Open University Cyprus   Hellenic Open University

Master's join degree/post graduate Programme
Enterprise Risk Management (ERM)

MASTER THESIS

RISK PERCEPTION:

A TAXONOMY OF THEORETICAL MODELS

Konstantinos Skarlatos

Supervisor

Dr. Antonios Targoutzidis

June 2020

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This thesis submitted for partial fulfilment of the requirements
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«Enterprise Risk Management (ERM)»
Faculty of Economics and Management

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EXECUTIVE SUMMARY

The perception of reality is a unique characteristic of every human. People tend to perceive the phenomena of the world and of their daily life in different ways than the person next to them. This is one of the features that makes each human distinctive.

Part of understanding the perception of life is also the characteristic of the perceptions of risks. Risks are existing in human life, from the early years of human evolution, in different formats and prominence for humans. Risks have evolved together with the human evolution and therefore have changed drastically. Together with the development of other fields of cognitive sciences and of technology, the academic community started theorizing and analyzing the risk perception relatively recently: the 2nd part of the 20th century. During the last decade of the 20th and as of the start of the 21st century, the importance of the risk perception became a notably critical aspect of the public life, and thus the analysis of the risk perception models was developed further.

This Thesis tries to examine the number and the qualities of the proposed theoretical risk perception models, via a structured literature review aiming to measure the appearance of relevant scientific papers in academic journals. The higher number of appearances in academic journals in regards with a specific risk perception model is an indication of its importance, however, it does not necessarily mean it is a more useful model. The applications of every model are a supplementary factor of each model's to be taken into consideration.

This Thesis will help and support teachers, students and interested readers to find in an easy and convenient way towards a catalogue of all the risk perception models and theories. It could be used as a guide to navigate a tour through the Risk Perception models via historical and usage routes. It provides also support in the understanding of the interpretation of the model. Furthermore, it indicates the scientific fields where each model is applicable and finally the importance that the academic community realizes all the models have. Finally, it offers a categorization spectrum of the models, which could be the basis of discussion and arguments, in favor or against the proposed categories.

The Thesis is divided into six chapters.

- Chapter One, is an introduction that presents the topic, the scope and the limitations of the study.
- Chapter Two, provides the methodology of the performed literature review and the results per risk perception model.
- Chapter Three, provides the results per engine and argues about which the most important models are, based on the research results.
- Chapter Four, presents all the accepted as valid theoretical risk perception models, with the exposition of their main characteristics.
- Chapter Five, posits the concept and the proposed split of the models into categories; presents their applications.
- Chapter Six, concludes with a review of the thesis and the most important suppositions, which are drawn from the analysis.

ACKNOWLEDGEMENTS

CONTENTS

TABLES

1.1. RISK PERCEPTION

Definition 1: a belief or opinion, often held by many people and based on how things seem (CambridgeDictionary, 2019).

Definition 2: a result of perceiving; a mental image; quick, acute, and intuitive cognition; a capacity for comprehension (Merriam-Webster, 2019).

The process of perception is to discover, interpret and amalgamate available data, which humans collect by various means. The individual uses this process to realize the information and therefore the environment in which s/he lives. It is a process, which has been developed during the evolution process of humans and it contains indications and signals that go through the nervous system. It assisted humans for their survival. It involves a number of extremely complex sub-processes that take place in the human nervous system. Humans do not realize these processes because they are happening without any additional endeavor; the reason is that the whole procedure occurs without conscious awareness.

To take a risk means to expose oneself to potential loss (Wilde, 1994). Risk was part of the human life from millions of years ago. Even before their cognitive revolution of Homo Sapiens, humans had to face a number of risks in their daily life. This was the case also during the human life after the beginning of history as we know it today and Homo Sapiens were spreading into different continents (Harari, 2014). The most important one was the daily survival among other species, without becoming their meal. Nonetheless, even till recent years for the vast majority of the human population the risk of survival remained. Famine was for thousands of years the worst enemy of the humans. The risk of making one wrong decision or a bit of bad luck could mean the extinction of a whole family, a tribe or even of a village. Similar was the risk of getting infected by plague and diseases that meant death. Last but not least, was the risk of being involved in a fight, a battle or a war with other human communities, which increased, notably, the risk of death (Harari, 2016). Nonetheless, humans decided to take risks. Through the history they tried to discover new worlds, new things, new methods (of

cultivation for example), other humans, new technologies (e.g. for energy) etc. These actions supported positively the evolution of our specie. Thus, it is valid to state that humans learnt to live with risks, use them and evolve with the existence of risks.

Scientists in the second part of the 20th century tried to understand risk perception. The main areas where the studies originate from are Psychology, Anthropology, Geography, Political Science and Sociology. Humans have a number of cerebral processes to assess the probabilities of risks; to assess the potential utility or danger, and to decide. Humans use these mental techniques in their effort to understand the uncertainties of the world where they live. These mental techniques in regards with the perception and acceptance of risk depend a lot on the social and cultural background and beliefs of each individual (Douglas & Wildavsky, 1982). An interesting finding is that people may disagree how much risky an uncertainty is, even when there is evidence. It depends on whether the proof is consistent with the pre-existing initials beliefs of the individual, in that case they are easily accepted. If the evidence is against the pre-existing initial beliefs the evidence (might be) rejected. The third occurrence though is even more interesting: when individuals do not have strong pre-existing beliefs, then they are at the mercy of how the uncertainty is conveyed to them. The same risk and data about a specific uncertainty, portrayed in different ways, result in humans acting in different ways (Tversky & Kahneman, 1981).

1.2. STUDY OF RISK PERCEPTION

During the evolution of the science of Psychology in the 20th century, the scientists and the specialists realized that humans, in general, understand and perceive risk, in different ways. This perception can be acknowledged in two separate categories:

a. The fact of empirical observation that humans having the same volume and quality of information, interpret differently a specific risk. The differentiation occurred also during scientific tests among people of the same educational level.

b. The reality of scientific experiments and practical observations, which indicated that although there is an existing risk, people were perceiving it at a higher or lower than the reality level.

Most of the studies in regards with risk perception are performed in related scientific fields; the exception to the rule are the studies that are associated with potential major

catastrophes: explosion on a nuclear facility, fire in a chemical or energy producing factory, etc. The perception of risk concept is considered as a rather cognitive procedure. In the area of health, it is contemplated that the prospect of probable health consequences also shapes the perception of the risk. Respectively, the likelihood of a disastrous accident at a nuclear facility influences the related perception of risk. When there is information available about the associated risk in each case, this fact increases the perception of risk and has as a result to motivate people to act in order to avoid the negative outcome that the they assume shall take place (Emmons, et al., 2004).

Once the above were realized, the scientific community, as of the 1960s decade, started experimenting with different kind of studies, given that the specific area was in a virgin status. Based on the set up of the studies and their results, the scientists produced several theories about why humans have different perceptions of risk. The theories themselves can be distinguished in categories based on various criteria. One of the concepts that the modern academic society accepts the categorization is based on the nature of the theory.

a. The psychologic theories based on heuristics and cognitive processes.
b. The anthropological and sociological theories. According to them, risk perception depends on people relations in a society. In this category, we recognize a subsection about the cultural theory; it supports that the specific public values, which a specific society transmits to its members define also the way the public perceive risk.
c. The interdisciplinary theory of the social amplification of risk framework.

The interested reader of the concept risk perception can immediately recognize from the existing bibliography that there is not one theory, which is accepted by the scientific community as the base to explain the whole spectrum of different risk perception phenomena. The argument is that there is not so far, a proven theory that can explain the risk perception framework and concept; a generic explanatory theory. The reasons behind this reality are simple: the complex notion of risk perception, and the reality that every human has a unique way of thinking. The understanding, the assessment and the judgement towards risk of every person creates concepts that cannot be explained by one theory. If we add to this equation, the numerous situations of risks in modern life, the task to find one theory becomes extremely difficult. Last, but not least, we should include the impediment of placing a value on the perception of every individual's interpretation of risk.

The theorists suggested models in accordance to the theories each one of them supported; models which are being still developed in the 21st century. Nonetheless, it is apparent that there is a significant number of models, which is one of the driving factors for the current Thesis. The need to create a taxonomy of risk perception models, which are based on dissimilar theories, and evaluate the ones that modern researchers consider as more important.

CHAPTER 2.

METHODOLOGY

2.1. METHODOLOGICAL APPROACH

The aim of this research was to find the importance that scientists assume for the different risk perception theories, approaches and models. Based on the number of articles published in generally accepted academic, scientific and university journals, it was attempted to define which approaches receive the most scientific support. In order to perform this research, systematic use of internet search engines is necessary.

The first step in the process was to define which are the models that will be included in the research. Hence, research on the theoretical field of risk perception was conducted. The results are quite interesting in terms that it is difficult -if not impossible- to find books that discuss a theory and a model. The literature consists mainly of articles on different kinds of publication. Occasionally, books were created with the accumulation of a number of articles examining similar or different models. Thus, research was quite difficult in the sense that there was no "catalogue" of models in a unique database. This meant that research had to be conducted to find, retrieve and read a number of articles, with a spectrum as broad as possible.

In this initial phase of the research, there was no filtering process as far as it concerned the presumed (by the respective authors of the articles) significance of the models. They were accepted in the list of models to be researched, even if there was only a slight reference on an article, which was found. Given that a number of authors used the term theory, approach or model, in an interchangeable way in their literature, it was decided to include in the research both terms (theories and approaches). The argument is that theories/approaches, in some cases, were not explained or researched via generic experiments in the literature towards the definition of a specific model.

It should be noted that in many cases recommendation in favor of a theory or approach came from scientists and authors of another specialty. In these cases, the scientists use only some of the aspects of a model and test the theory towards their scientific field of their own

expertise. It should also be noted that if during the research via the internet engines more models appear, these models would be included in the list and research would be done retroactively on them.

Once the list of risk perception models was defined, the research turned towards the determination of which search engines were going to be used as far as it concerns the results. Thus, the secondary phase of the research started with research on specific websites known for their articles. During this part of research, models were searched on several websites. The effort aimed to define which of them were trustable to produce a plethora of articles from each model, which would include as many as possible articles for each one of them. In addition, the search aimed in supplementing the risk perception model list, with models that were not found in the initial research of articles and their references.

Two of the websites that were included in the list for research did not contribute any value to the research. Sciseek.com is not anymore producing results for researchers. In its "about me" other than modest statement, it assumes that in previous lifetime, the website it was the oldest and most comprehensive science search engine on the Internet. However, search is considered as dead and thus SciSeek was reestablished two years ago with a different concept (SciSeek, 2019). Moreover, was expected that Google Correlate could be useful for the research. However, Google Correlate webpage states that Google Correlate will shut down on December 15th, 2019 as a result of low usage (GoogleCorrelate, 2019).

Continuing with the research, it was further realized and defined that sciencedirect.com included articles which were published only in Elsevier. Hence, although it included a sizeable number of articles from Social Sciences on risk perception, there were not including the population that could provide the researcher with sufficient size to extract the required confidence for the taxonomy.

Similar were the conclusions after the research on the psynet.apa.org website. Based on experience gained from sciencedirect.com, the research was not finalized given that the research was returning, a relatively small number of results per well known risk perception models.

An interesting outcome was produced by the research on the online library of the Wiley.com (Wiley, 2019). The research was returning a very high number of results when performed with keywords without quotes. Based also on the number of articles that the research was returning from Google Scholar and EBSCO, the results of the Wiley online library (research without quotes) were extremely high. It was obvious also from deeper empirical specific research on the actual results that such a research was returning results that had nothing to do with the subject of the research. Hence, research on keywords with quotes was selected. On a completely opposite outcome, such research was returning very small numbers of articles, of even well-known models; while resulting in zero numbers for other not so known models, theories and approaches. An additional research on the titles of articles brought back even smaller figures. Our assumption is that the research with quotes was more accurate, but the small number was a result of the fact that the certain search engine shows articles only published in Wiley.

Continuing the research, we reached the EBSCO Databases and more specifically the EBSCO Discovery Service; and the Google Scholar search engine. These two search tools provide the capability to explore the desired subject with time limitations or during particular chronological periods. Hence, the target of our study could be better determined with the evolution of approaches and models during time. The decision was made to define this evolution via periods of decades from 1960 till 2020. Sample search prior to 1960 indicated that the results were very poor to non-existent.

As far as the definition of the decade, and because of the two different arguments, we selected the start of the decade as of 1st January of the 1st year (e.g. 1961) till the 31st December of the 10th year of the same decade (e.g. 1970): thus, the period is between 01.01.1961 until 31.12.1970, and so on. Of course, this means that the last decade is in reality a period of only 9 years (01 January 2011 to November 2019). In total, we have 6 categories of decades; four from the 20th century: the 60s (1961-1970, the 70s (1971-1980), the 80s (1981-1990), the 90s (1991-2000); and two from the 21st century: the 00s (2001-2010, and the 10s (2011-2019).

Another valid note that should be highlighted is that research was performed only towards and articles on academic journals on Google Scholar and in EBSCO Discovery. Our exploration of the risk perception literature indicates that there are not a lot of books published on this field. The ones that our search found published, consisted only of articles, from different

authors and scientists, and included either articles supporting one model/approach or several that were even contradicting or supplementing each other. Thus, the clear signal in this explicit research was that books would not be the best source. In addition to this, the fact that it could take years to write and publish a book was considered, hence, for a topic whose current trend and its evolution are explored, books might be outdated when published. On the contrary, most of the articles that are published in academic journals follow a process of being checked (peer review) by other scholars. Thus, they are trustworthy in their content, and in most cases, they contain reviews, reports and firsthand research results. All relevant authors publish articles with their views, documented information and/or related studies or experiments to reinforce these views. There are theoretical articles, which use coherent deliberation to exhibit new or alternative ways of considering a subject. Alternatively, they provide an appraisal or criticism about the standing ways of thinking for a subject. Moreover, there are also empirical thesis articles, which provide new research to elucidate a topic in changed methods; and as well provide new comprehension or criticism about the prevailing ways of thinking on a topic. This kind of articles do not take so much time to publish and thus they document the academic trend of the respective chronological period. Due to the above, our thesis, argument and decision was to use scholarly articles because they are the best indicatory sources for original research on the topic of risk perception models.

In order to be able to depict in a more convenient way for the reader the lists and tables of the results we have used an acronym for each Model; in most cases the acronym exists already in the scientific literature, nonetheless, there were a few for which a new acronym had to be created. The alphabetical list with all the models' names and acronyms is as follows:

Table 1: List of Risk Perception Models

	List of Risk Perception models	
1	Conjoint Expected Risk Model	CERM
2	Cultural Theory	CT
3	Cumulative Prospect Theory	CPT
4	Differential Impact Hypothesis/Theory	DIH/T
5	Extended Parallel Process Model	EPPM
6	Health Belief Model	HBM
7	Impersonal Impact Hypothesis	IIH
8	Prospect Theory	PT

9	Protection Motivation Theory	PMT
10	Psychometric Paradigm/Approach	PP/PA
11	Risk Adaptation Theory	RAT
12	Risk Allostasis theory	RAlloT
13	Risk Compensation theory	RCT
14	Risk Homeostasis Theory	RHT
15	Risk Perception Attitude Framework	RPAF
16	Risk Perception Model	RPM
17	Social Amplification of Risk Framework	SARF
18	Theory of Planned Behavior	TPB
19	Theory of Reasoned Action	TRA
20	Utility Theory	UT
21	Venture Theory	VT
22	Zero Risk Theory	ZRT

2.2. RESEARCH ON GOOGLE SCHOLAR

The exploration on Google Scholar took place under the following conditions:

- Only the number of articles was recorded.

- There is no differentiation among academic articles.

- There is no segregation (not even offered by the tool) among articles originating from different languages.

- The resulted figures do not include figures of citations and patents.

- The "advanced search" functionality was used.

- The search was performed with the use of the model name.

- The option for the "exact phrase anywhere in the text" was used. This was selected as a more trustworthy option for the Google Scholar search, given that with the option "all the words" the results included -also- a significant volume of articles that had nothing to do with the risk perception topic. This occurred because the search would find the words one by one in different places in the text of the article, and it would include it in the results.

- When the model name did not include the word "risk", this word would be included in the field "all the words", simultaneously during the search per model. Hence, it was a supplementary "AND" condition of the search at the text of the articles. In this way the search results would not include articles which

concerned models/approaches which were used also in other scientific fields. For example, this could occur in medical subjects or psychology without the inclusion of the risk perception topic.

- In addition to the above search, a secondary search took place based on the titles of articles. This search undeniably excludes the vast majority of the articles per model and approach. Nonetheless, it is considered by the researcher as a further exploration, which provides complimentary hints about the importance of every model.
  - Again, when the word "risk" was not included in the title of the model, this word was included in the field "all the words", simultaneously during the search per model.
- The total results per model were logged in an Excel file. The total figures are based on the sum of results of the searches for the same model per decade.
- The results for the Differential Impact Hypothesis & Theory although searched separately are summed together because they concern the same model/theory.
- The results for the Psychometric Approach & Paradigm although searched separately are summed together because they concern the same model/theory.

2.3. RESEARCH ON EBSCO DISCOVERY SERVICE

The exploration on EBSCO took place under the following conditions:

- Only the number of articles was recorded.
- The results concern articles from academic journals.
- On every search of a model the choice of "Academic Journals" was selected and clicked. This way, the returned resulted number appears in the upper-middle of the webpage.
- The documented results were selected to include the articles from all languages. This choice increased considerably the number of articles in some approaches.
- The research was performed with the use of the "advanced search" functionality.
- The selected search option was with a Boolean/Phrase.

- The designation was executed by placing as keyword the name of the model at the "TX All Text" field.

- When the word "risk" was not included in the name of the model, then the word "risk" was placed in the secondary search field (again "TX All Text") with AND placed among the two fields. The search was happening therefore simultaneously, requiring the achievement on both fields, in order to return a successful result.

- Similarly, to the Google Scholar search, a secondary search took place based on the titles of articles. The exploration was done with the use of the model name in the field "TI Title". We note again, that indisputably the vast majority of the articles per model and approach are excluded. Nonetheless, it is considered by the researcher as a further exploration, which implies additional indications about the significance of every model.
  - Again, when the word "risk" was not included in the title of the model, this word was included as an AND condition in the field "TX All Text", simultaneously during the search per model.

- Analogically to the Google Scholar results, the grand total results per model was logged in an Excel file. The total figures are the sum of the results of the searches for the same model per decade.

- Access to EBSCO Discovery Service took place through the Open University of Cyprus Library access and permissions.

- The results for the Differential Impact Hypothesis & Theory although searched separately are summed together because they concern the same model/theory.

- The results for the Psychometric Approach & Paradigm although searched separately are summed together because they concern the same model/theory.

RESULTS

3.1. JUSTIFICATION FOR EXCLUDED MODELS

During the research, the review of literature came across to models, which were related partially with risk; however, they were excluded from the risk perception list. The <u>Mental Noise Model</u>, the <u>Negative Dominance Model</u> and the <u>Trust Determination Model</u> are models for risk communication (Sato, 2015). They are based on a number of risk perception theories and models; nonetheless, their aim is to communicate effectively the respective risks during a crisis, an accident, or a health issue. Hence, they were not considered as (direct) risk perception models but as communication models (Covello, Peters, & Hyde, 2001).

Furthermore, the <u>Problem Behavior Theory</u> and the <u>Social Cognitive Theory</u> are occasionally being discussed in relationship with risks, and rarely with risk perceptions. Problem Behavior Theory (PBT) is a social-psychological framework concentrated on the justification of variation in adolescents' participation in behaviors that are socially defined as a problem. These behaviors are deemed unwelcomed by the standards of society, and usually cause some form of social punishment (Donovan, 1996). The Social Cognitive Theory (SCT) describes the effect of personal experiences, of other people's actions, and environmental factors on individual health behaviors. In other terms, SCT describes human behavior in terms of a dynamic and reciprocal model in which personal factors, environmental influences, and behavior continually interact (Glanz, 2001). Nonetheless, the dedicated literature suggests that these theories mainly provide (and are used as) a conceptual framework for understanding risk behaviors during adolescence (Knight, 2009).

3.2. GOOGLE SCHOLAR

The results of the Google Scholar research are documented in the Templates below, separated by decade and per kind of search (<u>exact phrase anywhere in the article</u> and <u>exact phrase in the title of the article</u>).

Table 2: Results on Google Scholar for Text research

	TEXT	1961-1970	1971-1980	1981-1990	1991-2000	2001-2010	2011-2019
CERM	45	0	0	3	6	30	6
CT	43.816	54	180	942	6.940	17.900	17.800
CPT	7.954	2	6	7	269	2.110	5.560
DIH/DIT	164	0	1	7	11	47	98
EPPM	4.543	0	1	4	128	1.090	3.320
HBM	40.813	8	205	1.420	5.480	14.900	18.800
IIH	146	0	0	9	18	47	72
PT	52.000	15	105	1.600	5.180	18.200	26.900
PMT	12.695	0	8	105	762	3.220	8.600
PA/PP	9.923	20	100	272	951	3.010	5.570
RAT	19	0	0	0	0	4	15
RAlloT	101	0	0	0	0	13	88
RCT	610	0	1	33	47	168	361
RHT	1.586	0	2	103	237	476	768
RPAF	501	0	1	1	4	79	416
RPM	921	0	0	5	45	274	597
SARF	1.493	0	0	3	28	402	1.060
TPB	41.066	26	9	71	1.860	16.500	22.600
TRA	36.179	32	10	477	3.760	15.800	16.100
UT	55.652	482	1.810	3.870	9.090	18.300	22.100
VT	860	14	23	39	144	286	354
ZRT	458	0	0	13	79	161	205
	311.545	**653**	**2.462**	**8.984**	**35.039**	**113.017**	**151.390**

Table 3: Results on Google Scholar for Title research

	TITLES	1961-1970	1971-1980	1981-1990	1991-2000	2001-2010	2011-2019
CERM	1	0	0	0	1	0	0
CT	109	0	2	8	39	33	27
CPT	306	0	0	0	9	87	210
DIH	3	0	0	0	1	0	2
EPPM	105	0	0	0	6	15	84
HBM	2.109	0	26	92	157	294	1.540
IIH	0	0	0	0	0	0	0

PT	1.774	0	4	19	86	505	1.160
PMT	379	0	1	13	36	59	270
PA	127	1	7	12	24	37	46
RAT	1	0	0	0	0	1	0
RAlloT	4	0	0	0	0	1	3
RCT	14	0	1	0	2	7	4
RHT	38	0	0	10	15	8	5
RPAF	23	0	0	0	0	8	15
RPM	16	0	0	0	1	3	12
SARF	21	0	0	1	0	5	15
TPB	3.664	2	1	10	176	755	2.720
TRA	704	1	0	62	158	191	292
UT	1.502	42	109	174	216	412	549
VT	2	0	0	1	0	0	1
ZRT	2	0	0	2	0	0	0
	10.904	**46**	**151**	**404**	**927**	**2.421**	**6.955**

3.3. EBSCO DISCOVERY SERVICE

The results of the EBSCO Discovery Service research are documented in the Template below, separated by decade and per kind of search (<u>Boolean exact phrase anywhere in the article</u> and <u>exact phrase in the title of the article</u>):

Table 4: Results on EBSCO for Text research

	TEXT	1961-1970	1971-1980	1981-1990	1991-2000	2001-2010	2011-2019
CERM	33	0	0	2	17	8	6
CT	98.862	116	440	1.654	10.269	32.220	54.163
CPT	8.184	0	1	0	429	2.167	5.587
DIH/DIT	900	3	7	8	102	260	520
EPPM	3.905	0	0	2	110	1.032	2.761
HBM	43.908	1	119	1.006	5.299	13.157	24.326
IIH	105	0	0	2	10	16	77
PT	54.214	25	139	1.534	5.444	15.822	31.250
PMT	10.667	0	3	135	813	3.317	6.399
PA/PP	13.776	12	62	330	1.080	4.560	7.732
RAT	462	0	3	2	12	143	302

	TITLES	1961-1970	1971-1980	1981-1990	1991-2000	2001-2010	2011-2019
RAlloT	81	0	0	0	0	6	75
RCT	1.113	1	6	57	103	302	644
RHT	1.245	0	0	108	204	397	536
RPAF	763	0	0	1	2	178	582
RPM	12.736	0	8	100	1.017	3.845	7.766
SARF	3.239	0	0	11	223	1.048	1.957
TPB	69.322	2	7	56	1.880	16.536	50.841
TRA	32.606	1	6	265	3.049	10.415	18.870
UT	72.466	460	1.805	3.999	9.284	21.869	35.049
VT	13.839	17	26	201	1.220	4.259	8.116
ZRT	385	1	3	15	75	140	151
	442.811	**639**	**2.635**	**9.488**	**40.642**	**131.697**	**257.710**

Table 5: Results on EBSCO for Title research

	TITLES	1961-1970	1971-1980	1981-1990	1991-2000	2001-2010	2011-2019
CERM	2	0	0	0	2	0	0
CT	832	2	4	12	157	264	393
CPT	328	0	0	0	11	75	242
DIH/DIT	3	0	0	0	1	0	2
EPPM	161	0	0	0	2	10	149
HBM	1.640	0	4	29	199	290	1.118
IIH	0	0	0	0	0	0	0
PT	1.831	0	6	18	125	475	1.207
PMT	440	0	0	7	21	113	299
PA/PP	103	0	1	2	17	22	61
RAT	5	0	0	0	0	1	4
RAlloT	2	0	0	0	0	1	1
RCT	16	0	1	2	3	7	3
RHT	27	0	0	9	10	6	2
RPAF	19	0	0	0	0	7	12
RPM	601	0	2	1	20	359	219
SARF	15	0	0	2	0	1	12
TPB	3.216	0	0	2	139	1.012	2.063
TRA	386	0	0	7	95	104	180
UT	1.159	6	61	134	247	307	404
VT	67	0	0	4	12	25	26
ZRT	1	0	0	1	0	0	0
	10.854	**8**	**79**	**230**	**1.061**	**3.079**	**6.397**

3.4. MODELS WITH HIGHER RESULTS

The research of the literature indicates that there is an increased volume of academic journals in regards with the risk perception models as of the decade 1991 to 2000. This increased volume is substantial in comparison to the previous decades. Furthermore, the volume of academic journals increases substantially even between the last three decades (with few exceptions for models that do not have sizeable grand total figures in any case).

The grand total figures of the academic journals about risk perception models can be considered as the best indicatory aspect of the models' importance. However, if we would add the absolute the figures of the two engines, we would end up skewing the volume per model sequence, in favor of models from the engine that has more results. Thus, we used the listing of the percentage per model towards the grand total figures of the engine. Hence for example, in Google Scholar UT has 55,652 results out of 311,545 , which is equal to 17.86% of that figure. In EBSCO it has 72,466 out of 442,811, which is 16.36% of that figure. We added the two percentages and then divided their sum by 2, in order to find the average percentage of UT in both engines; it is 17.11%. The template below shows the first 10 models from the two research engines/tools with the highest average percentage; plus, the two that are included in one engine but are missing from the other engine. In order to help the reader, realize the similarities among the two tools, we have highlighted the models with the same color.

Table 6: Higher Percentages of Results for all 6 decades

GOOGLE SCHOLAR		EBSCO		GRAND TOTAL	
UT	17,86%	CT	22,33%	CT	18,20%
PT	16,69%	UT	16,36%	UT	17,11%
CT	14,06%	TPB	15,65%	PT	14,47%
TPB	13,18%	PT	12,24%	TPB	14,42%
HBM	13,10%	HBM	9,92%	HBM	11,51%
TRA	11,61%	TRA	7,36%	TRA	9,49%
PMT	4,07%	VT	3,13%	PMT	3,24%
PA/PP	3,19%	PA/PP	3,11%	PA/PP	3,15%
CPT	2,55%	RPM	2,88%	CPT	2,20%
EPPM	1,46%	PMT	2,41%	VT	1,70%

					95,48%
VT	0,28%	CPT	1,85%	RPM	1,59%
RPM	0,30%	EPPM	0,88%	EPPM	1,17%

It is interesting to observe out that the first 10 models in Google Scholar and EBSCO as researched per text, are very similar. Moreover, that the grand total percentage of the first 10 models sums up to an average of 95.48% of the grand total results. In both lists, eight of the models are the same, and almost with the same sequence depending on the volume, which is a reassuring characteristic for the validity of our research. Moreover, the first six models are the same in both lists with a minor difference in sequential priority.

Nonetheless, based on the assumption that as science and academics are improving their theories and understanding, using the research results as well, it was decided to present an additional sequence of importance based on the last decade. Thus, the same exactly calculation method was performed as for the 6 decades above, only this time it concerned the results of the two engines per model for the last decade (2011-2019).

The template below shows the 10 models from the two research engines/tools, with the highest average percentage for 2011-2019. In addition, there are the models included in one engine but missing in the other engine. In order to help the reader, realize the similarities among the two tools, we the models with the same coloring convention have been highlighted as in the previous sequence listing.

Table 7: Higher Percentage of Results for the last decade

GOOGLE SCHOLAR LAST DECADE RESULTS		EBSCO LAST DECADE RESULTS		GRAND TOTAL AVERAGE FROM G SCHOLAR & EBSCO OF THE LAST DECADE	
PT	17,77%	CT	21,02%	TPB	17,33%
TPB	14,93%	TPB	19,73%	CT	16,39%
UT	14,60%	UT	13,60%	PT	14,95%

HBM	12,42%	PT	12,13%	UT	14,10%
CT	11,76%	HBM	9,44%	HBM	10,93%
TRA	10,63%	TRA	7,32%	TRA	8,98%
PMT	5,68%	VT	3,15%	PMT	4,08%
PA/PP	3,68%	RPM	3,01%	PA/PP	3,34%
CPT	3,67%	PA/PP	3,00%	CPT	2,92%
EPPM	2,19%	PMT	2,48%	RPM	1,70%
					94,71%
VT	0,23%	CPT	2,17%	VT	1,69%
RPM	0,39%	EPPM	1,07%	EPPM	1,63%
SARF	0,70%	SARF	0,76%	SARF	0,73%
RHT	0,51%	RCT	0,25%		

The outcome provides some interesting insights on the difference that the last decade present towards the results of the last 60 years. In order to help the reader, realize easier the differences the two grand total results were place next to each other:

Table 8: Results Comparison among all six decades and the last decade

GRAND TOTAL AVERAGE FROM G SCHOLAR & EBSCO OF THE LAST SIXTY YEARS		GRAND TOTAL AVERAGE FROM G SCHOLAR & EBSCO OF THE LAST DECADE	
CT	18,20%	TPB	17,33%
UT	17,11%	CT	16,39%
PT	14,47%	PT	14,95%
TPB	14,42%	UT	14,10%
HBM	11,51%	HBM	10,93%
TRA	9,49%	TRA	8,98%
PMT	3,24%	PMT	4,08%
PA/PP	3,15%	PA/PP	3,34%
CPT	2,20%	CPT	2,92%
VT	1,70%	RPM	1,70%
	95,48%		**94,71%**

Here are some interesting points from the comparison of the two periods:

- In both of the template results the 9 out of 10 models are the same; which means small changes occurred during the last decade as far as it concerns the interest of the academics. Although, more models were proposed the focus of the academic community remained relatively steady.

- In both templates the 10 first models in results (out of 22 that we researched), depict approximately 95%, on average, of the grand total figures of academic journals.

CHAPTER 4.

MODELS

4.1. UTILITY THEORY (UT)

Utility Theory is a decision analysis segment that builds models to explain behavioral choices under uncertainty in situations. The roots of the UT (and Expected Utility Theory) go back to the 18th century with the postulation of Daniel Bernoulli that the solution to the problem that his cousin Nicholas Bernoulli raised (known as the St. Petersburg paradox) is that the decision maker should display risk aversion and support a logarithmic cardinal utility function. Later, in the 20th century John von Neumann and Oskar Morgenstern, used the expected utility maximization in their game theory (Neumann & Morgenstern, 1953).

People have to make risky decisions under uncertainty. The expected UT attempts to theorize and predict how people choose rationally under uncertainty, having as aim to act in such way that the outcome might have the highest expected utility (Fishburn, 1968). Every action has a weighted average of the utilities due to the various possible consequences. The utility of every result is weighted according to the probability that the action will produce that result. Von Neumann and Morgenstern established a set of axioms for their theory of expected utility. In the following decades, researchers developed them and reduced them to three basic axioms, which stipulate settings on preferences over pairs of risky prospects.

Together the axioms suggest the presence of a utility function u, which has the ensuing characteristics:

- The utility function preserves the order of preferences among risky prospects; that is, p is preferred to q if and only if the utility of p is greater than the utility of q: $p > q$ if and only if $u(p) > u(q)$.
- The utility function is "linear in probabilities"; that is, $u(Xp + (1 - X)q) = Xu(p) + (1 - X)u(q)$.
- The linearity characteristic is significant in decision analysis. It allows the individual to evaluate compound lotteries easily by reducing them to an evaluation of their components (Bell & Farquhar, 1986).

4.2. PROSPECT THEORY (PT)

Kahneman & Tversky proposed PT in 1979 by criticizing the existing utility theory and developing PT as an alternative model for decisions under risk (Kahneman & Tversky, 1979). The PT differentiates two segments in the decision process that an individual follow: the framing & editing segment, and then a segment of evaluation. In the initial segment, there is an analysis of the decision problem. Hence, a framing-process takes place that sets the actions, likelihoods and outcomes. Framing is very important because its structure is based in the way that the problem is presented and the standards, traditions and expectations of the decision maker. During the latter segment, the prospects are assessed and the one that has the higher value is selected. It can happen either by the domination of a prospect towards another one or with the comparison among their values (Tversky & Kahneman, 1986).

According to the Prospect Theory:

- Individuals have a tendency to reason in terms of gains and losses rather than in terms of their net assets.
- Individuals exhibit a standard pattern: risk aversion in gains and risk proneness with respect to losses.
- Individuals consider losses as larger than gains, even if they both have the same absolute value.
- Individuals value more things they have in comparison to things they do not have.

The over-valuation of current possessions is named as the endowment effect. Loss aversion and the endowment effect indicate that the selling prices should be higher than procurement prices: the smaller reimbursement individuals request in order to give up one of their own goods, in most cases, is quite larger than the highest amount they are willing to pay for an equal title (Levy, 1992).

4.3. CUMULATIVE PROSPECT THEORY (CPT)

In 1992, the authors of PT developed it further with the creation of the CPT model (Tversky & Kahneman, 1992). On the theoretical level CPT is considered as an improvement

of PT. Nonetheless, other authors further developed and questioned some of its sub-components and outcomes under very specific conditions (Schmidt & Zank, 2008).

The main differences between the two are:

- CPT employs cumulative rather than separable decision weights.
- CPT allows different weighting functions for gains and losses. Individuals overweight extreme, unlikely events, however, they underweight average events. In PT, the supposition is that individuals overweight unlikely events, impartially of their outcomes.
- These differences lead in weighting more the extreme events that occur with insignificant probability.

It is worth mentioning that Kahneman received in 2002 the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel for his contribution in integrated economic analysis with fundamental insights from cognitive psychology in particular regarding behavior under uncertainty, which includes also his contribution in CPT (Nobel, 2002).

4.4. VENTURY THEORY (VT)

The scientific discussion about theories and models on risk behavioral aspects in conjunction with expected values of outcomes continued through the years, with scientists proposing further developments. One of these is VT. Venture Theory was suggested by Hogarth & Einhorn in 1990; they both have worked also on similar theories of the ambiguity model, etc. Based on previous theories that argue that people replace probabilities by decision weights when evaluating risky outcomes. The VT model theorizes on how people assess decision weights. It is assumed that people first fixate on a given probability and then adjust this by mentally simulating other possible values. The mental replication is influenced by the absolute size of results; the range to which the fixed-point deviates from the extremes of 0 and 1, and the degree of perceived ambiguity concerning the pertinent probability.

The final adjustment mirrors the relative weight given in imagination to values above the fixed-point. This process is influenced by the presence of uncertainty on the outcome, the sign and size of payoffs, and ambiguity. This effect is considered as a function of individual

and situational variables. Hence, cognitive and motivational factors are significant functions in determining decision weights (Hogarth & Einhorn, 1990).

4.5. RISK COMPENSATION THEORY (RCT)

RCT came to existence at the start of the 1970s, when Lave (Lave & Weber, 1970) and Peltzman (Peltzman, 1975) suggested the concept of risk compensation. The argument is that the term compensation is used to denote offsetting behavioral responses to safety improvements such as regulations and design modification. Hence, when the government requires that brakes or tires conform to a particular standard or builds better roads, then the drivers will tend to increase their driving speed or act in a reckless manner. Thus, feeling safer in their vehicles may encourage drivers to increase speed or take other risks. The risk compensation term was mainly developed by economists. The argument is that it is a direct trade-off between risk involved and counteracting benefits rather than compliance to the requirements imposed by regulations and other safety measures. It is an effort to explain actions that would have not ordinarily taken place by the driver or the manufacturer of vehicles.

The importance of the risk compensation aspect rests on the extent of its effects for specific policy changes. There are authors who argue that the effects are weak, such as the evidence of the empirical studies. A small compensation is recognized in some cases; however, they consider the offsetting behavior as limited, at most. The counter argument is that the magnitude of the risk compensation manners is prone to fluctuate from law/directive to law/directive and from population to population (Miller & Levy, 2000).

4.6. RISK HOMEOSTASIS THEORY (RHT)

The analysis of RHT indicates that it is an elaborate effort to develop further RCT and to explain better the concept of humans taking compensatory counteractions to events, actions, regulations, etc. These theories can only work when there is a counter-benefit (money, pleasure, etc.) for taking a risk. Also, that this relationship (i.e. how much benefit per risk – if they evolve linearly or there is a limit of full benefit, etc.), as well as the extent to which it is perceived by humans, defines the effect of the trade-off. E.g. diving in gutter is risky but nobody would do it more if better medication for infections was provided.

Another important issue is feedback. In situations where feedback is delayed, unclear or non-existing, the homeostasis process cannot work. Homeostasis assumes direct feedback is required to properly adjust behavior. Moreover, homeostasis assumes that people can take action to influence and control their exposure to risk (Targoutzidis & Antonopoulou, 2009).

RHT is a hypothesis theorized by Gerald J.S. Wilde, a professor of Psychology at Queen's University, Ontario, Canada, dealing with the notion that humans have an acceptable amount of risk that they find tolerable. Homeostasis is a process that retains the result close to the target by compensating for upsetting external influences. For example, the temperature of the human body is homeostatically preserved inside narrow boundaries despite major variations in the temperature of the surrounding air.

Analogically, risk homeostasis is the process of maintaining a certain degree of risk (e.g. magnitude of loss due to accidents and lifestyle-dependent disease) by adjusting the risk-taking behavior to the changes that happen in the environment, unless there is a change in the target level of risk (Wilde, 1994). According to the RHT the risk perception level is important. If one's perception of risk level changes, one will compensate by either increasing or decreasing the volume & harshness of risks one takes - all in order to maintain an equilibrium of perceived risk. A famous example comes from Sweden where the State decided to change driving on the left towards driving on the right in the year 1967. This change was followed by a reduction in the traffic fatality rate for the first 18 months. Later the figures returned to their prior values. Wilde argued that the drivers had perceived the danger originally, as very high, and became more careful in the beginning. However, after 18 months they reverted to their original driving behavior as they became familiar to the new regime (Wilde, 1998), thus perceiving it as less dangerous. The model/theory suggests that humans, who (for whatever reason) underestimate risk, shall take more risks, up to their level of acceptable risk; and they will be performing this subconsciously. Therefore, feedback is an important process in such situations, since it can provide corrections to poor perception of risk. Of course, this can only happen to risk where consequences are reversible (e.g. not fatal).

Although there is a substantial number of articles for RHT, from the validity point of view though there are authors who question them. For example, Pless, Madgalinos & Hagel argue that their study results provide no backing for risk homeostasis theory among children using Physical Education. They suggest that the rationality of the theory appears very unlikely

for children in this age between 8 to 18 (Pless, Magdalinos, & Hagel, 2006). The RHT and its consequence process of risk compensation have been criticized. This is happening because it is considered that humans are not capable enough to evaluate rationally their risks and adjust their behaviors as a reaction to a preventive intervention (O'Neill & Williams, 1998).

Other authors although tending to support the RHT, feel obliged to admit that in their area of research and specialty they could not find sufficient behavioral data on risk compensation to extract valid proof; a significant cause could be the lack of accepted study designs in their field for the identification of risk compensation behavior (Underhill, 2013).

4.7. RISK ALLOSTASIS THEORY (RalloT)

Risk Allostasis Theory is a more recent evolution of Risk Homeostasis Theory. It is proposed by Fuller (Fuller, 2011) and it suggests that when one drives one wants to keep the sense of risk and task difficulty inside a tolerable range, which fluctuates over time. Drivers perceive risk feelings in the same way as they experience task difficulty. Partially it is established on the outcomes of research where contributors were requested to assign a value to the task difficulty, feeling of risk and chance of collision of scenes shown in digitally altered video clips (Lewis-Evans & Rothengater, 2009).

Moreover, experiments indicated that there is a baseline point: the valuations of risk, difficulty, effort, and comfort go through a stability phase; it starts increasing once a baseline point has been passed. Inside the stability phase, the subjective experience of risk and difficulty is absent or low and is where the drivers mostly prefer to function (Varotto, Farah, Toledo, Arem, & Hoogendoor, 2018). When the speed of the vehicle is higher than the maximum contented speed for the driver, the perceived feeling of risk and task difficulty correlate with estimations of statistical risk. At lower speed though, the perceived feeling of risk does not correlate to estimates of statistical risk (Fuller, McHugh, & Pender, 2008). There is dispute in the field of driver psychology if the drivers can perceive changes in risk feelings in low risk situations and are informed by these changes in their behaviors. The research suggests that there are not many authors who have followed this theory and model with articles, improvements and suggestions.

4.8. RISK ADAPTATION THEORY (RAT)

The risk adaptation theory is considered as an attempt to combine other risk theories; one of them being the risk homeostasis theory. RAT discusses mainly risk behavior of road users. It assumes that vehicle users subconsciously evaluate their risks by emotions with contradictory directions. The emotions of excitement and danger are sensations, which are characteristics of risks in road traffic. Due to the dependence on these characteristics there is an adaptation into changing risk levels. These separately measured emotional functions are combined and thus a dynamic shifting interval of undecided, uncertain risk indifference exists (Koornstra, 2009).

Risk adaptation theory, theorizes that:
- casualty risks decline exponentially,
- the respective slope parameter is 1½ time larger than for the traffic growth function,
- at the start of the implementation of a safety measure with a significant effect, the effect will be compensated to a lesser low risk level than otherwise expected,
- the influence of a road safety measure to fear perception and excitement level defines whether its projected safety effect will be reinforced or negatively counterweighed.

It is worth mentioning that the supporters of RAT recommend that transportation policy makers should be more aware of the RAT predictions instead of being influenced by the questionable validity of the risk-homeostasis theory. They argue that human risk behavior of road users is explained by the RAT in a better way than RHT (where from the latter it is often derived the popular belief of measure ineffectiveness, which influences the political decisions). Nonetheless, it seems that thus far, RAT has not gained substantial acceptance.

4.9. ZERO RISK THEORY (ZRT)

It should be noted that the Risk Adaptation Theory has borrowed a couple of basic components from the Zero-Risk Theory (Naatanen & Summala, 1976). ZRT argues that due to their cognitive perception process the drivers tend to adapt to road risks, while they are being enthused towards higher speed and thus a riskier behavior. Nonetheless, it is theorized, that the

drivers are not adjusting risk. The driving function becomes an unconscious mechanical activity, due to gained experience, in which risk control is based on keeping safety margins. Due to the aforementioned adaptation to risk, the drivers are not competent enough to take the traffic risks into account to a level that is reasonable. ZRT posits that the government and the society have to prevent the propensity of drivers to be motivated towards faster speeds. Something like that would mean adaptation to a greater risk in the total traffic system. Hence restrictions are required in the traffic system and thus the conclusion is that speed limits are consequently a vital condition for an effective traffic-safety system (Summala, 1988).

4.10. THEORY (of) REASONED ACTION (TRA)

The Theory of Reasoned Action was suggested in the end of 60s and start of 70s, mainly via recurring articles from Icek Ajzen and Martin Fishbein (Ajzen & Fishbein, 1973). It argues that people in most cases act, and thus take risks, in a rational way so that they could accomplish positive results and achieve other peoples' expectancies. It suggests that the behavioral purpose is a direct predecessor of a behavior and it's controlled by attitude toward behavior and subjective norm. The Theory of Reasoned Action suggests that greater intentions lead to amplified effort to perform the behavior, which also increases the probability for the behavior to be performed. TRA assumes that it can predict how a person will act based on the person's pre-existing attitudes and behavioral objectives. In other words, a person's choice to employ a certain behavior is based on the results the person presumes will happen as a direct outcome of acting with the specific behavior. Hence, there is a direct relationship between attitude and behaviors (the A-B relationship). Nonetheless, there was criticism that attitude concepts were not substantiating to be so worthy indicators of human behavior (Park & Levine, 1991). However, the TRA was later revised and expanded by the two theorists Ajzen and Fishbein in the following decades to overcome any discrepancies in the A-B relationship with the theory of planned behavior (TPB).

4.11. THEORY (of) PLANNED BEHAVIOR (TPB)

Theory of Planned Behavior came into existence as an elaborate effort to expand the relevance of the Theory of Reasoned Action further than the cognitive will of a person to decide and commit towards a specific action, which may include a level of risk. TPB tries to integrate the obvious concerns of perceptions of control over performance of the behavior as a

supplementary prognosticating factor. The perceived behavioral control (PBC) is essential because it increases the relevance of TPB further than the volitional behaviors; towards the composite aims and human actions that depend on implementation of a convoluted chain of other behaviors (Ajzen, 1991). The addition of PBC in this theory offers data on limitations of the action as perceived by the individual, and tries to describe why intentions are not constantly good predictors of behavior (Ajzen & Fishbein, 2005).

TPB portrays behavior as a linear regression operation of behavioral objective and perceived behavioral regulator:

$B = w_1 BI + w_2 PBC,$

where B is behavior, BI is behavioral intention, PBC is perceived behavioral control, and w_1 and w_2 are regression weights (Conner & Sparks, 2015).

4.12. PROTECTION MOTIVATION THEORY (PMT)

The PMT is considered to derive from studies during the 50s in the USA. The research was on the convincing influence of fear applications that concentrated on the conditions under which fear applications may affect attitudes and behavior. Principal to these studies was the examination if fear applications could affect attitudes and behavior, or alternatively, if their effects were not direct. The research was constructed on the so-called fear-drive model: the argument was that fear acts as an influential power that provokes trial-and-error behavior and thus the risks the individual takes. Later, in 1975 Rogers theorized PMT as a structure to comprehend the influence of fear applications (Rogers, 1975). Almost a decade later, Rogers again, argued on a revision and expansion of the theory. His effort was to postulate the prominence on the cognitive processes that facilitate and negotiate the modification of behavior (Rogers, 1983). In the following years researchers, theorists and academics employed PMT as a basis to advance, appraise and assess persuasive communications. Moreover, in a different field of science it was utilized as an approach to forecast health behavior.

4.13. HEALTH BELIEF MODEL (HBM)

As with most of the theories, HBM was started being developed in the 70s. Research indicated that the HBM could identify some vital health beliefs that provided a helpful skeleton in order to comprehend distinctions among human health behavior patterns, including the

respective risky decisions. The HBM emphasizes on two characteristics of individuals' depictions of health and health behavior: threat perception and behavioral evaluation. The arguments in favor of HBM were that it provides the stipulation of common-sense beliefs, which can illuminate the consequences of demographic elements on health behavior forms which are repeated. And that these beliefs are responsive to adjustment through education (Rosenstock, 1974). Later in the decade, a paper from Becker et al. validated the HBM framework. The elements of HBM the model were described. (Becker, Haefner, & Maiman, 1977). This was followed by more studies about the interactions among distinct beliefs and health behavior. This was beneficial because it offered a frame for influencing behavior patterns, which are pertinent to public health. Moreover, the model supported the education of health care specialists in regards with the perception of patients. The usefulness of HBM is its application to a variety of health behaviors. The recognition of the utility of HBM is helped to bring at the heart of health service research the cognition modelling.

4.14. EXTENDED PARALLEL PROCESS MODEL (EPPM)

In 1992 Kim Witte suggested the EPPM framework, which (as the author states) expands the previously recommended studies and theories of Leventhal on danger-fear control, and Rogers protection motivation theory (Witte, 1992). Two years later, Witte published also the results of a test of EPPM (Witte, 1994). The EPPM attempts to clarify why fear appeals fail, with the integration of fear as a principal factor and the description of the connection between threat and efficacy. EPPM argues that elevated fear: if primarily instigated due to the perception of an excessive threat; and then strengthened due to the perception of small efficacy, it would provoke defensive stimulus, which shall involve maladaptive results. The EPPM exhibits that fear straightforwardly produces maladaptive reactions. However, fear could be subtly linked to adaptive reactions, if cognitively assessed. Hence, threat defines the intensity of the reaction, while efficacy defines the nature of the reaction. Thus, fear appeals have enormous probability to inspire behavioral transformation when applied properly, which affects the decision on undertaken risks.

4.15. RISK PERCEPTION ATTITUDE FRAMEWORK (RPAF)

The RPA framework was derived from the assertions of the extended parallel process model (EPPM) and of the social cognitive theory (Skubisz, 2014). RPAF posits that whether

individuals will take action to mitigate imminent risks depends upon risk perception and efficacy beliefs. The two pillars of RPAF are based on their RPAF given definitions. Hence:

- A perceived risk is the level that an individual believes is vulnerable towards a threat and simultaneously makes a cognitive assessment of the threat's weighting.

- Efficacy is the individual's confidence to his competence of changing a probable outcome and the belief that the action taken will be effective.

The Risk Perception Attitude Framework classifies people into one of four attitudinal groups: responsive (high risk, high efficacy), avoidance (high risk, low efficacy), proactive (low risk, high efficacy), and indifference (low risk, low efficacy) (Rimal & Real, 2003). Inside health-related frameworks, efficacy is a reliable prognosticator of behavior change. The RPAF posits that risk perception motivates behavioral action, and that efficacy beliefs are critical for facilitating changes in behaviors. It is suggested that RPAF can be used for health campaigns: if audience members are classified into these four groups, then group-specific messages can be conveyed to maximize message success.

4.16. SOCIAL AMPLIFICATION (of) RISK FRAMEWORK (SARF)

A well-known framework from the interdisciplinary school of thought is SARF. It signifies the importance of factors and theory from various fields of science. The framework depicts that several sub-processes are taking place when information is conveyed. Among others: the means that transfer the information; the institutional structures that exist; the behavior of the social group behavior that is affected; and the peoples' pre-existing ideas and beliefs. All these factors influence and form the understanding of a risk, at a social level, and therefore affect and contribute to the risk effects. SARF tries to explain how the communication of risk events spreads from the sender via various in-between stations to a receiver and this procedure serves for the amplification of risk perceptions. It should be noted that all the connections in the series of communication the individuals, groups, media, etc., have filters through which the information is sorted (Kasperson, et al., 1988).

SARF argues that an incident shall affect and be affected by cultural, social and psychological factors. This relationship will reduce or enhance the risk perception that the society has. Moreover, the individual and group behavior will also affect, on a secondary level,

and this will reduce or enhance the risk of the incident in discussion. The argument continues though that even these secondary impacts, as other groups and individuals perceive them, may amplify even further the risk perception, and thus the society may experience third-order impacts. Thus, there will be a ripple effect. Hence, there is a continuous notion of the social amplification of risk because of the collective interactions.

4.17. PSYCHOMETRIC APPROACH/PARADIGM (PA/PP)

The psychometric paradigm (or approach) is an interesting model in the risk perception field and created a paradigm of mechanisms in the related research as of 1978 (Fischhoff, Slovic, Lichtenstein, Read, & Combs, 1978). It aims to explore what the stable personality traits and risk behaviors have in common with an individualistic approach. It uses psychophysical measurements and analysis of more than one variable in order to construct quantitative illustrations of risk attitudes and perceptions (Slovic, 1987).

The basic assumption is that *"risk does not exist out there, waiting to be measured, irrespective of the human beliefs and norms"* (Slovic, 1992). The supporters of this model argue that their studies show that perceived risk is measurable and foreseeable. Individuals make quantitative judgments about the current and also about the desired risk of several hazards. In addition, they make quantitative judgments about the preferred degree of adaptation for each one of these hazards.

The psychometric approach research and theory characteristics, which influence the risk perception results are the following:
- How much a risk is perceived as dread, which depends on the seriousness of its consequences, and
- How much a risk is known or not, which depends on the degree of unfamiliarity and mystery that surrounds it.
- It supposes that people provide meaningful answers to difficult questions
- The results rely on the risks studied, the questions asked about these risks, the types of persons questioned, and the methods followed for the data analysis.
- The questions evaluate cognitions and not the actual behavior.

Although the aforementioned limitations exist, the proponents of the psychometric paradigm support that it the respective research invariably produced coherent and interesting results that have motivated further use ofthe paradigm. The research also indicates that humans believe that most of the risks in society are unacceptably high; however, humans have a significant level of risk acceptance, when the perceived potential benefit is also significant.

4.18. RISK PERCEPTION MODEL (RPM)

RPM was conceived from Sjoberg, and it is considered as a slightly different model in comparison with the Psychometric Approach (Sjoberg, 1993). The model is also using questionnaires, factor and regression analyses. Nonetheless, the size of the samples is larger and more representative of the general population. Moreover, in the statistical analyses, the individual is used as the unit of analysis. RPM develops the psychometric dimensions and tries to describe variance in risk perception. It inserts the elements of attitude, risk sensitivity, specific fear, trust and moral value. Its supporters consider that the measurements from an RPM research are a more constant from study to study than those of the Psychometric Approach.

Sjoberg continued his work in the following decades with a significant volume of research and papers, substantiating his model (Sjoberg, 1999), arguments (Sjoberg, 2002) and thesis (Sjoberg & Engelberg, 2005). He has also been a fierce critique of the Psychometric Approach, among other authors. One of his main arguments is that in the Psychometric Approach experts are generally considered logical and objective in their risk perceptions. He argues that the Psychometric Approach is responsible for the generally accepted notion that policy decisions should ignore the publics' perceived risk.

The Psychometric Paradigm places an asymmetrical importance on investigating and correcting distortions in lay people's appraisals of hazards. Thus, it has provided the scientific foundation of decision making that pursues to shield supposedly rational expert judgments from infection by irrational public fears. However, this notion disregards the simple fact that the views of the public cannot and should not be ignored in a democracy (Sjoberg, Moen, & Rundmo, 2004).

4.19. IMPERSONAL IMPACT HYPOTHESIS (IIH)

The Impersonal Impact Hypothesis was initiated as a theory in the 80s. According to the IIH the assessment of risk originating from media messages is perceived by people to exist more for society (in general) than themselves (Tyler & Cook, 1984). Hence, the argument is that media messages affect people's perceptions of risk for society; however, they have a narrow impact on a person's perceptions of their personal risk. The argument continues with the suggestion that the communication for the crowds and interpersonal communication influence perceptions of risk in a different way. Interpersonal communication can influence individuals' personal risk assessments, while the media communication is more probable to influence individuals' perception of risk to society as a whole.

The research indicates that there are not a lot of articles developing the specific theory. The articles tend to refer to the IIH, use the theory wherever possible or useful, without elaborating on it or developing it. In general, there is an acceptance level of the hypothesis, although it cannot be specifically proven at which level it is valuable. For example, Wu & Li support that the impersonal impact hypothesis, is not confirmed by their research, while the differential impact hypothesis is supported (Wu & Li, 2017). Their findings show the inconsistency in the effect of interpersonal communication on perceived personal risk and suggest an interaction of the predictors of precautionary behavior.

4.20. DIFFERENTIAL IMPACT HYPOTHESIS/THEORY (DIH/DIT)

During the decade of the 90s a slightly different argument from the original Impersonal Impact Hypothesis was proposed. The Differential Impact Hypothesis recommends that mass media messages could influence the perception of personal risk if the message is considered as personally relevant. This could be the case when people see themselves as having a social or even a para-social relationship with the media source; for example, with a celebrity (Snyder & Rouse, 1995) and (Basil & Brown, 1997). An interesting aspect is that in DIH even if stories may originate from mass media, the placement of these stories in a social media environment, might cause perceptions that the stories are distributed via a more interpersonal way. The DIH seems to have a better acceptance by the scientific community.

Scarberry et al. suggest that for both hypotheses IIH & DIH the identification is the crucial factor for humans, which defines the personal relevance (Scarberry, Ratcliff, Lord, & Lanicek, 1997). Makana recommends that an important factor in determining identification is the perceived realism. She argues that research has found that individuals engage in motivated differential perceptions of themselves and others and that the extent and nature is determined by both motivational and cognitive factors (Makana, 2011).

4.21. CONJOINT EXPECTED RISK MODEL (CERM)

The original CERM (authors refer to it also as CER Model) was originally produced by Luce & Weber in 1986. It was developed as a risk perception model for financial lotteries and gambles. It is a weighted function model with five dimensions: probability of gain, loss and status quo, and expected gain and loss (Luce & Weber, 1986). The CERM model includes (individual difference) parameterization by which gains, and losses are raised to some power before the expected values of benefits and losses are calculated. Power parameters estimated from observed data are often close in value to unity.

A few years later Holtgrave and Weber developed a simplified version of the Conjoint Expected Risk. This version of the model theorizes that the perceived risk is a linear permutation of the subjective judgments of the probabilities of harm, benefit, and status quo, and the expected harm and benefit of an activity. Hence, it adjusts the original CERM to include technology and health technology where values of the model variables are subjective (Holtgrave & Weber, 1993). Researchers who studied the simplified model came to the conclusion that the results suggest that the estimations of the simplified CER model parameters and the ratio of variance in risk judgments accounted for by the model are similar under these two conditions. Thus, the simplified CER model is feasible with activities for which harm and benefit information is subjective (Carlstrom, Woodward, & Palmer, 2000).

4.22. CULTURAL THEORY (CT)

The cultural theory (of risk) is also a conceptual framework. CT states that social organization structures provide humans with perceptions that strengthen those structures in antagonism towards different structures. The theory originates from the anthropologist Mary Douglas (Douglas, 1970) who later she developed it further together with the political scientist

Aaron Wildavsky (Douglas & Wildavsky, 1982). CT posits that risks are culturally biased phenomena: individuals perceive and act towards risks influenced mainly by their socially embedded values and beliefs. Hence, CT denounces justifications of risk perception based on personality traits or on a hierarchy of psycho-physiological needs and preferences (Boholm, 1996). CT argues that the election about taking or avoiding a risk is made based on the "way of life or world view" an individual follows specifically, the prospects and value systems that the individual has due to membership to distinctive groups. Cultural theory for health-related risks considers that perceptions on expertise, scientific integrity, professional reliability, and credibility of health-related messages will be influenced from the reciprocal environment in which the conclusions are made.

The Cultural Theory (of Risk) received criticism, which some authors find positive because this means that its contribution to the social theory is significant. In following years, CT (of Risk) theorists added some caveats in regards with the typologies of CT (of Risk) for example: that it makes no claim to understanding the nature of individual free will and thus is not fully deterministic. In addition, that it applies to social environments rather than to societies and hence is technically unable of distinguishing completely social systems (Tansey & O'Riordan, 1999). It should be noted that more than one theorist altered the original grid that Douglas created, and thus it created confusion about the typologies of the CT.

CHAPTER 5.

TAXONOMY

5.1. INTRODUCTORY COMMENTS

Justifications and predictions of people's choices are often founded on the assumption of human rationality. There is consensus that rational choices follow elementary requirements of uniformity and prudence. Issues requiring a decision are outlined by the existing alternative optional actions and furthermore, by the potential consequences of these actions. Last but not least, by the probabilities of the consequences of the respective actions. The researchers and authors on risk perception refer to the decision-maker's understanding of the actions, consequences, and probabilities of every choice with the term decision frame. This decision frame is based both: on the construction of the matter to be decided and on the standards, customs, and personal characteristics of the decision-maker (Tversky & Kahneman, 1981). Therefore, a decision problem can have various decision frames. The rational choice necessitates that the preference among the options should not change due to the variations of the frame. Nonetheless, due to limitations of human perception and decision, changes of perspective often alter the comparative appeal of the available options.

If the same matter is outlined with different methods, this difference has an effect on the risk perception. The psychological codes that rule the perception of risk in difficult decisions/choices, together with the appraisal of the likelihoods of the forecasted results of the choices, influence also the preference and priority of the selected choices. Differences in preference are proven in selections regarding financial consequences, and even about the loss of human lives. The effect that the reliance of the preferences has on the construction of the matter, when a difficult decision is required, creates a major uneasiness on the rational choice theory (Tversky & Kahneman, 1981).

One of the terms that is very often used in the respective literature is risk aversion. Risk aversion is the behavior of humans (especially consumers and investors), who, when exposed to uncertainty, attempt to lower that uncertainty. It is the hesitation of a person to agree to a situation with an unknown payoff rather than another situation with a more predictable but

possibly lower expected payoff. For example, risk-averse investors might choose to put their money into a bank account with a low but guaranteed interest rate, rather than into a stock that may have high expected returns, but also involves a chance of losing value.

5.2. SOCIAL ASPECT OF CATEGORIZATION

A -relatively small- number of authors have performed the categorization of risk perception theories and models through the last two decades. Each effort assumes generic factors, nonetheless, it is influenced from the personal views and knowledge field of the researcher. One of the important factors used for categorization is the social aspect of the influence. In some categorizations of risk models, social, is a separate category itself. Nonetheless, in this Thesis, it is concluded that research and the consequent categorization, so far, has failed to distinguish and discuss the dual aspect of the social factor/category.

The society in which a person lives has an effect on the person's beliefs. In addition, with the current way of life, it is not uncommon, that a person belongs to a small or large number of groups due to her/his work, religion, hobbies, political ideas, sports, etc. These groups can be considered as smaller societies, which also affect every person to some extent. The participation on the generic society and the smaller, more individualistically selected societies/groups are affecting also the levels of risk perception of each participating person.

The position of this Thesis is that there is a duality of the social effect towards the risk perception level of every individual. This duality is not depicted in the categorization of the risk perception theories thus far. Specifically:

- There is the social effect towards the perception of risk that the society (generic or smaller group) influences the participating member towards perceiving a risk in his/her own mind. The individual who has selected participation in political, environmental, religious, lifestyle, sport groups, has a dual-direction influence effect. The individual influences the group (at some small level) with her/his beliefs and perceptions. Simultaneously, the group usually at a higher than the individual, influences every member's beliefs and perceptions. One field of perceptions is undoubtably the risk perceptions. This is a process that takes place indirectly due to the member's participation. For example, membership in a group that cares about environment will increase the level of perception on

risks associated with the environment. This could be identified as the subconscious social effect on risk perceptions.

- There is also the social effect towards the perception of risk where the societal viewpoints are so strong and prevalent, that a number of humans support the same perceptions in order to avoid being the "black sheep" of the group. This is valid both in smaller groups (religious, ethnic, sports, etc.) but also on more generic societies (employment in large organizations, life in cities, country nationality, etc.). Failing to follow the same perceptions on risks that are considered as important from the group or the society, might lead to -different levels- of ostracism towards the differentiating member. In these cases, the person does not decide herself/himself about the level of risk perception. Instead, the established viewpoints of the group or society define the level of the perception for the risk. Usually, this is the case only for the risks that are considered as very or more important. The level of how risky and threatening is a militarily strong neighboring country that has claims on national territorial interests, might not be debatable by the nationals of the affected country. Questioning such perception may be deemed socially inappropriate, if not worse than that. We name this as the conscious social effect on risk perceptions.

We consider that the aforementioned clarification should be taken into consideration on the categorizations of risk perception models.

5.3. CATEGORIZATION MAPPING

Our categorization of risk perception models is based on the realization of the spectrum that the respective theories and models belong. In order to cover this spectrum, we consider a mapping process taking place from one edge to the other. There is specific reasoning for each category we present.

- First, we distinguish the theories-models into the ones that are directly related with risk perception, even if this was not the reason for their initial theorization.
- Then we distinguish the risk perception models into two large categories based on their theories and the organism they best suit and fit: the individual level categories and the social level categories of models. There are models who posit

in a direct way towards the individual human level, while others theorize towards a more generic social level. Nonetheless, our mapping categorization takes in consideration a significant number of models that belong in both of the aforementioned sub-categories.

- Last but not least, we define specific sub-categories due to the nature of the theory and application of the model.

- Although there are models that step into two categories, this fact does not oppose the conceptual mapping of the risk perception spectrum. By default, the theories and models were developed by the same necessities. In order to define and cover the human risk perception field (a task by definition extremely difficult, if not impossible), the theories either loaned partial components of other models or developed an initial idea in a similar but not the same way.

Table 9: Proposed Risk Perception Model Categories

| Generic theories of behavior | RISK PERCEPTION MODEL CATEGORIES | | | | | | Risk Communication Models |
| | individual level | | | social level | | | |
	Individual Cognitive Models	Individual Value Models	Rational Individual Models	Rational Social Models	Social Value Models	Social Amplification of Risk	
Behavioral Decision Theory	Zero Risk Theory	Conjoint Expected Risk Model	Differential Impact Hypothesis	Impersonal Impact Hypothesis	Theory of Reasoned Action	Social Amplification of Risk Framework	Mental Noise Model
Problem Behavior Theory	Psychometric Paradigm/ Approach	Cumulative Prospect Theory		Cultural Theory	Theory of Planned Behavior		Negative Dominance Model
Social Cognitive Theory		Prospect Theory	Risk Perception Model				Trust Determination Model
		Utility Theory	Health Belief Model				
		Venture Theory	Extended Parallel Process Model				
	Risk Adaptation Theory		Protection Motivation Theory				
	Risk Allostasis Theory						
	Risk Compensation Theory						
	Risk Homeostasis Theory						
		Risk Perception Attitude Framework					

5.4. CATEGORIZATION ANALYSIS

The categorization starts with the theories and models that are not included in the Risk Perception Models. These are the <u>Generic Behavioral Theories</u>. These are closer to the **Individual** level risk perception models. They are describing behaviors of individuals, which lead to (potentially) risky actions and perceptions. Nonetheless, they cannot be considered as a risk perception model as they do not provide a systematic explanatory framework for all potential individual risk perceptions.

The first main group in the risk perception mapping are the **<u>Individual Level Models</u>**. They are split into three basic categories: Individual Cognitive Models, Individual Value Models and Individual Rational Models.

The category, which is mainly discussing risk perceptions at an individual cognitive level, without adding necessarily value next to the perceptions it is hereby called **Individual Cognitive Models**. In this category the <u>Zero Risk Theory</u> and the <u>Psychometric Paradigm</u> models belong; both are directly related and depend on the cognitive process followed by an individual. They try to find standards and common elements in personality individualities, which lead to risk behaviors.

Nonetheless, partially, in this category the family of the <u>Risk (Adaptation, Allostasis, Compensation and Homeostasis) Theory</u> models belong as well. Similar to ZRT and PP, the basis of these four models has its roots in the behavioral cognitive field of individuals.

The next category consists of models that irrespective on what theoretical grounds have their commencement, they provide, through mathematical equations and surveys, a numerical value of the estimated risk perception. They aim in calculating via theoretical and practical means the risk perception value of an individual. Hence, they will be called **Individual Value Models**. In this category, have their place the <u>Conjoint Expected Risk Model</u>, the <u>Cumulative Prospect Theory</u>, <u>Prospect Theory</u>, <u>Utility Theory</u> and <u>Venture Theory</u>.

However, as it was mentioned before, partially belong also in this category, the family of the Risk (Adaptation, Allostasis, Compensation and Homeostasis) Theory models. Although that their basic theory has its roots in the Behavioral Cognitive field, they all try to provide a risk perception value based on their respective equations.

Last category in this group is the **Individual Rational Models**. This category is defined based on two main characteristics of the models: that the effect is on individual level, the way of thinking, behavior and perception is based on rational reasoning, while they do not necessarily offer a valuation of the perception. The main Model that fits perfectly in this category is the Differential Impact Hypothesis. DIH concerns the impact of individual risk perception, when the information about the subject information, although provided via mass media, is considered as personally related to the individual.

There are four other models that belong partially in the same category because (according to their theory) they affect risk perception both on Individual and on Social level: the Risk Perception Model, the Health Belief Model, the Extended Parallel Process Model and the Protection Motivation Theory.

Moving further to the right into the spectrum of risk perception, one can find the **Social Level Models** group, where the most important characteristic of the models according to their theory, is that they consider that risk perception is a process, which takes place, primarily, at a social level.

The initial category is the **Social Rational Models**. These are models that consider that perception is affected primarily from the social environment that an individual participates and that there is a rational reasoning why the individual accepts the perception and why the groups project such a perception. The models that fit directly are the Impersonal Impact Hypothesis and the Cultural Theory at first level. IIH theorizes that the risk perception deriving from the media exist more for the society than for individuals. CT argues that social groups and societies that an individual belongs provide the individual with perceptions that reinforce those structures in opposition towards different structures. Hence, the individual perceives a risk based on the value systems of the groups and societies the individual belongs.

As mentioned in the previous paragraph the <u>Risk Perception Model</u>, the <u>Health Belief Model</u>, the <u>Extended Parallel Process Model</u> and the <u>Protection Motivation Theory</u> because they argue that there is a direct effect on the perception of risk on a social level (as well as on individual level).

The next category is the **Social Value Models** where the main models are the <u>Theory of Reasoned Action</u> and the <u>Theory of Planned Behavior</u>. These two models fit perfectly in the definition of the category because they are theories that try to explain behavior (which includes risky behavior and risky decisions) based on attitudes that are influenced mainly from the social environment that the individual lives. In addition, they provide equations where they try to place values on the variables affecting the behavior.

The group of <u>Social</u> categories ends with the **Social Amplification of Risk**, which is a category by its own terms; this is a point that we agree in full with Williamson and Weyman in their substantiation and analysis. The social amplification of risk model receives attention due to the amalgamation of multi-disciplinary approaches to risk. The particular area of attention is how types of a hazard intermingle with social, cultural and psychological processes that reinforce or deteriorate the risk perception. Risk is considered a social concept and also an objective attribute of the threat. The level of enquiry in the social amplification of risk model is a rather collective degree than individual degree (Williamson & Weyman, 2005).

Finally, yet importantly, there is a category regarding the Models that belong to the <u>Risk Communication</u>, and they are just outside the Risk Perception Models. They almost step on the risk perception pool and conceptual field. However, they were created with aim, **<u>mainly</u>**, to communicate the risk and dangers from hazards when they have already occurred or while they are occurring. Hence, they are outside the risk perception generic conceptual area. As it was aforementioned, these are the <u>Mental Noise Model</u>, the <u>Negative Dominance Model</u> and the <u>Trust Determination Model</u>.

In the template below we depict these six models with the higher results during the research, as they are placed in the risk perception model categories we propose above.

Table 10: Models with Higher Results depicted on the Categories Template

Generic theories of behavior	RISK PERCEPTION MODEL CATEGORIES						Risk Communication Models
	individual level			social level			
	Individual Cognitive Models	Individual Value Models	Rational Individual Models	Rational Social Models	Social Value Models	Social Amplification of Risk	
Behavioral Decision Theory	Zero Risk Theory	Conjoint Expected Risk Model	Differential Impact Hypothesis	Impersonal Impact Hypothesis	Theory of Reasoned Action **6**	Social Amplification of Risk Framework	Mental Noise Model
Problem Behavior Theory	Psychometric Paradigm/ Approach	Cumulative Prospect Theory		Cultural Theory **1**	Theory of Planned Behavior **4**		Negative Dominance Model
Social Cognitive Theory		Prospect Theory **3**	Risk Perception Model				Trust Determination Model
		Utility Theory **2**	Health Belief Model **5**				
		Venture Theory	Extended Parallel Process Model				
		Risk Adaptation Theory	Protection Motivation Theory				
		Risk Allostasis Theory					
		Risk Compensation Theory					
		Risk Homeostasis Theory					
		Risk Perception Attitude Framework					

The result is interesting: the six models with the highest percentage of journals are almost perfectly distributed in the spectrum between the Individual Value Models towards the Social Value Models. This fact has its worth. It presents the reality that the researchers consider with equal importance models from the proposed categories, if the results of the last 60 years of research and articles on academic journals are considered. In addition, it seems that specific Value and Rational based models provide some opportunities for tangible and workable results both on Individual and Social level.

5.5. APPLICATIONS

As one would expect, due to the number of risk perceptions models and the acceptance that one model does not fit all objectives, there are plenty of different fields where they are applied. In addition, the variety of the fields is significant among health, psychology, finance, driving, communication, both on personal and on public level.

Table 11: Fields of use for the Risk Perception Models

	List of Risk Perception models		**Fields that they are used**
1	Conjoint Expected Risk Model	CERM	evaluate financial gambles, health/technology activities
2	Cultural Theory	CT	political science, public policy, public management, law, health: from the social group (point of view) that the patients belong
3	Cumulative Prospect Theory	CPT	management, political science, situations that do not appear to follow the rational economic behavior, same as PT
4	Differential Impact Hypothesis	DIH	public management, communication management, hazard communication management
5	Extended Parallel Process Model	EPPM	psychology, health behavior, public communication management on health issues
6	Health Belief Model	HBM	health, health behavior, psychology
7	Impersonal Impact Hypothesis	IIH	public management, communication management, hazard communication management
8	Prospect Theory	PT	management, political science, lottery, insurances, financial issues, behavioral economics & same as CPT

9	Protection Motivation Theory	PMT	information security, antiprivacy laws, personal health, disaster preparedness, driving regulations, personal health behavior
10	Psychometric Paradigm	PP	environmental risk (wastewater use), lay people risk perception, relationships
11	Risk Adaptation Theory	RAT	traffic psychology, driving regulations, driving behavior
12	Risk Allostasis theory	RAlloT	traffic psychology, driving regulations, driving behavior
13	Risk Compensation theory	RCT	driving behavior, sports, safety equipment, health behavior
14	Risk Homeostasis Theory	RHT	traffic psychology, driving regulations, driving behavior, sports, safety equipment, health behavior
15	Risk Perception Attitude Framework	RPAF	health behavior, public communication management on health issues
16	Risk Perception Model	RPM	environmental risk (wastewater use), lay people risk perception, relationships, driving
17	Social Amplification of Risk Framework	SARF	environmental risk, media-communication risk, health communication risk issues
18	Theory of Planned Behavior	TPB	online issues, customers, driving, health behavioral intention, applied nutrition intervention, voting, enviromental psychology
19	Theory of Reasoned Action	TRA	communication, consumer behavior, health behavior
20	Utility Theory	UT	distribution network, financial behavior decision making
21	Venture Theory	VT	financial behavior decision making
22	Zero Risk Theory	ZRT	driving behavior

CHAPTER 6.

CONCLUSIONS

… the pathology of thinking that the world in which we live is more understandable, more explainable, and therefore more predictable than it actually is (Taleb, 2007)

In this Thesis the following have been presented in regards with risk perception models:

- The research of a number of engines for academic journals about the models.
- The results in total figures from two of the engines, where the research indicated coherence and validated results: Google Scholar and EBSCO Discovery Service.
- The results in total figures per decade, starting from the '60s till the current decade.
- The most important models as per the research on the aforementioned engines, based on academic journals; for the last 60 years and for the last decade.
- A brief description per model of all the accepted as risk perception models, based on the researched literature.
- A proposed categorization for all the models, along with a presentation of the risk perception spectrum covered by the models and the respective categories.
- The fields of science and research that every model is used.

Based on the research during this Thesis, the following findings can be concluded:

- The risk perception theories and models are either absolutely associated with risk perception or they are modifications from more generic perception theories.
- The risk perception theory started being researched during the 1960s. It was initiated when the "specialists" realized that humans had differences on how they perceived, understood and experienced risks.
- The idea behind the research and the respective theories was that the decision behavior was influenced (up to a level; a level which was investigated and theorized) by the risk
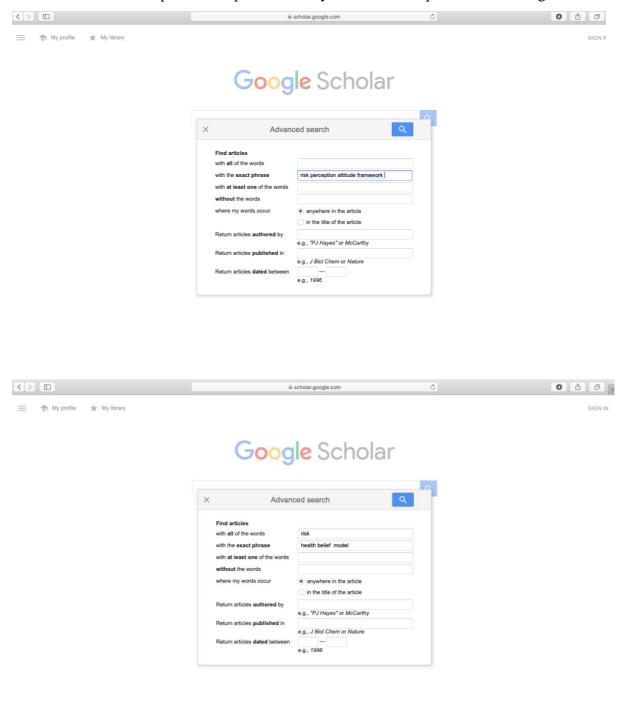
perception of certain decisions. The literature review of the academic journals indicates that approximately 10 theories were researched during the initial decade of research.

o As research was evolving, scientists concluded that the risk perception played a significant role in the behavior of every person. However, the resulted behavior was not always the expected one under the rational theories, as envisioned by science. Hence, more research was performed. Thus, other elements were included in the mix of factors to be taken into consideration.

   o The idea was, in most cases, to posit towards a theory-model, which might be a further development of a previous one, and try to prove it via real experiments: questionnaires, existing statistical data, etc.

   o The other alternative was to (try to) analyze existing data of behavior and then construct a model-theory that fits the data.

o None of the two worked perfectly and thus till today there is not a theory-model that is universally acceptable. The accepted truth is that depending on which realistic field of human behavior the risks are examined, there are models that fit better than others.

o In this Thesis, it was found that although the number of models has increased significantly, the ones with the most appearances in academic journals are among the "eldest" ones. This might be happening because it takes years and lots of research with substantiated results, to convince the academic community about the validity of the model. In addition, a number of models, seem to relate with specified areas, and thus it is difficult to receive academic attention from all over the scientific spectrum.

o The historical research of the last six decades indicates that academics do not change their views easily. The theory-model they supported at the start of their career, has a greater potential to be continued to support, with only minor developments.

o Another finding of this Thesis is that the categorization of the existing models was not given a lot of consideration. And in the cases that there was a categorization, it is also not universally acceptable.

o Given that, there were areas, subjects and even models, which were not taken into thought, it was decided to expand the Thesis, with the proposal of a categorization spectrum under specific elements, that would include all the models researched from this Thesis.

   o The main distinction made is whether the model discusses the perception on individual or social level, understanding that a number of them step on both sides.

- The secondary level distinction is whether they concern models that discuss the perception on rational basis; or try to find a value for the perception; or whether there is cognitive aspect of the perception, which of course is only at an individual level; lastly, there is the social amplification of risk, which is considered to constitute a social category on its own.
- The category of models that are hereby recommended as Value models, either Individual or Social level, retain for the last 60 years main the focus, interest and higher numbers of academic articles.

As it has been shown in parts of this Thesis, the way a risk is presented can alter its perception. This fact in relation to the multi-dimension of risks and perceptions, creates a fascinating field for further research, which is expected to continue to develop in decades to come.

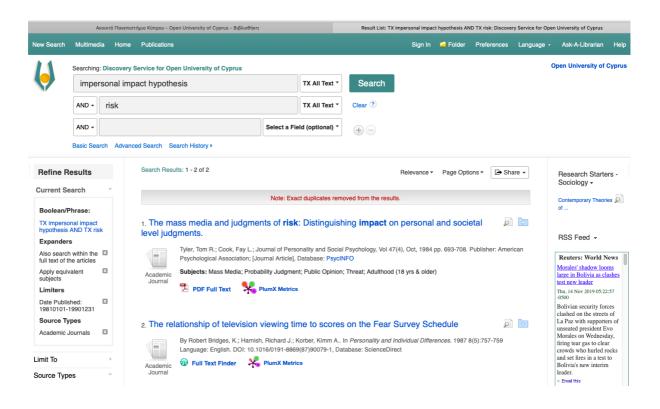# APPENDIX "A"- GOOGLE SCHOLAR EXAMPLES

Below are a couple of examples of the way the search was performed at Google Scholar:
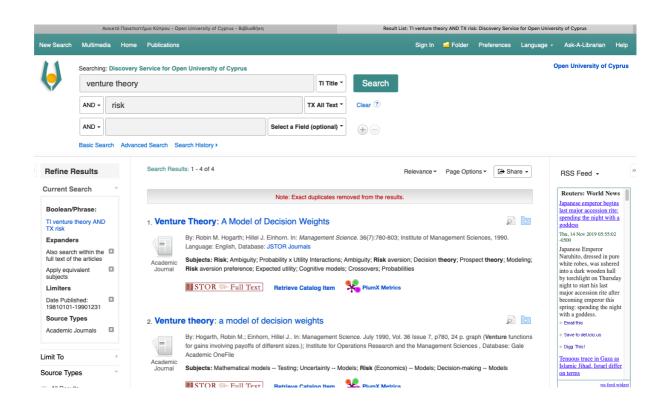
APPENDIX "B"- EBSCO DISCOVERY EXAMPLES

Below are a couple of examples of the way the search was performed at EBSCO:

New Search   Multimedia   Home   Publications   Sign In   📁 Folder   Preferences   Language ▾   Ask-A-Librarian   Help

Searching: **Discovery Service for Open University of Cyprus**   **Open University of Cyprus**

| venture theory | TI Title ▾ | **Search** |

| AND ▾ | risk | TX All Text ▾ | Clear ❓ |

| AND ▾ | | Select a Field (optional) ▾ | ⊕ ⊖ |

Basic Search   Advanced Search   Search History ▸

Refine Results

Current Search   ∨

Boolean/Phrase:
TI venture theory AND TX risk

Expanders
Also search within the
full text of the articles ☒
Apply equivalent
subjects ☒

Limiters
Date Published:
19810101-19901231 ☒

Source Types
Academic Journals ☒

Limit To ▸

Source Types ∨

Search Results: 1 - 4 of 4   Relevance ▾   Page Options ▾   ⤴ Share ▾   RSS Feed ▾

1. **Venture Theory**: A Model of Decision Weights

   📄 Academic Journal

   By: Robin M. Hogarth; Hillel J. Einhorn. In: *Management Science*. 36(7):780-803; Institute of Management Sciences, 1990.
   Language: English, Database: JSTOR Journals

   Subjects: Risk; Ambiguity; Probability x Utility Interactions; Ambiguity; **Risk** aversion; Decision **theory**; Prospect **theory**; Modeling; **Risk** aversion preference; Expected utility; Cognitive models; Crossovers; Probabilities

   JSTOR ☞ Full Text   Retrieve Catalog Item   🌸 PlumX Metrics

2. **Venture theory**: a model of decision weights

   📄 Academic Journal

   By: Hogarth, Robin M.; Einhorn, Hillel J.. In: Management Science. July 1990, Vol. 36 Issue 7, p780, 24 p. graph (**Venture** functions for gains involving payoffs of different sizes.); Institute for Operations Research and the Management Sciences , Database: Gale Academic OneFile

   Subjects: Mathematical models -- Testing; Uncertainty -- Models; **Risk** (Economics) -- Models; Decision-making -- Models

   JSTOR ☞ Full Text   Retrieve Catalog Item   🌸 PlumX Metrics

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