited as better as possible. For the opportunities in addition with threats there is considered that there is not any meaning of re-evaluating them.

7.4.3 Summarized of risk treatment

After completing the risk treatment of the threats and opportunities, the conclusion is that the best approach is to create teams to deal with both the High Priority Threats and the Opportunities that are interesting and they should be exploited the most . Through the identification the analysis and finally the treatment of the risks of this proposition we can reach a summarized of the situation. That is, before any proposal, it would be good for the teams (scientific team, data collectors, communicators) that will face and mitigate the threats as well as those that will try to take advantage of the opportunities (economic team and environmentalist team) to be ready to act. appropriately and quickly, since as will be presented in the last chapters of the general conclusions, the movements of all the teams in collaboration with the team leader should be very carefully planned.

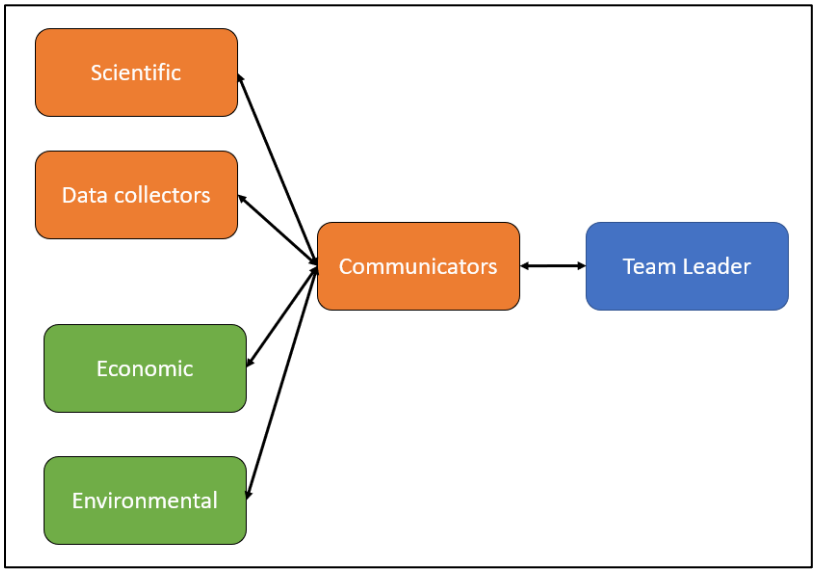

Figure 14 – Teams risk treatment

If the proposal of dealing with the risks were to be presented schematically in the first stage there would be four groups, two that would take advantage of the opportunities in green and two that would face the threats in orange. Although the communicators will be responsible for dealing with threats, they will mainly have two-way communication with the other teams, as they will help and strengthen the position of team leader.

8. Conclusions

This thesis is based on a quality control study of two different concrete mix designs in the early 2000s. The only difference between the two mix designs is in the sands. In the mix design that is currently used mainly in the concrete companies of the Famagusta area but generally in the whole island, washed limestone sand is used in combination with calcareous sandstone as shown in Table 3, The alternative mix design Table 4 has only unwashed limestone sand in the place of the two sands. After reviewing the test reports regarding the strength of the specimens following the instructions / requirements of those EN standards governing the preparation of concrete tests, it turned out that in the part of quality control there was no difference between the two mix designs.

The first conclusion that has to do with this thesis has to do with the cost of production of $1m^3$ of concrete with the two mix designs table 6. By using real data from the concrete company Nikos Odysseos who is purchasing raw materials from that Quarry we end up in the tables 7 and table 8. The conclusion to that is that if the second mix design is used instead of the first , a reduction of 25.%, can be achieved . A reduction that can be beneficiated either from the producer, the concrete manufacturer, or the final consumer.

The reason why the second mix design is not used is simple. Cyprus, through the Technical Services of the Ministry of Interior, issued a decree called Regulatory Act 164/2011. This among others is to specified the percentage of fines (filler) that is allowed to be present in the sand produced in the quarries and has set it at the maximum permissible limit of 5%, contrary to European standards that allow the aggregate producer to specify this percentage of the filler that the product will have (the second mix design has 15% filler in relation to the whole material). The second part of this thesis deals with the risk assessment of a possible change of the legislation, in the essence of the abolition of Regulatory Act 164/2011 and use of the same European standards.

In paragraph 5 an early conclusion is reached regarding stakeholders, which this is a great indicator considering the choice of the risk framework to be used.

Stakeholders include many different sections of Cypriot society, several government / administrative services, organized, sets as well as ordinary citizens / consumers. Since there are so many different stakeholders, the risk assessment framework becomes more difficult. This can be

seen in the qualitative assessment of the risks where both the opportunities and the threats concerned the majority of the society as a whole i.e. the IRGC framework would be better suited (Paragraph 6.1), but there were also risks which are corporate, the quarries as companies they would be better suited to use the COSO framework (Paragraph 6.2). The Basic risk treatment was chosen (Paragraph 7) which would be better suited in case you are studying.

Regarding the threats it is clear in chapter 7.3 that the whole logic of the proposal can be shattered in the change of legislation (repeal of the legislation Regulatory Act 164/2011), or if the political turmoil becomes large. After analyzing the risk treatment, we also conclude that such a change would help both financially and environmentally, socially, and even politically the wider area and the whole island.

As a final conclusion and to better manage the proposal, it is suggested that risk analysis has a lot of the characteristics of crisis management and specifically of crisis management that has to do with management of an event crisis (Sharaagen &Van de Ven 1997, Jaque 2007). Since the reactions to the proposal will be large and intense and maybe instantaneously by specific stakeholders at the same time known will. It is therefore proposed to manage those risks as a pre-crisis stage and the to reduce the crisis (Crisis response).

The setup of the groups (paragraphs 7.4.1 and 7.4.2) are developed to mitigate threats and make the most of opportunities just as the proposal becomes known to the general public. This is the turning point if the proposal. If it proceeds from this point and on there is quite a high probability that it will be promoted and perhaps implemented.

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