

UNCERTAINTY IN FUTURES STUDIES

CONCERNING CONCEPTUAL CLARITY



PINAR ŞENOĞLU

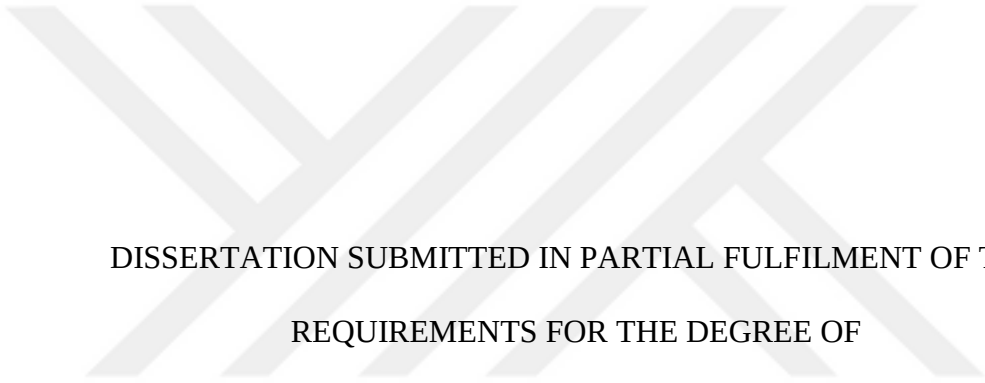
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UNCERTAINTY IN FUTURES STUDIES
CONCERNING CONCEPTUAL CLARITY

BY:

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PLAGIARISM

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

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ABSTRACT

The concept of uncertainty is discussed in different disciplines as management, economics, engineering, sociology, psychology, and history, in futures studies, as well. Future-oriented assumptions generally encounter the lack of completeness, and additionally subjectivity of decision-makers. To minimize these problems in decision making, concepts, which are the main source of researchers, should be handled in a clear, formal, and good way.

The purpose of this thesis is to review uncertainty in futures studies for conceptual clarity. The standpoint of this approach is the necessity of concept clearness as a condition for validity in theory construction (Wacker, 2004). The unknown character of the futures leads us to study the uncertainty in conceptual dimensions in terms of design-based foresight as one of the futures studies in the thesis for the Master Program in Business Administration.

First, the theoretical and methodological background of uncertainty related to foresight is discussed. Then a conceptual framework is presented to the policymakers and corporations as well as the third sector for communicating the process leading to decision-making under uncertainty,

Regarding formerly handled research, this study is helpful to deal with uncertainty via the broader perspective. Interdisciplinary point of view provides diverse choices for understanding and absorbing uncertainty. In addition to this, the historical analysis and discourse highlights the change in handling the uncertainty. Finally, this study models the methodology of the qualitative research perspective.

ÖZET

Belirsizlik kavramı yönetim, ekonomi, mühendislik, sosyoloji, psikoloji ve tarih gibi farklı disiplinlerde ve uz görüş alanında çeşitli şekillerde ele alınmaktadır. Geleceğe yönelik öngörülerde, belirsizlik söz konusu olduğunda, genellikle karar vericilerin bütünsel bakış açısına sahip olmamaları ve ilaveten öznelliğin ön plana çıkması gibi hususlar ön plana çıkmaktadır. Karar verme süreçlerindeki bu tür eksikliklerin en aza indirilebilmesi, olguların temel kaynağı olan kavramların, şeffaf ve çok yönlü bir şekilde ele alınması ile mümkün olabilir.

Kavramı esas alan analizlerin, hem akademik çalışmalarda etkili bir kaynak olması, hem de karar verme süreçlerinde etkili olması bizi, belirsizlik sözcüğünü kavram olarak detaylı bir şekilde analiz etmeye yönlendirdi. Bu araştırma, bir sözcüğün tanım ve teori safhalarından önce, kavram olarak algılanırken oluşan sapmaların ondan sonraki tüm safhaları olumsuz etkilediği görüşünü esas almaktadır (Wacker, 2004).

Bu çalışmada belirsizlik sözcüğünün kavramsal boyutta ele alınması, uz görüş perspektifi ve nitel araştırma prensiplerine dayanmaktadır. İlk olarak, belirsizlik kavramının teorik ve metodolojik arka planı tartışılmaktadır. Ardından, karar vericiler açısından, belirsizlik kavramının hâkim olduğu süreçler için, kavramsal bir çerçeve sunulmaktadır.

Daha önce yapılan çalışmalar göz önünde bulundurulduğunda, bu çalışmada belirsizlik geniş bir perspektif ile ele alınmaya çalışıldı. Disiplinler arası yaklaşım, belirsizlik kavramını anlamak ve özümsemek için seçeneklere sahip olunmasını sağladı. İlaveten tarihsel analiz ve söylem analizi belirsizlik kavramının ele alınmasındaki değişiminin vurgulanmasında uz görüş perspektifini aydınlatıcı oldu.

DEDICATION

I prefer to dedicate this research to my former advisor, Prof Dr. Atilla Öner (1955-2018), for his encouragement, guidance and for his illuminating role in my intellectual journey.

Seneca'dan (MÖ 4- MS 66) öğrencisine mektup

-Yeni “Seneca” Prof.Doç.Dr. M. Atilla Öner (1965-2018) tarafından tez öğrencileri ile paylaşılmıştır.

Seneca Lucilius'unu selâmlar,

Yaptığın, yazdığın her şeyde kendini ne kadar aştığını gördükçe (kalabalıktan çoktan sıyrıldın çünkü), dört köşe olup, neşemden, sevincimden zıplıyorum âdeta, üstümdeki ihtiyarlığı atıyorum da bir sıcaklık yayılıyor yüreğime.

Çiftçi diktiği ağacın meyve vermesinden hoşlanıyorsa, çoban sürüsünde yeni yavrular doğunca, mutlu oluyorsa, herkes kendi evlâdına, sanki kendi gençliği gözüyle bakıyorsa, zihinleri eğiten kişiler, taze bir filizken, biçim verdikleri zihinleri birden olgunlaştırmış gördükleri zaman. Ne hissedersin sence?

Seni ben yetiştiriyorum, benim eserimsin sen. Ben senin yeteneğini görünce el koydum sana, yüreklendirdim, kıskırttım, ağır gelişmene katlanamadım, durmadan dürttüm seni. Şimdi de aynı şeyi yapıyorum, ama artık sen koşmaktayken, bana güç verirken, güçlendiriyorum seni.

“Ne demek bu?” diyorsun, “şimdiye kadar hep istekliydim, sözü?” İşin can alıcı noktası bu. “İşe başlamak, yarısını yapmaktır” diyen atasözünün anlamında değil bu söz. Bu iş ruhsal bir iş. Bu yüzden iyi olmayı istemek, iyiliğin önemli bir bölümüdür. Biliyor musun, kime iyi derim ben? Yetkin, kararlı, hiçbir gücün, hiçbir zorluğun kötü yapamayacağı insana!

Eğer tuttuğun yolda yürürsen, işi ciddiye alırsan, bütün işlerinin, sözlerinin birbirini tutmasını, uymasını sağlarsan bir kalıba dökülmüş gibi, bu iyi kişinin sen olacağını öngörüyorum. Davranışları birbiriyle çelişen insanın ruhu, doğru yolda değildir.

Sağlıkla kal.

Mektup IV, 34

Seneca, Ahlâki Mektuplar – Epistulae Morales, Kitap I-XX, çev. Türkan Uzel, 2. baskı, Türk Tarih Kurumu, Ankara, 1999.

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1. INTRODUCTION

Trying to refine uncertainties is the most dominant issue in futures studies recently. Besides, anticipating futures under uncertainty is a significant phenomenon in decision-making management, as well. In this thesis, we are inclined to keep thinking about how we can practice foresight as futures studies and methodologies to assist us to construct more notified choices and deal with the process of change in the subject of uncertainty.

The contributions of this thesis to the foresight are detailed in the claim for originality in this chapter. Subjects being focused on in this thesis are briefly explained in the background in this chapter. Explanation of this study on a research basis is handled in research scope, aim, objectives, questions, and significance subheadings. Finally, the methodology which is preferred for this thesis is explained to the point in justification of research.

1.1 Claim for Originality

This thesis contributes to the foresight studies about the conceptual clarity of the concept of uncertainty. The contribution is based on having improved clarification of a concept via enhancing words or expressions to a current concept for differentiating numerous kinds of the main concept in this thesis (Wacker, 2004).

This thesis is included of two features:

1. The first one is the Integrated Decade Analysis via content analysis, contributing to the foresight with the approach for the conceptual clarity of uncertainty via integrating the tendencies in handling the uncertainty within the seven decades. Historical analysis, multi-disciplinary handling, and discourse

analysis are the basis for the first approach. In our work, we systematically reviewed the historical literature to find unique definitions of the uncertainty concept in order to give an experiential sense of the past and provide an integrated framework (Meredith et al., 1989). The knowledge from diverse disciplines guides us in a better understanding of uncertainty via broader perspectives. In addition to that, the discourse analysis is done via analyzing with the usage of the verb, adjective, and concept with uncertainty. The paradigmatic shift in handling uncertainty is shown with the Integrated Decade Analysis.

2. The second one is the Integrated Conceptual Framework via conceptual modeling, contributing to the foresight with the approach for the development of uncertainty through taxonomy and characterization. This framework comprises analyzing four conceptual models in-depth with their attributes, definitions, as well as taxonomies and categorizations.

1.2 Background

For decades, researchers have sought a sufficient definition of uncertainty. The study of uncertainty is not restricted to any discipline; it is searched in diverse fields as business administration, economics, technology, physics, engineering, and environment. The futurists are also professionals who have dealt with uncertainty. Focusing on conceptual uncertainty in foresight (Asselt, 2005) commented:

Foresight implies dealing with prognostic uncertainty, the notion ‘prognostic uncertainty’ refers to instances in which professional futurists have doubt about something in the future, partly or fully because (scientific) knowledge is perceived as absent, incomplete, irrelevant, insufficient, inaccurate, ambiguous, equivocal, inconsistent, fragmented, manipulated, complex or otherwise limited (pg.42).

Although several moderating factors that are so complex and uncertainty dominant in the thoughts of people lead to them tend to act “as though”, it is difficult to suggest an accurate and perfect model of conditions describing the future thoroughly (Haveman, 1977). Therefore, uncertainty could be defined as a “phenomenon that produces overlapping distributions of potential outcomes “ (Alchian, 1950).

Distinguishing itself from utopia, Mendonça, Sandro, Sapio and Bartolomeo (2009) highlighted that foresight is handled as analytical, conscious, innovative, and reflexive forward-looking commitment with future. Moreover, the key tasks and developments, which are classified by foresight professionals, may include aspects of the occasion, segments, districts, eco-systems breakdowns, in addition to powershift (Öner, Benson, & Beşer, 2014).

Tuomi (2013) differentiates including forecasting, foresight, and design-based foresight where the latter is based on the consequences which are resulted from forecast and foresight models and targets to execute them in decisions and actions, in addition, it is unpredictable, qualitative, and focuses on incoherence.

In future creating, Appadurai (2013) stated that “the interactions between three notable humans’ preoccupations that shape the future are imagination, anticipation, and aspirations”. However, “we have not yet found ways to articulate how these three come together in the work of future-making” (Appadurai, 2013).

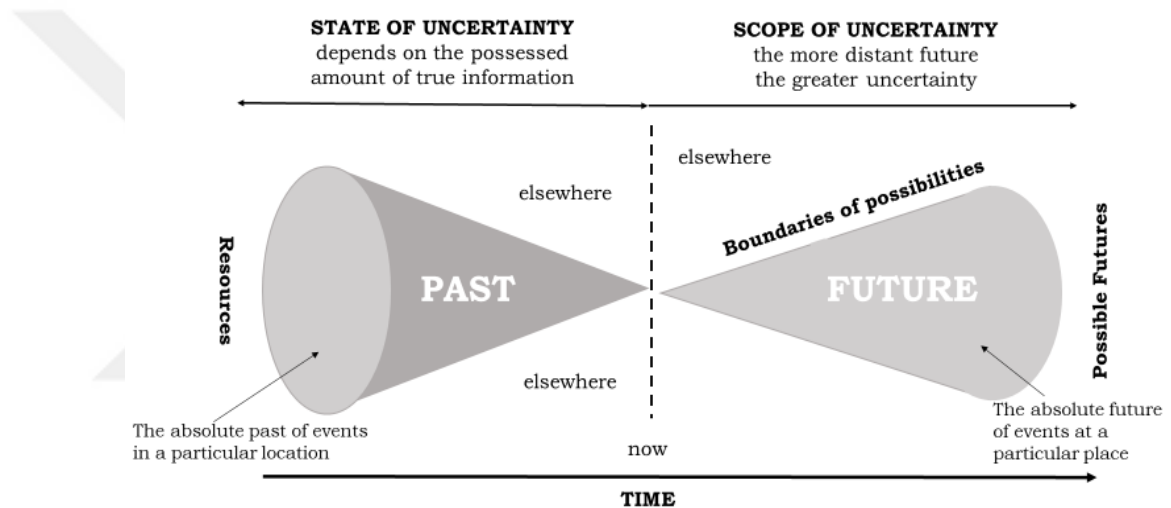
In the study of the future, which is a compound manner, is expected to compromise evaluating, experiencing, and explaining uncertainties (Brown & Eisenhardt, 1997). The starting point of uncertainty in futures studies links with handling uncertainty in the present and past studies. Facing up to the uncertain

environments, futures studies aim to identify alternative futures and develop strategies to address alternative futures (Burt & Heijden, 2003).

Managing uncertainty in the light of past and present knowledge in futures studies is a kind of phenomenon which is named as “ cone of uncertainty and possibilities”(see Figure 1) expounded by (Hawking, 1990) and, (Magnus, 2012).

Figure 1

Cone of Uncertainty and Possibilities



Note. From “Concept of uncertainty in relation to the foresight” (Magruk, 2017)

Magnus (2012) stated that, “*cone of uncertainty and possibilities* “is a kind of simulation that comprises progressive paths for the future where it is shaped up by data, information, and knowledge which belong past and present. (Magruk, 2017) emphasized that this model grounds on realistic and probable paths near to center where improbable paths are situated in the outer edge of the cone.

In line with an entirely deterministic method, if it would be acknowledged what was taking place at a precise time in an exacting location in past, it could be a

probability to forecast with an above-average possibility what would come about in the future (Magruk, 2017). Nevertheless, events that are in “elsewhere” do not influence on possible future instances (Hawking, 1990).

In decision making management has no option, however, anticipating the future under uncertainty and balancing short and long-term goals, the research which is constructed on long-range planning because of a period of twenty years and more, medium-range planning as ten to twenty years and short-range planning as five to ten years (Kavrakoğlu, 1990).

The nature of contemporary problems is focal point of interconnecting sciences and have characteristic uncertainties in their areas which requires multidisciplinary approaches and mindset to solve problems and decrease uncertainties (Gyawali & Dixit, 2001). Defining uncertainties is the most leading concern in futures studies, as well.

In this thesis, we tend to keep considering how foresight as futures study and methodologies support to make more updated alternatives and manage the development on the subject of uncertainty.

Through the source of wide-ranging literature review, this thesis initially analyzes the characteristics of uncertainty, and subsequently make a framework for a clear conceptual clarity, in the light of experiencing, understanding, and decreasing uncertainty in various disciplines, whereas displaying a place for discussion on updated structures of futures decision-making.

This thesis also intends to be part of the analysis on the theoretical and methodological background of uncertainty, which is related with futures studies (taking into consideration of all foremost sectors in conjunction with managerial, economic,

and technological trends), and will exhibit a conceptual structure to the policymakers and corporations, the third sector as well, for interconnecting the methods which are in the lead in decision-making under uncertainty.

1.3 Research Problem

Numerous outcomes of our decisions, activities, and actions are not certain in general and the largest part of decisions going ahead of routine, uncertainty exists (Future Learning, 2020). There is not a decision that is based on an absolute list of whole probable things that might happen. Not only because of deficiency in the ability to compute or insufficient creativity potential, but it is an unavoidable trait of human reality (Future Learning, 2020).

The features of contemporaneous problems are the main theme of interrelating sciences and have typical uncertainties in their areas which have the need for multidisciplinary attitudes and approaches to resolve problems and reduce uncertainties (Gyawali & Dixit, 2001).

Uncertainty is one of the weak points of dynamical concerns in science which is a fundamental phenomenon for its development as being interdisciplinary, societal contribution, contextual theme, and capacitation of reflexivity (Healy, 1997).

Due to being unavoidable truth and weakness of dynamic matters in science, uncertainty is handled with numerous approaches for understanding and absorbing it. Reducing uncertainty is one of the most significant concerns of those approaches. Therefore, the effectiveness of conceptual clarity on reducing uncertainty is the key examination of this research.

1.4 Research Scope, Aim, Objectives, and Questions

1.4.1 Research scope

During the management of the research process, conceptual clarity of uncertainty as a concept for foresight was the focal point of this thesis. The standpoint of this study is the necessity of concept clearness as a condition for validity in theory constructing (Wacker, 2004). Thus, the research method was designed in the light of that necessity. In addition to the aforementioned focal point, a multidisciplinary approach determined the scope of this study. Decision-making under uncertainty is a vivid phenomenon in future studies, and in various disciplines, as well. Therefore, the multidisciplinary scope was taken into consideration for conceptual clarity of uncertainty as a concept.

1.4.2 Research Aims

Framing conceptual clarity for uncertainty as a concept was the main goal of this research. Because anticipating the future and balancing short and long period goals with uncertain situations in decision making are significant challenges in numerous disciplines, and futures studies, as well. Thus, there is a need to clarify uncertainty for short, medium- and long-term planning, setting the strategy, and designing the future accurately in decision making under uncertainty.

1.4.3 Research Objectives

The key points of the research are to refine uncertainty as a concept in decision-making within foresight as a futures study. The detailed goals comprise below-mentioned subject:

- i. To contribute to the discussion on the theoretical and methodological background of uncertainty related to foresight as futures studies.

- ii. To present a conceptual framework, for communicating the process leading to decision-making under uncertainty, to the policymakers and corporations as well as the third sector.

1.4.4 Research Questions

To manage and steer uncertainty in the conceptual framework, there is a need to have the guidance of questions in this research. Questions that arise are below:

- i. How do we think about and respond to uncertainty during the decision-making process in foresight as futures studies?
- ii. Is there any paradigmatic shift within the taxonomy of uncertainty? And how revolutionary are they?
- iii. Is there one method capable of dealing with all sources of uncertainty? What ways/means have been developed to deal with uncertainty?

1.5 Significance of Research

By clarifying uncertainty as a concept for foresight, this research delineates a plain conceptual clarity for understanding, interpreting, and decreasing uncertainty in various disciplines whilst constructing a place for discussion on different structures of decision-making in futures studies.

It emphasizes the requirement of new perspectives on conceptual clarity. Focusing on a clear concept and outlining a conceptual frame may facilitate to have precise continuity and outcome both in theory-building (Wacker, 2004) and in the management process.

About formerly handled research, this study is helpful to deal with uncertainty via a broader perspective. Interdisciplinary point of view provides diverse choices for understanding and absorbing uncertainty. In addition to this, the historical analysis

(Meredith et al., 1989) and discourse analysis as the analysis as beyond the sentences highlights the change in handling the uncertainty.

Due to concerns with the chase of completely precise knowledge, uncertainty has been ignored or eliminated in the Western scholar approach until recently (Smithson, 1988). Historicity has helped us to understand the development of dealing with uncertainty in science and management practice. According to Smithson (1988) increasing in complexity and paradigm shift about technologies and organizations ever since World War II have given rise to concern about the concept of uncertainty.

Today, the probability of managing uncertainty via absorbing or decreasing it is the main point of various approaches. There is a change in handling the concept of uncertainty. Thus, discussion of uncertainty based on period may create a new platform for conceptual clarity in foresight.

1.6 Justification of Research

The study examines different approaches for achieving effective results about conceptual clarity of uncertainty, which is essential for clear description and analysis of uncertainty as a concept. Having concluding effects which are about conceptual clarity is overall goal of this research.

According to Wacker (2004) “any statistical validity tests are not meaningful if the concept is not formally defined”; therefore “good formal conceptual definitions are necessary conditions for construct validity”. Thus, aiming at reaching clarity of uncertainty as a concept is based+ in the light of Wacker’s (2004) approach on “good formal conceptual definitions” in this study. Wacker (2004) stated that conceptual definition should have some rules for clarity (See Table 1).

Table 1

A summary of the Rules for a 'Good' Formal Conceptual Definition

Rule 1: Definitions should be formally defined using primitive and derived terms. Formal conceptual definitions should differentiate between formal concepts and non-formal measurable terms. All definitions should follow the 'rule of replacement'

Rule 2: Each concept should be uniquely defined. It should be excluded (as many as possible) shared terms with other definitions to reduce confusion with related concepts. This rule means that the formal conceptual definitions denotation matches as closely as possible match its connotation

Rule 3: Definitions should include only unambiguous and clear terms. Put another way, do not use vague or ambiguous terms

Rule 4: Definitions should have as few as possible terms in the conceptual definitions to avoid violating the parsimony virtue of 'good' theory

Rule 5: Definitions should be consistent within the production/operations management field. That is, formal conceptual definitions should be the similar as possible between studies

Rule 6: Definitions should not make any term broader. New definitions should not expand the concept to make it broader and less exclusive

Rule 7: New hypotheses cannot be introduced in the definitions. In production/operations management, the definitions should not include instances where only 'good' events happen

Rule 8: Statistical tests for content validity must be performed after the terms are formally defined. These empirical tests are not testing of the conceptual validity of a concept but rather are used to test if the formally defined concepts sample the conceptual domain

Note. From: "A theory of formal conceptual definitions: developing theory-building measurement (Wacker, 2004)

The reasoning of the above-mentioned rules for "good, formal conceptual definition" are grounded on features of 'good' theory (Wacker, 2004). First, the concept has to be described both simple and originated forms without any damage on the being one-of-a-kind feature of 'good' theory (Wacker, 2004). Then, "formal conceptual definition" is supposed to comprise explicit and clear few terms without expanding present description in the light of parsimony (Wacker, 2004). Last, new, and different hypotheses should not be in the definition and statistical or "empirical validity test" is carried out after succeeding of related rules (Wacker, 2004).

It is seen that conceptual clarity has a significant role in formal definition when those rules are analyzed. Wacker's (2004) approach is guidance for this research on the importance of conceptual clarity.

Major research paradigms are divided into three groups as positivist, interpretive, and critical paradigm based on ontological, epistemological, methodological positions, and methods that are utilized in the process of research (Scotland, 2012).

The interpretive paradigm which is based on subjectivist epistemology where understanding concept from individual's (participants) perceptions via collected data through cultural and historical context and critical paradigm which is also based on subjectivist epistemology where researchers and participants are both subject matters in the dialectic task through critically questioned cultural, historical, and political context are the guides of this study (Scotland, 2012).

Interpretivism points to take along awareness which is unseen social structures (Scotland, 2012). Lincoln (1995) stated that managing a search via the interpretive methodology includes precedence of fundamental social structures as it should, utilization of the interpretive standpoint demanded the evaluation of the diversity of literature about uncertainty as a concept through a multidisciplinary approach.

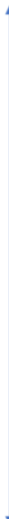
Utilizing interpretive analysis comprises comprehending the phenomenon which is based on the perception of individuals in the light of both cultural and historical background (Scotland, 2012). Therefore, uncertainty as a concept is analyzed in a great deal of academic data formed with quoted potential studies (field and period) and specific topics (concept and unique description of uncertainty) with the aiming of conceptual clarity.

The philosophical point of view about "people's perception of objective reality" approach is dealt with the research using two fundamental dimensions, "rational-existential" and "natural-artificial", which broadly structure the studies in business

policy (Mitroff & Mason, 1984; cited in Meredith, Raturi, Amoako-Gyampah, & Kaplan, 1989) (See Figure 2).

Table 2

A Framework for Research Methods

		NATURAL ← → ARTIFICIAL		
RATIONAL  EXISTENTIAL		DIRECT OBSERVATION OF OBJECT REALITY	PEOPLE'S PERCEPTIONS OF ONJECT REALITY	ARTIFICIAL RECONSTRUCTION OF OBJECT REALITY
	AXIOMATIC			* REASON/LOGIC/ THEOREMS * NORMATIVE MODELING * DESCRIPTIVE MODELING
	LOGICAL POSITIVIST/ EMPRICIST	* FIELD STUDIES * FIELD EXPERIMENTS	* STRUCTURED INTERVIEWINF * SURVEY RESEARCH	* PROTOTYPING * PHYSICAL MODELLING * LABORATORY EXPERIMENTATION * SIMULATION
	INTERPRETIVE	* ACTION RESEARCH * CASE STUDIES	* HISTORICAL ANALYSIS * DELPHI * INTENSIVE INTERVIEWING * EXPERTS PANELS * FUTURES/ SCENARIOS	* CONCEPTUAL MODELLING * HERMENEUTICS
	CRITICAL THEORY		* INTROSPECTIVE REFLECTION	

Note. From “Alternative research paradigms in operations” (Meredith et al., 1989). The methods which were used in this research were highlighted in bold.

Meredith et al. (1989) stated that, the “rational-existential dimension” comprises the involvement of pure logic which is unconnected with subjectivist standpoint, or personal understanding, which is based on experience, while “natural-artificial dimension” is interested in type and resource of data, information and knowledge benefited from in research study.

The interpretive standpoint which comprises “the context of the phenomenon”, is the role of being a vital part of the purpose of the study (Meredith et al., 1989). Meredith et al. (1989) stated that meanings, and interpretations are the main criteria to understand the construing, and conceptualizing of concepts, and events by other researchers in interpretivism.

Historical analysis which is based on interpretivism looks into the former documents or research to make a comparison, finding similarities or differences, and examining a phenomenon from a specific approach (Meredith et al., 1989). In our work, we systematically reviewed the historical literature to find unique definitions of the uncertainty concept in order to give an experiential sense of the past and provide an integrated framework. In addition to that, historical analysis was utilized in this study due to having the goal of understanding the concept of uncertainty from different period and field perspectives.

This thesis, it is aimed to have more knowledgeable options which can be used for managing the development of uncertainty through taxonomy and characterization. Conceptual modeling is utilized as a method for taxonomy and characterization of uncertainty in this study. “Conceptual modeling is a mental model of the suspected relationships which may be evaluated through a framework” (Meredith et al., 1989).

Trying to refine uncertainty is the most leading concern in futures studies. The other method which is utilized to reach conceptual clarity is content analysis in this study. “Content analysis is a family of systematic, rule-guided techniques used to analyze the informational contents of textual data” (Mayring, 2000); that is, it is a form of conceptual analysis, whereby key concepts or terms are evaluated.

Due to common judgment about qualitative research for the shortage of scholarly rigor (Gioia, Corley, & Hamilton, 2013), in this research, the concept, uncertainty, is placed into free-standing nodes and subsequently used to build broader themes or sets by NVivo 12. NVivo 12, a commonly used qualitative software package, is employed to analyze uncertainty as a concept (QSR International, 2019).

1.7 Research Outline

This research is projected with three stages like planning, execution, and interpretation. The first phase of the planning section was to identify the research area for designing a framework. After setting a general framework, comprehensive literature scanning was utilized in the light of a multidisciplinary approach. Besides, the research method was determined from the standpoint of qualitative research rigorousness.

A comprehensive literature review which was based on historical analysis and discourse analysis was realized in the execution phase. Due to having determining effects of conceptual clarity as to the focal point of this study, content analysis and conceptual modeling for clear concept with NVivo 12 was utilized in the execution stage. The whole knowledge and information which were obtained from previous stages were analyzed and interpreted during the last phase of this research.

2. LITERATURE REVIEW

This chapter aims to offer knowledge on the subject of uncertainty for conceptual clarity. Thus, uncertainty as a concept is handled via three sections. First, the theoretical framework about uncertainty is the starting point for understanding uncertainty on a theoretic basis. Then, uncertainty is dealt with by definition and taxonomy to figure out the concept comprehensively. Finally, the knowledge about uncertainty in future studies is discussed.

2.1 Theoretical Framework

Science is widely accepted by scientists and decision makers, as the cause and the starting point for the solution of current and future problems (Healy, 1997). However, science is a dynamic variety of matters, which supplies its progress from its weaknesses and opportunities instead of its strengths in terms of its application, context, and structure (Healy, 1997).

Knowledge, information, or data about any subject and correlated environment mainly influence the types of decisions people make. Uncertainty, risk, and certainty are named as decision-making environments, depending on assessment probabilities of each possible outcome or consequence (Heizer & Render, 2008). Although uncertainty is one of the weaknesses of dynamic matters in science, it is a significant phenomenon for the development of science in terms of interdisciplinary feature, societal contribution, contextual theme, and capacitation of reflexivity (Healy, 1997).

Production of scientific knowledge is formed by conceptualizing from empirical studies, which include empirical models and measurements, is then reflected as effective if they have positive outcomes for the present and future (Healy, 1997). Healy

(1997) stated that negative results are obtained due to having circumstantial uncertainties in addition to effective outcomes as well.

Science is precisely the process of using one's previous experience as a basis for prediction (George, 1968; cited in Strand, 1999 pg. 333). The prediction is important, the whole point of having a science, is to be able to make (accurate) predictions (George, 1968; cited in Strand, 1999 pg. 333). On the contrary, Blackman (1994; cited in Strand, 1999) nearly sets aside old-style forecasting as simple; in place of prediction, futures studies and approaches are preferred to handle the management of change.

The concept of uncertainty includes diverse meanings and being highlighted in various disciplines as physics, engineering, statistics, economics, finance, philosophy, and psychology (Dorsser, Walker, Taneja, & Marchau, 2018). Uncertainty, accepted as incomplete knowledge, has an extremely long past which is based on the ancient Greeks with philosophical discussions on certain knowledge (Dorsser et al., 2018).

"Heisenberg's Uncertainty Principle" is significant in the theoretical progress of the concept of uncertainty. According to the "Uncertainty Principle" which Heisenberg introduced in his work in 1927, the position and velocity of a subatomic particle, could not be determined simultaneously in a physic experiment (FOCUS, 2005 pg. 33). Nevertheless, still now, 80 years after its inception, there is no consensus over the scope and validity of this principle (Bush, Heinonen, & Lahti, 2007 pg. 155).

The contemporary approach of uncertainty sets off about 1921 via Knight's approach, which is centered difference between risk and uncertainty (Dorsser et al., 2018). "Knightian Uncertainty" is described through the relatively restricted choice of

“Risk, Uncertainty, and Profit” in general (Knight [1921], 1985; cited in Nash, 2003). The Knightian difference, concerning uncertainty and risk, is based on the description that probabilities are less surrounded with uncertainty in contrast to possibilities (Nash, 2003).

For Knight, a measurable uncertainty, or ‘risk’ proper ... is so far different from an unmeasurable one that it is not in effect an uncertainty at all (Knight, 1921; cited in Stirling, 2010 pg. 1029). According to Knight, risk indicates “the calculable and thus controllable” part of all which is “unknowable”, and the rest is “the uncertain” (Dorsser et al., 2018). Decision-making under uncertainty and decision-making under risk are also separately handled by Luce & Raiffa (1957; cited in Dorsser et al., 2018).

It is observed that innovative studies realized ignorance when probability theory was issued (Smithson, 1988). More than a few structures which are related to non-probabilistic uncertainty have been formulated, as well (Smithson, 1988). Researches in the judgment of psychology and decision-making have caused penetration and differentiation on ignorance, in particular (Smithson, 1988).

Demonstration, exemplification, and management of ignorance, in other words, replies of researchers and theories to ignorance, has changed in the context of time, fields, and methods via diversification of ignorance as a concept (Smithson, 1988). Such as “economics, management science, sociology of organizations, cognitive psychology” as older disciplines and “risk analysis, engineering, and artificial intelligence” as newer handle ignorance as a vital matter (Smithson, 1988).

Mainly, diverse approaches and theories are emerged because of coping with ignorance (Smithson, 1988). In addition, uncertainty is discussed in a special position

as the “most manageable kinds of ignorance” and “in some fields is employed as a synonym for ignorance” (Smithson, 1988).

Probability theory covers certain types of uncertainty while banishing vagueness, ambiguity, lack of information, distortion, and irrelevance (Smithson, 1988). However, in the last forty years, numerous non-probabilistic approaches have been proposed for dealing with uncertainty, surprise, doubt, fuzziness, vagueness, and possibility (Smithson, 1988). On the other hand, modern probability theory stems from several fields, especially those that concern the connections between people and contemporary complex technologies, besides people’s behavior.¹

Hacking (1975) searches for the past of chance at large and it is understood that theories of probability or randomness did not show up between the 15th century and the 17th century. Probability, which originates from those centuries, is based on a dual hypothesis about uncertainty: epistemic - belief and aleatory- frequency (Hacking, 1975).

The classical probability theory discusses its insufficiency on risks in a complex world of decision-making (Blockley, 2013). Blockley (2013) states that studies that are related to risk, deal with uncertainty both epistemic and aleatoric. Aleatory is explained as “randomness” and epistemic as “what we know” (Blockley D. , 2013).

Although there are many ways for the explanation of probability theory, four ways of interpretation as follows (Blockley, 2013): (1) Statistics of frequencies, (2) Statistics of tendencies, (3) Degrees of belief, and (4) Measures of evidence.

¹ Walley (1991) argues that it may never be possible to completely formalize decision-making because intelligence, intuition, experience, and judgment required cannot capture.

Blockley (2013) stated that “statistic frequency” and “statistic of tendency” are generally accepted as aleatory; on the other hand, “degrees of belief” and “measures of evidence” were dealt with as epistemic.

Evidence theory was developed by Dempster and Shafer, for enlarging the probability theory (Shafer, 1976; cited in Blockley, 2013). The rules of Bayesian theory revise the *a priori* probability that restricted on a context by the evidence approach in the model (Blockley, 2013).

The theory of de Finetti (1974,1975; cited in Hodges, 1987), tries to make connections between statistical areas and sort of uncertainties, even though having shortage in critical relation to actual difficulties in statistical studies (Hodges, 1987). The theory of probability based on de Finetti (1974,1975; cited in Hodges, 1987), in which de Finetti (1974,1975; cited in Hodges, 1987) aimed to be sufficiently variable for being appropriate in all conditions include uncertainty (Hodges, 1987). According to Hodges (1987), making connections between statistical areas and uncertainties in statistics is significant for analyzing, due to imperfect sources of continuance, capital, know-how, and calculating strength.

Necessities of managing those deficient sources provide handling uncertainty in detail via characterizing and reducing (Hodges, 1987). It targets to make a suitable system and to decrease problems in statistical studies (Hodges, 1987). Thus, Hodges (1987) considers the relationship between statistics, and uncertainty besides dividing in the light of two approaches: descriptive and analytic.

Although normative approaches forecast and describe authentic actions and attitudes via numerous analyses, the reasoning of choice does not comprise a sufficient basis for a descriptive approach for decision-making theory (Tversky & Kahneman,

1986). According to Tversky & Kahneman (1986) out of ordinary explanations generally lead to widespread options, in opposition to the notion of invariance which is based on “the rational theory of choice”.

Destruction of the theory of choice is evidence of the regulations which rule the structuring of decision-making and the psychological values of analysis (Tversky & Kahneman, 1986). Opacity destroys in contrast to being transparent in the application of invariance and dominance, in terms of characteristics of those rules which are normatively vital on the contrary descriptively null and void (Tversky & Kahneman, 1986). During the previous periods, uncertainty, as a concept, has achieved awareness via various articles and books, which is vital and fundamental to numerous disciplines, such as economics, managerial, environmental, and innovative studies, as well as remarkably that to technical improvement and its ethical assessments (Sollie, 2007).

Technical improvements, comprising uncertainty, were handled is the fact in the analysis of technological development, due to having unpredicted and unanticipated outcomes in the penetration of technology (Sollie, 2007). Sollie (2007) firmly signifies the interaction of technology and uncertainty by a sentence as “complex technology developments characterized by uncertainty”. There need to compare between the past and today for explaining those developments (Sollie, 2007). The improvements in technology include more complexity than past because of going beyond human evaluation and mental power with recent scientific findings in the light of Newtonian technicalities, molecular structures, and quantum leap (Sollie, 2007). In addition to that, growing penetrated interactions of technology and uncertainty have resulted from inherent unexpected, and unanticipated recent improvements in technology (Sollie, 2007).

First, the reality of having different agencies in a process influences the degree of uncertainty in those developments (Sollie, 2007). Second, uncertainty was caused by the speed and frequency of technical progress and, finally multifaceted processes which consist of dealings between global and local studies are sources of uncertainty (Sollie, 2007).

Intellectual historians express empirical and conceptual statements, which comprise possibilities of comments, without certainty although still, these statements are correct (Blau, 2011). Blau (2011) stated that having uncertain statements make uncertainty an unavoidable concept for intellectual historians. Therefore, uncertainty is a constant characteristic of historical studies (Blau, 2011). Collingwood (1993; cited in Blau, 2011) explained this characteristic as “The historian cannot have a certain knowledge of ... past”.

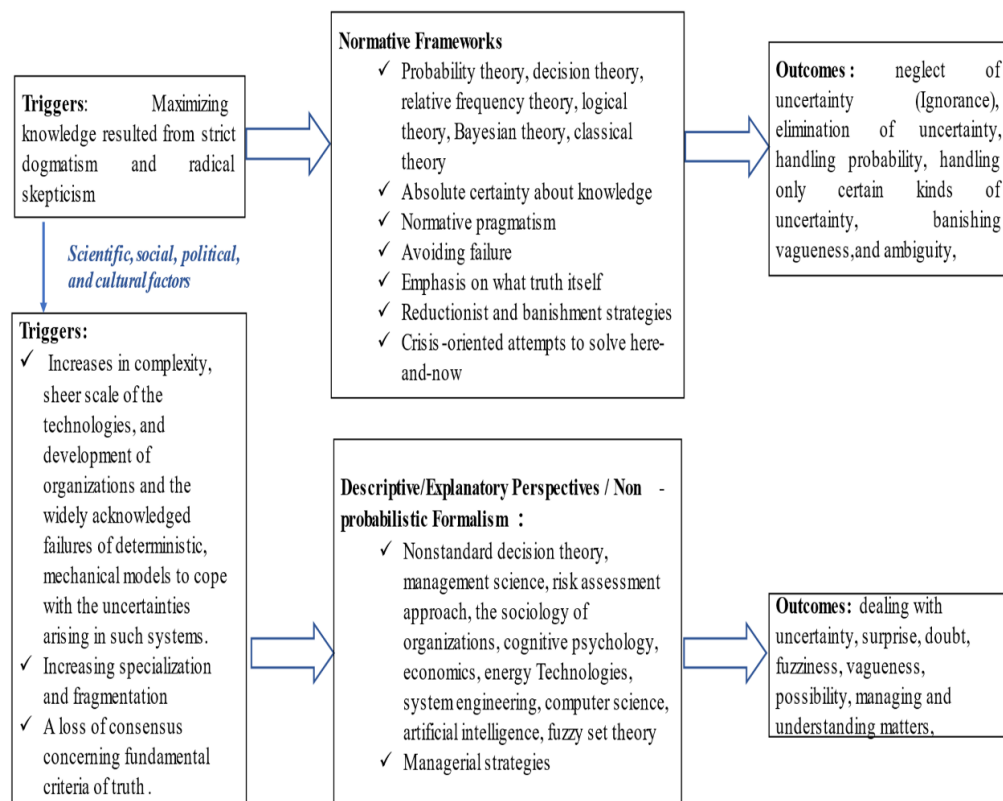
Throughout recent times, the quantum-like methods for demonstrating cognition and decision-making under uncertainty via modeling have been gradually operated in behavioral outcomes surprising or problematic from classical perspectives (Bagarello, Basieva, & Khrennikov, 2018). One of the specific features of this approach is to handle interdependent decision-making difficulties within all models grounded on quantum probability (Bagarello et al., 2018). Quantum physics corresponds to the fundamental quantification of uncertainty, the observer alters related items throughout the procedure of observation even as forecasting, not a specific outcome but rather a few of possible outcomes which have an assumed variety of scheduled stages of probability (Strand, 1999).

To conclude, many new technologies are surrounded by uncertainty due to opacity, complexity, multi-agency, long-development trajectories, orientation at the

future, global character, impact, and technology often shifts in the application. The fact that uncertainty is an essential concept in modern, complex technology development and, consequently, it needs serious attention from those involved in the ethics of technology (Sollie, 2007). To sum up, some theories and approaches related to uncertainty are divided into two groups, triggers, features, and outcomes of these approaches are detailed as a result of systematic review of literature about uncertainty (see Figure 2)

Figure 2

Systematic Review of Literature about Uncertainty



Note. Classification and explanations from “Ignorance and Uncertainty” (Smithson, 1988). Format from “Pathways of institutional change: An integrative review and research agenda” (Micelotta et al., 2017).

2.2 Uncertainty Issues

2.2.1. Uncertainty definition

Setting up a framework is generally preferable for enlightening the changing aspects of any phenomenon to reach a conceptual structure (Meredith et al., 1989). Meredith et al. (1989) detailed the benefits of a conceptual structure as precise research design, clarifying present research, and creation of hypothesis.

It is needed to concentrate on the causative structure of theory to understand what the theory means. Therefore, an explanation is a tool for dealing with theory (Meredith et al., 1989). Before having an explanation of theory structure, a related phenomenon, which is discussed with the theory should be explained.

According to Hospers (1956), three general comments about “explanation of phenomenon” are detailed as follows: (1) “Stating the phenomenon’s goal or purpose” (2) “Showing the phenomenon to be an instance of a familiar phenomenon” is to connect the phenomenon. (3) The comment that “bringing the phenomenon under a law” reflects the matter in which the phenomenon is made recognizable by twinning a law, that is current or will be, via explanation.

Uncertain and ambiguous definitions of the same concept can result in superficial differences but with potential consequences, and this is even more evident when the concepts are frequently used as if the definitions were, in fact, unequivocal (Strand, 1999 pg. 336). As minimum three approaches for definition are on hand: (1) certain or direct., (2) by reduction to another concept(s), and (3) by antithesis or keeping out (Smithson, 1988).

In our thesis, we have chosen to focus our attention on the reductionist strategy where it is usually “invoked when the framework to which probability is being reduced

appears to have agreed-upon foundations” (Smithson, 1988). It is possible to achieve unique conceptual definitions, as long as they are eliminated (Osigweh, 1989).

According to common impression in decision making, much more knowledge or information, which people have regarding the subject, affects the diversity of decisions people make, and there are three decision-making environments, namely decision making under uncertainty, under risk and under certainty depending on the assessment probabilities each possible outcome/consequence (Heizer & Render, 2008).

Instead of going over widespread review of different approaches used to describe uncertainty, we would rather focus on diverse approaches for conceptual definition in the study of uncertainty in decision-making.

Descriptions of uncertainty tend to depend on common explanations, using such terms, for example as “ the absence of relevant information”(Galbraith, 1977); “probability of outcome is unknown” (Duncan, 1972); “the lack of information” “the inability to predict the outcome of a specific decision made” (Tapinos, 2012). These definitions imply mentioning values about uncertainty, whereas, in the light of Wacker’s (2004) view on a definition, which is the conceptual definition, that should be clear, unique, and useful for analytic purposes lead inference for determinants and impacts of any concept (Wacker, 2004).

Some of the literature defines uncertainty by explaining determinants and the impact of uncertainty. In the definition of uncertainty, imperfect foresight, and human inability to solve complex problems are the sources and determinants of uncertainty (Alchian, 1950). As Newman (2006) stated, we are faced with incredible uncertainty, not only unable to predict the consequences of events but unable to determine which events are the ones that will lead to future change (pg. 635).

Walker et al. (2003) handle uncertainty, via differentiating the concept as uncertainty, which is based on lack of knowledge and that is based on inherent variability of any situation. Thus, the concept is described to cover types of uncertainties as: “any deviation from the unachievable ideal of completely deterministic knowledge of the relevant system” (Walker et al., 2003).

2.2.2. Typology of uncertainty

By ‘uncertain’ knowledge, let me explain, I do not mean merely to distinguish what is known for certain from what is only probable. The game of roulette is not subject, in this sense, to uncertainty; ... Even the weather is only moderately uncertain. The sense in which I am using the term is that in which the prospect of a European war is uncertain, or the price of copper ... About these matters there is no scientific basis on which to form any calculable probability whatever. We simply do not know (Keynes, 1937, pp. 213-214; cited in Bradley & Drechsler, 2013 pg.10).

To carefully review uncertainty in addition to the study of knowledge, completeness of information and data are critical points (Smithson, 1988). All types of uncertainties are described as the absence of knowledge in the light of linguistic perspective (Blockley, 2013). According to Walker et al. (2003) uncertainty is not a deficiency in knowledge. However, additional information or knowledge may disclose the existence of various uncertainties which are formerly undetermined or non-anticipated (VanAsselt & Rotman, 2002).

Having multiple facets makes it difficult to describe uncertainty in an approach (Sollie, 2007). Besides of possibility of an increase in uncertainty, using new information (Beck, 1999; cited in Sollie, 2007), indefinable situations, which for the basis of their nature, might be the cause of different uncertainties (Sollie, 2007).

Participants in the decision-making process frequently have diverse insights of actuality, due to having different interpretations of phenomena (Schön & Rein, 1994; Van de Riet, 2003; cited in Walker et al., 2003). Thus, consisting of all parties in the decision-making process is a crucial point to handle agreed terminology and typology of uncertainty (Walker et al., 2003). At that point, fundamental features of uncertainty which are illustrated in the “uncertainty matrix” (see Table 3) provide a kind of tool to understand uncertainty (Walker, et al., 2003).

Table 3

Uncertainty Matrix

Location		Level			Nature	
		Statistical Uncertainty	Scenario Uncertainty	Recognized Ignorance	Epistemic Uncertainty	Variability Uncertainty
Content	Natural, technological economic social and political representation					
Model	Model Structure					
	Technical Model					
Inputs	Driving Forces					
	System Data					
Parameters						
Model Outcomes						

Note. From “Defining uncertainty: A conceptual basis for uncertainty management in model-based decision support” (Walker et al., 2003).

For modeling the taxonomy of the concept, the preference of structure is subject to suitability, submission, and framework (Blockley, 2013). Even though the purpose

of the “uncertainty matrix” is to offer an instrument for the decision-making process (Walker, et al., 2003), it is used for restructuring a “typology of uncertainty” which comprises three main features as location, level, and nature of uncertainty, as well (Sollie, 2007).

Walker et al. (2003) stated that needing a conceptual structure, which comprises generally agreed and distributed terminology and typology of uncertainty, in modeling of decision-making process guides them to make a theoretical structure for methodical uncertainty scrutiny. In addition to the separated dimension of uncertainty as location, level, and nature, current typologies are brought into line, thereby offering a conceptual structure for enhanced interaction among the parties in management sciences (Walker et al., 2003).

The methodical uncertainty scrutiny by numerous dimensions of uncertainty provides a deeper understanding of uncertainty as a concept via distinguishing, clearing, and prior uncertainties for supporting the decision-making process (Walker et al., 2003). Location of uncertainty is a classification where the concept discloses itself inside the model structure (Walker et al., 2003). Identification of location is dependent on an understanding of a focal point where within the model uncertainties connected to results are produced (Walker et al., 2003). As a result of this approach, subsequent locations are classified for the model: context, model, and inputs (Walker et al., 2003).

“Context” indicates borders of the model and comprises situations, settings, characteristics, and awareness of any phenomenon, where structuring matters and codifying problems are directed within the limits of related borders (Walker et al., 2003). “Context uncertainty” includes uncertainties related to “the external economic,

environmental, political, social, and technological situation” which shapes the framework for problems that are scrutinized (Walker et al., 2003).

“Model” covers both the conceptual modeling, and computer basis modeling thus, uncertainty is related to structures of the model or technical problems within this type of uncertainty (Walker et al., 2013). “Input” comprises the uncertainty on “external driving forces” that cause change as variables of scenario or policy, and the uncertainty on “system data” (Walker et al., 2013).

Walker (2013) states that. “levels of uncertainty” is an advance from known to the unknown and is named as a blurred area that affects the path to the decision -making and, he adds, the decreasing unwanted effects of surprises in facing with each level of uncertainty, should be the goal of decision-makers, instead of reducing uncertainty.

According to Walker (2013), evaluating the nature of uncertainty affects the perception of precise uncertainties. “Epistemic” or “epistemological uncertainty” and “variability uncertainty” are located at both ends like uncertainty dimension (Walker, 2013). Epistemic uncertainty is a kind of uncertainty that is related to knowledge of circumstances of a structure and involves uncertainty because of restriction in measurement methods, inadequate data, and changeability about time-based and dimensional (Regan et al., 2002).

The uncertainty typology is concerned in “Policy Analysis”, due to having links between policymaking and futures studies (Dorsser, Walker, Taneja, & Marchau, 2018). Various futures-related disciplines can be constructed in keeping with the level of uncertainty, which they cover via a typology of uncertainty (Dorsser et al., 2018).

Dorsser et al. (2018) stated that the connection between futures studies and the level of uncertainty comprises generating “an unambiguous typology” for future

studies. According to Dorsser et al. (2018), clarifying ambiguity and misperception should be preferred to connect a direct link, instead of generating a certain typology in that situation.

2.3. Uncertainty in Futures Studies

2.3.1. Futures studies

At the beginning of the 20th century, a novel era started with approaches that honored both extraordinary progress of the past and hopeful anticipations for “things to come” in Western technological societies. (Clarke, 1996). Usage of the concept “forecast” explained any type of literature concerning the future (Gidley, 2017). From the 1820s, sources of “things to come” matured, associated with expanding of articles, that were written by specialists of the army, industries, engineering, and social sciences on future developments (Wells, 1902; cited in Clarke, 1996).

Clarke (1996) states that trends about the future were routed by using history as a highway of the coming century and specified this approach as “from the *Sicut erat* of past achievements they moved smoothly forward to the *Sicut erit* of the next century”. For instance, history defined such as an auxiliary field for students to “modify his views of the present and his forecast of the future ... it ought to exhibit the general tendency of English affairs in such a way as to set us thinking about the future and divining the destiny which is reserved for us “(Seeley, 1883; cited in Clarke, 1996).

From the 1870s rising number of books and brochures such as “A City of Health” by B. W. Richardson (1876), “Tomorrow: A Peaceful Path to Real Reform” by E. Howard (1898) led awareness of societies concerning the future (Clarke, 1996). “Anticipations” by H. G. Wells (1902) was the influential opening of the 20th century, in addition to that, “from Anticipations to The Salvaging of Civilization in 1921”, he

made a continuous of future design, comprise discourses which were a combination of foretelling and preaching on solutions of “ transportation, urban life, social change, war, and the New Republic” (Clarke, 1996).

Introduction to principal approaches on futures idea, which covers establishment of forthcoming institutions and journals about futures, started in the 1920s (Clarke, 1996). Those approaches progressed with specialist knowledge about statistics, economics, technology, and education in in the period of between two wars (Clarke, 1996). The most significant example of them was Keynes’s “The Economic Consequences of the Peace” (1920) in economics and the other important examples were Lubke’s “Technik und Mensch im Jahre 2000” (1927), Ford’s “Today and Tomorrow” (1928), and Freud’s “The Future of An Illusion” (1928) (Clarke, 1996).

Significant samples of futures studies continued into the 1930s and during the following years which were the basis for 1960s institutions called think-thanks (Clarke, 1996). The first try belongs to Ossip K. Flechtheim in terms of “academic approach” and, he used the concept “futurology” in the studying future during the post-second World War (Gidley, 2017). The future-thinking started to be an academic discipline by the 1970s (Clarke, 1996).

In today’s world, futures study considers and constructs “images of possible, probable, and preferable futures and paths to such futures” (Ahvenharju, Minkkinen, & Lalot, 2018). Discussions on futures studies show us that “the study of ‘the future’” has mainly two standpoints which they cannot be separated from each other: one standpoint of futures is interested in thinking about the formation of an association, the other concentrates on its effect, results, and process of actual realization (Sardar, 2010).

According to Sardar (2010), improvement of futures discourse on “conceptual methodological, and academic aspects” should be treated in a comprehensive way. He organizes the future studies via four laws at this point: (1) “Future studies are wicked”: due to having an excess of complex, uncertain, and interdependent problems, all problems in future studies are defined as “wicked problems” by Churchman (1967; cited in Sardar, 2010). (2) “Future studies are MAD” – “Mutually Assured Diversity”: diversity in being human is the basis in this approach in terms of cultural conditions and it should be covered by every aspect of futures studies (Sardar, 2010). (3) “Future studies are skeptical” during the process from “pluralistic potentials” towards “certain ends” (Sardar, 2010). and Finally, (4) “Future studies are futureless” because evaluations of future approaches are done at present (Sardar, 2010).

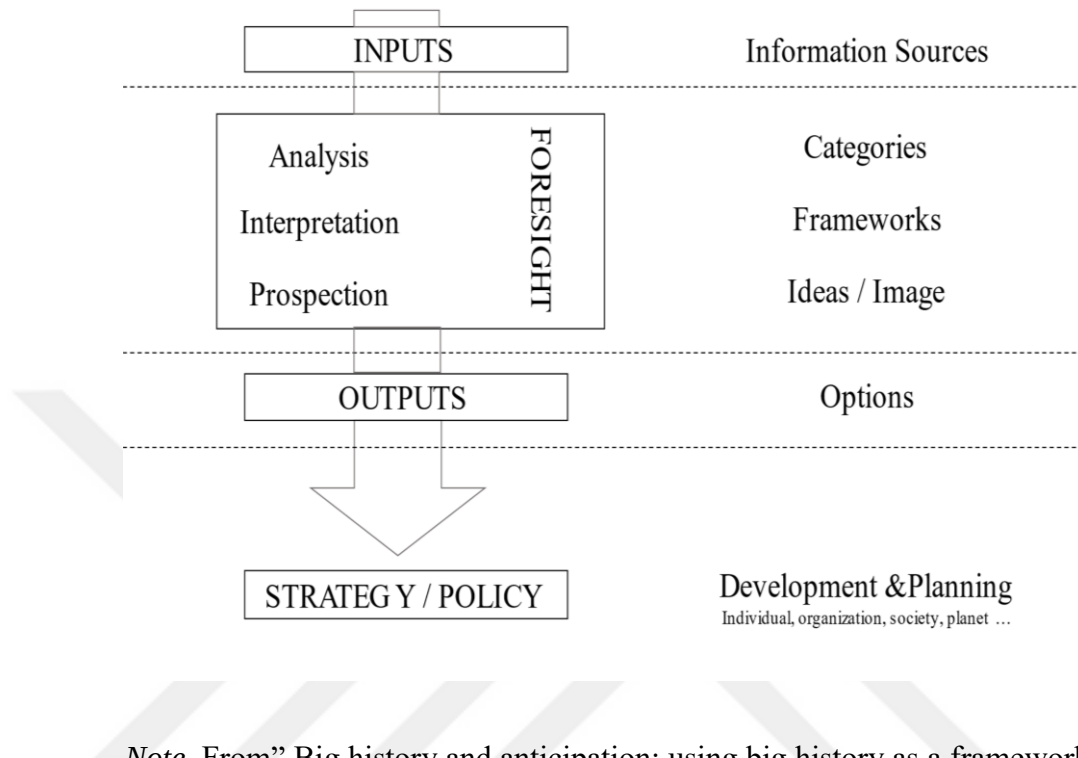
2.3.2. Foresight as Futures Studies

Futures studies, containing “strategic foresight”, have settled numerous functional connections with policymaking directly or indirectly via early exposure, assessment of knowledge (information, and data), creation of insights, support in increasing of choices (Dorsser et al., 2018). The main concern of Foresight is to concentrate on the generation of different visions of the future (Dorsser et al., 2018)

Managing uncertainty, in the light of past and present knowledge in futures studies, is a kind of phenomenon which is named as a “ cone of uncertainty and possibilities”(see Figure 1) expounded by (Hawking, 1990) and, (Magnus, 2012). We structure our research based on the “cone of uncertainty and possibilities” in terms of foresight. Thus, the past and the present are analyzed via historical analysis to shed light on the foresight studies. Foresight has an important effect in the process of strategy (see Figure 3).

Figure 3

The “Generic Foresight Process (GFP) Framework with the “Focus” of each Phase Shown



Note. From” Big history and anticipation: using big history as a framework for global foresight” (Voros, 2017).

The “Foresight Part” comprises three stages “Analysis”, “Interpretation”, and “Prospection”, respectively (Voros, 2017). The first stage is “Analysis”, which is best considered as a preliminary stage to more in-depth work, rather than as a stand-alone technique itself (Voros, 2017 pg.5). The main question which is asked in this stage is: “What seems to be happening?” (Voros, 2017). The second stage is “Interpretation”, which asks the question ‘what’s happening? And seek to “probe beneath the surface” (Slaughter, 1989) of the analysis to look for deeper structure and insights (Voros, 2017 pg. 5). The third stage is named “Prospection” where numerous approaches of futures are analyzed or created via scenarios and methods (Voros, 2017).

2.3.2. Uncertainty in Futures Studies

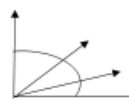
Uncertainty, as a concept, is analyzed in different disciplines regarding several methods (Sykes, Bell, & Dissanayake, 2019). It has a significant influence in the decision-making process which has complex and interrelated surroundings; that is; those methods aim to distinguish the main impacts, and the sources of uncertainty by relating systems to classify and handle the uncertainty originated from various fields (Sykes, Bell, & Dissanayake, 2019).

Van Asselt et al. (2010; cited in Dorsser et al., 2018) recommend grounding on uncertainty levels as a benchmark for setting a suitable progressive method in decision-making for futures studies. Continuousness and steadiness are focal points in this rational strategy thus, it should be aimed to set a convincing connection between futures methodology and related situations via clarify first the kind of future and then the level of uncertainty (Drosser et al., 2018).

By considering the decision-making, a contrast can be discussed among the levels of uncertainty, especially between the complete certainty and total uncertainty which are determined as the extreme levels, and four intermediary levels (Courtney, 2001; Walker et al., 2003; cited in Walker et al., 2019).

Walker et al. (2003; cited in Walker et al., 2019) explain those four intermediary levels in terms of knowledge which is supposed on four features of a situation or a problem: “(a) the future state of the world, (b) the model of the relevant system for that future world, (c) the outcomes from the system, and (d) the weights that the various stakeholders will put on the outcomes” (Walker et al., 2019). Walker (2011; cited in Drosser et al., 2018) structures uncertainty levels as well-defined levels which offer construction for categorizing uncertainty without practicing ambiguous expressions (See Table 4).

Table 4*Four Levels of Uncertainty*

		LEVEL				
		Level 1	Level 2	Level 3	Level 4	
LOCATION	Context	A clear enough future 	Alternate futures (with probabilities) 	A multiplicity of plausible futures 	An unknown future 	Total Uncertainty
	System Model	A single (deterministic) system model	A single (stochastic) system model	Several system models, with different structures	Unknown system model; know we don't know	
	System Outcomes	A point estimate for each outcome	A confidence interval for each outcome	A known range of outcomes	Unknown outcomes; know we don't know	
	Weights on Outcomes	A single set of weights	Several sets of weights, with a probability attached to each	A known range of weights	Unknown weights; know we don't know	

Note. From “Improving the link between the future field and policymaking” (Walker, 2011 & Walker et al., 2013a; cited in Dorsser et al., 2018)

“Complete Certainty” is, also named as determinism, one of the extreme levels of uncertainty spectrum in which the whole thing is known specifically (Walker et al., 2019). Although knowing everything specifically is not feasible in detail, “Complete Certainty” is treated as regulating feature of the uncertainty spectrum (Walker et al., 2019).

Level 1 uncertainty is capable of being defined sufficiently in terms of point estimation and its sensitiveness (Dorsser et al., 2018). In addition, the future is foreseen, and an optimal strategy is likely projected in Level 1 (Dorsser et al., 2018). Although future is foreseen, the situation is not unconditionally certain, and measurement of “the degree of uncertainty” is not seen as a necessity or having no capability to measure it

clearly in the process of Level 1 (Hillier & Lieberman, 2001; cited in Walker et al., 2019). However, short-term decision-making is adequate and usage of historical data as a benchmark is rational for future planning in this Level (Walker et al., 2019). Level 1 uncertainty is commonly handled within a basic sensitivity analysis where the effect of limited variation of system inputs on the outputs is evaluated (Walker et al., 2019). Examples of Level 1 uncertainty, which are grounded on the past, can be seen regularly in our lives such as “garbage collection” and “mail delivery” (Walker et al., 2019).

Level 2 uncertainty characterizes the condition in which alternatives can be defined, and their probabilities can be specified via a stochastic system model (Dorsser et al., 2018). Surface uncertainty represents Level 3 uncertainty in which the “direction of change is known, but the magnitude and probability of events and consequences cannot be estimated” (Dorsser et al., 2018).

Deep uncertainty represents Level 4 uncertainty (Dorsser et al., 2018). According to various views, making a good decision is problematic in facing deep uncertainty, Sardar & Sweeney (2016) described the deep uncertainty as a consequence of being unable to have knowledge of what occurs in the system and unaware of direction, aspect, and effect of change; in addition to these, there is inadequacy about our epistemology and world view.

One of the purposes of analyses of uncertainty is to achieve a vision into the function of variables during the decision-making procedure in any method. Sykes et al. (2019) preferred operating a “structural dynamic model” that is constructed according to complexity theory which is one of the approaches dealing with uncertainty that should be managed in a process.

Before managing uncertainty in the model, characteristics of uncertainty are handled through a taxonomy of uncertainty, which requires modeling and evaluation fields through its constructing process (Sykes, Bell, & Dissanayake, 2019). The main categories of uncertainty in taxonomy are detailed as below by Sykes et al., (2019): (1) Stochastic variance in algorithms and data: analytical field, (2) Incompleteness of modeling comprises inadequate correlation, (3) Process of describing the environment. Furthermore, scientific, and technological improvements are similarly influential sources of uncertainty and these improvements are subjects of “envisioned future”, as well (Meyer, 2019).

The concept of “envisioned future” has an analytical approach that emphasizes the significance of the interactions among dissimilar organizations and technological progress (Meyer, 2019). The progress of “envisioned future” can be realized through the multidimensional repetitive procedure, which comprises “sensemaking” aim to the reduction of uncertainty (Meyer, 2019).

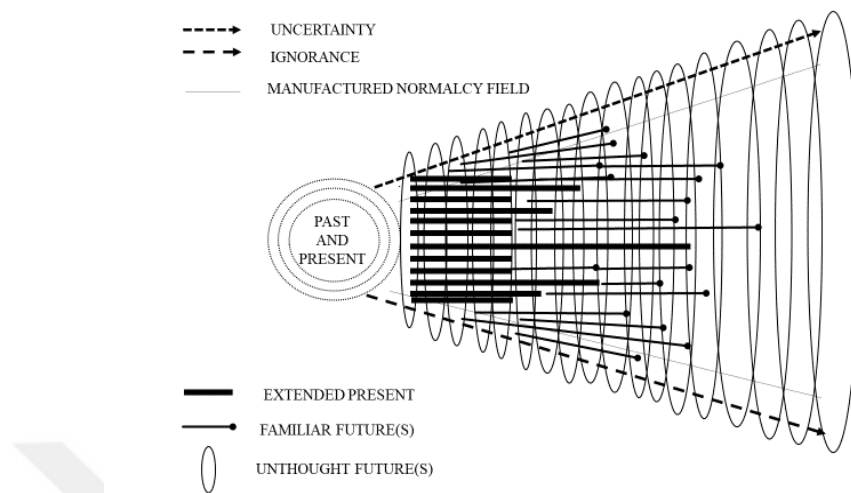
The characteristics of activities and relations which direct to appearance of envisioned future are defined by “sensemaking” that is strategically the act of inventing of situation (Meyer, 2019). As stated by Meyer (2019), “sensemaking” is affected by uncertainty which is not lack of information; instead, it is lack of interpretation of knowledge on hand.

According to Meyer (2019), futures that are illustrated as viable, accomplished, and worthwhile, are assumed, and predicted in present in the light of collective expectations to decrease uncertainty in an effective model. For instance, “vision” as a concept pursues the gripping of ideas and understandings distribution about futures

with the purpose of decision-making within circumstances that are covered by uncertainty (Meyer, 2019).

Post-normal science discriminates a variety of uncertainty types and focuses significance of uncertainty in post-normal circumstances (Hauge & Barwell, 2017). “Three Tomorrows of Post-normal Times Framework” (hereafter 3Ts) is constructed to examine the “complexity, chaos, and contradictions of post-normal times” and to forecast what might occur during the following periods (Sardar & Sweeney, 2016).

Sardar & Sweeney stated that focusing on simultaneous, dynamic, and complex nature of post-normal times with the recognition of uncertainty and ignorance are the main characteristics of 3Ts; in addition to these, empirically observable trends, mechanisms that are theoretically understood and incorporation of creativity and inspiration should be considered in the framework. Three tomorrows are handled in the two-dimensional image with the acknowledgement of uncertainty and ignorance as represented in Figure 4.

Figure 4*Spatial-Temporal 3T Rendering*

Note. From “The tree tomorrows of post-normal times” (Sardar & Sweeney, 2016)

Although 3Ts are perceived as separated units, they are intensely interrelated spatial -temporal areas of real and comprehensive phenomena which have a remarkable influence on both here and now (Sardar & Sweeney, 2016). Sardar & Sweeney stated that the familiar future is an essential division of extended present; both comprise a considerably unthought future with having the influence of any occasion or phenomenon from the distant horizon to both here and now.

According to Sardar & Sweeney (2016) uncertainty, which is named with a specific kind for all tomorrows separately, is resulted from chaos, conflict, and complexity. First, extended present is identified with surface uncertainty, which can be handled with almost adequate knowledge and instruments of foresight (Sardar & Sweeney, 2016). On the other hand, familiar future, which has wide-ranging alternatives and future possibilities with limited knowledge of the route of change, is

associated with shallow uncertainty that comprises complexity within plain future imaginaries (Sardar & Sweeney, 2016)

The togetherness of contradictions, complexity, and chaos is concluded with uncertainty which basically occurs in the light of having knowledge of the route of change; however, the estimation of events and results magnitude and probability cannot be done (Sardar & Sweeney, 2016). According to Sardar & Sweeney, uncertainty is discussed in three categories as surface, shallow and deep uncertainty with taking into consideration of knowledge level, possibilities, and direction of change.



3. CONCEPTUAL MODELING IN UNCERTAINTY

3.1. Confusion between Terms

Uncertainty, ambiguity, and ignorance take their sources from the unknown feature of foresight as potential research subjects on theory modeling in future studies, probable with mention to various technologies (Öner, 2010). Intending to assess uncertainty and set up standards for ignorance, having complete knowledge and epistemological consciousness are fundamental phenomena (Blockley & Godfrey, 2000).

Smithson (1988) said that the concept is utilized as an alternative word for ignorance in some fields. It should be stated that, however, uncertainty is not a comprehensive concept, even though it is the address of probability theory and quite a few other innovative normative methods for ignorance (Smithson, 1988).

3.2. Conceptual Modeling

Due to features of complexity, it is obvious that a lot of outcomes of undertakings and decisions which belong to human being are not entirely certain in a complex world (Öner, Beşer, & Şenoğlu, 2019). In the light of this phenomenon, some methods like modeling and scenario planning are applied to achieve certainty in different disciplines (Öner et al., 2019). Corotis (2009) describes that situation as the world is less precise than our models, even our probability ones ... advances ... require bridging the gap ... between theory and uncertainty measures (cited in Öner et al., 2019).

The continuing existence of uncertainty is the cause of being taken into consideration in all methods, which aim to make situations certain (Öner et al., 2019). Der Kiureghian and Ditlevsen (2009) distinguish a level of subjectivity in the choice of

methods. Hence, the goal of a method is decisive about the selection of uncertainty type or level (DerKiureghian & Ditlevsen, 2009).

Those models are likely centered on a mathematical statement, illustrations, flow charts, and computer models. However conceptual definitional tools are used to support being perceived of uncertainty as a concept in this study.

Meredith et al. (1989) explains conceptual modeling as, with conceptual modeling, a mental model of the suspected relationships is posited which may then be evaluated using a framework that captures the essence of the system under investigation (pg.316).

In the circumstance of philosophy, it is observed that conceptual modeling is an inclusionary and dynamic method that supports making phenomena, and data differences, in addition to that, to recognize the effect of intuition and experiment (Löwe & Müller, 2011).

This section will be analyzing only four conceptual models in-depth with their attributes, definitions as well as, taxonomies and categorizations. It is essential to point out that in this section we neither claim that all uncertainty can be neatly and easily classified into four nor that the categories presented here are the only ones possible.

3.2.1. Conceptual model I

The uncertainty is an attractive problem which can be seen easily from studies that try to make an explanation of uncertainty as a concept in different disciplines. Therefore uncertainty, also ignorance, are kind of phenomenon which takes all attention of various scientists. According to Smithson (1988) the more we know why we are collectively and individually preoccupied with ignorance, the more able we will

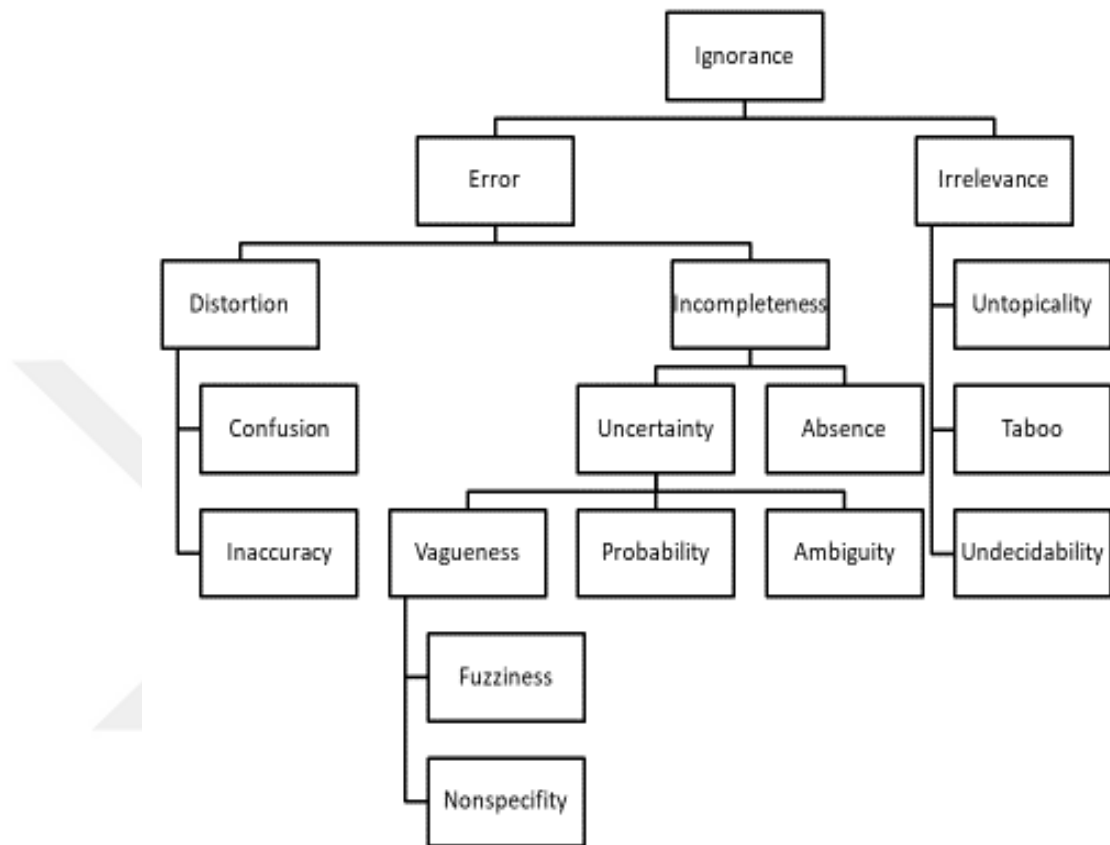
be to adopt mindful strategies and choices regarding ignorance (cited in Öner et al., 2019).

Smithson (1988) stated that innovative studies about ignorance have been continuing since emerging probability theory in 1660. In addition to probabilistic studies, non-probabilistic approaches have emerged in various disciplines such as economics, finance, management, sociology, and artificial intelligence (Smithson, 1988).

Smithson (1988) explains the increase in preoccupation with uncertainty, via primarily two methods: the first is named as ‘techno-rational’ approach, which is linked with complexity, especially complex technologies and the other one is the ‘stage-model’ approach, which is based on a historical explanation of difficulties and crisis.

Besides having advantages, as progress in scientific awareness, complex systems or complexity leads the human being to be aware of how uncertainty is common, how knowledge of people insufficient and due to negative impact, how decision making is crucial (Smithson, 1988). According to Smithson (1988), the above-mentioned matter has made scientists achieving knowledge for certainty, or being aware of ignorance for managing it, which is generally based on strategic and economic sagacity.

The wide-ranging “taxonomy of ignorance” in Figure 6, which is demonstrated by Smithson (1988), is handled as a sustainable structure to demonstrate the concept of uncertainty. Smithson (1988) stated that uncertainty dominates, a distinctive position as one of the maximum manageable types of ignorance, where it is one of the constant function of the human circumstance.

Figure 5*Taxonomy of Ignorance*

Note. From “Ignorance and Uncertainty” (Smithson, 1988).

By the taxonomy of ignorance, demonstrated by Smithson (1988), ignorance is generally thought through as “either the absence or the distortion of ‘true’ knowledge – a loss of consensus fundamental criteria of truth”, and several appearances of incompleteness in information or knowledge.

However, the majority of all Western cultures direct us to decrease ignorance or uncertainty sooner than decision making and acting (Smithson, 1988). The same as Smithson (1988) highlights it, if contemporary Western civilization is experiencing an

alteration of its ways and means for coping with ignorance, at that point uncertainty and risk are the spotlights of that alteration.

The last 40 years have witnessed a wind of new approaches about uncertainty together with ignorance, whose significance is possibly overshadowed by the rising of modern probability theory (Smithson, 1988). According to Blockley (2013), causes of interpretations in probability theory are based on coping with uncertainty and ignorance where uncertainty is named with superiority as “most manageable kinds of ignorance” or “in some fields is employed as a synonym for ignorance”.

However, ignorance as a concept is applied by several scientists (Hacking, 1975; Huber, 2010) to disclose the conception of the unknown. From an applied perspective, it is possible that ignorance indicates a kind of disregard as a deficiency in learning, being educated, and being informed or not to be appropriately capable (Blockley, 2013).

Blockley (2013) stated that, as a consequence of the above-mentioned perspective, ignorance may generally be defined as, not acting suitable duty of care. Smithson (1988) understands the concept as “ignorance like knowledge, is socially constructed and negotiated” and “is multiple and has distinct levels”.

Due to highlighting the dissimilarities between error and ignorance, Socrates (in his dialog with Meno) expressed that the person in error believes he knows that he does not know while the ignoramus is conscious of his lack of knowledge (Smithson, 1988). Smithson (1988) prefers to rename error, which was named by Socrates, as conscious ignorance, and ignorance as meta-ignorance where the concept necessitates stand points of people due to being “socially constructed and negotiated”.

Normative approaches concentrate on benchmarks for expression of ignorance, based on diversity of subjective evaluation, and acceptances case by case, and descriptive analyses, mainly aim to discover the motivation of people on coping with unknown instead of disclosing cognitive “errors” (Smithson, 1988).

Smithson (1988) stated that cognitive researches, which are related to thinking under uncertainty, have mainly centered on “judgmental errors”. In addition, focusing on errors may allow understanding the cognitive shortcomings of the decision-making process (Kahneman & Tversky, 1982a).

The error may have resulted from distortion, which is stated as a substitute for bias, or/and inaccuracy, or/and incompleteness, which has significant consideration from philosophers and scholars since it is more amendable than distortion (Smithson, 1988). The taxonomy displays incompleteness in type be expressed as absence, whereas incompleteness in level is assessed as uncertainty (Smithson, 1988).

Classical approaches named uncertainty, with incompleteness, due to accepting insufficient probability instead of complete probability (Smithson, 1988). According to Smithson (1988), the probability may come as a kind of tool for evaluating the lack of knowledge among the Classicists. Moreover, incompleteness is characterized through ethnomethodology and symbology, due to acceptance as socially constructed (Smithson, 1988). Languages of special areas, like mathematics, reduce incompleteness, whereas ordinary and natural languages are widely known for their incompleteness (Smithson, 1988).

On the other hand, descriptive approaches ask some questions on making use of ignorance in organizations as “how organizations operate under ignorance” and “which ignorance is to be used and the norms within an organization” (Smithson, 1988).

Incompleteness is illustrated as safe and frequently more tolerable and in the sense of this tendency, incompleteness would appear as understandable selection, which involves strategic options for utilizing under ignorance in organizations (Smithson, 1988).

Smithson (1988) stated that uncertainty, which is accepted as a replacement of ignorance in some approaches, holds a position as the most controllable type in the taxonomy of ignorance. Intrinsic uncertainty of whole challenges, also daily dilemmas is hardly restricted to probability, in addition to being pluralistic and controversial as a concept (Macdonald, 1986; cited in Smithson, 1988). ²According to Smithson (1988) unforeseeable phenomenon, stochastic trends, deficiency in whole knowledge, and quick change are defined as ‘uncertainty’ without taking into consideration of key differences and types of ignorance by classical approaches.

On the contrary, uncertainty to be regarded as modern versions of ignorance comprises concepts as vagueness, probability, ambiguity, fuzziness, and non-specificity. New manners propose methods that involve approaches to understand and manage those concepts (Smithson, 1988). Categorizing non-probabilistic uncertainty compromise old approaches which have various challenges in differentiation (Smithson, 1988). Mack Black (1937) is one of the important attempters who described ‘uncertainty’ which is typical of vagueness is at once demonstrated” (Black, 1937). ³

² Berkeley and Humphreys (1982; cited in Smithson, 1988) argue that there are seven kinds of uncertainty entailed in such problems that must be resolved before one can conclude that subject and experimenter viewpoints coincide, only four of which are explicitly addressed by normative decision theory.

³ Vagueness is a feature of scientific as of other discourse. Vagueness is distinguished from generality - is Black’s (1937) term for non-specificity and he upbraids earlier philosophers for failing to distinguish it from vagueness (Smithson, 1988) - and from ambiguity. The former is constituted by the application of a symbol to a multiplicity of objects in the field of reference, the latter by association of a finite number of alternative meanings having the same phonetic form; but its characteristic of the vague symbol that is no alternative symbol in the language, and its vagueness is a feature of the boundary of its extension and is not constituted by the extension of itself.

The vagueness which is correctable and expelled by probability theory is defined as a combination of fuzziness and ambiguity (Zadeh, 1976; cited in Smithson, 1988) in fuzzy sets theory (Smithson, 1988). Zadeh (1976,1979; cited in Smithson, 1988) handles concepts as vagueness, ambiguity, and non-specificity in a different approach and describes ambiguity as a function of vagueness, whereas Max Black (1937) describes ambiguity “as a condition in which referent has several possible and distinct interpretations” (Smithson, 1988).

Smithson (1988) stated that ambiguity is treated with less consideration rather than vagueness and fuzziness due to preliminary misunderstanding of concept as a conflation of ambiguity with different types of uncertainty in fuzzy sets approaches. Lately, conversely, ambiguity is accepted as independent in possibility theory (Smithson, 1988). New uncertainty models compromise probability and fuzziness (Smithson, 1988). Various fuzzy set theorists use fuzziness in a way that locates it as a special kind of vagueness, which intuitively seems like a qualitatively different kind of uncertainty than probability (Smithson, 1988).

3.2.2. Conceptual Model II

Due to improving technological approaches and environmental sensibility, energy supply strategies are paired with environmental and technological issues. Risk, as a concept, one of the main concerns which are related to both environment and technology. Risks belong to technology, strongly linked with strategies of electricity production is a vital subject in the regulation of environmental risk (Stirling, 2001). Therefore sectors, associated with electricity, compromise cases that negotiate the management of risk in general (Stirling, 2001).

Numerous leading subjects in comprehensive public arguments on managing the ecological risk, for example, “acid gas emissions, radioactive waste management, nuclear safety, and global climate change”, affect the preferences for technology in electricity trade (Stirling, 2001). The characteristic feature of this field is particularity, thus this circumstance provides contemporary cases in which have a connection between scientific, also named as risk-based, method and precautionary method (Stirling, 2001). According to Stirling (2001) comparison of those methods is needed for decision and policymaking.

Our second model (Table 5) offers a graphic design of the connections among formal descriptions for the concepts of risk, uncertainty, ambiguity, and ignorance where uncertainty relates to a case cover which having courage in a perfect state of the described set of results, on the other hand where there is accepted to be present unjustifiable theoretical or experiential sources allocate probabilities to the related results (Stirling, 2001).

Table 5

The Formal Definition of Risk, Uncertainty, Ambiguity, and Ignorance

KNOWLEDGE ABOUT LIKELIHOODS	KNOWLEDGE ABOUT OUTCOMES		
	Continuum of outcomes	Set of discrete outcomes	Outcomes poorly defined
	INCERTITUDE		
firm basis for probabilities	apply : RISK		AMBIGUITY apply : fuzzy logic sensitivity analysis
shaky basis for probabilities	frequent distribution functions	discrete frequentist probabilities	
	Bayesian distribution functions	discrete Bayesian probabilities	
	UNCERTAINTY		IGNORANCE
no basis for probabilities	apply : scenario analysis		apply: precaution

Note. From “Science and precaution in the appraisal of electricity supply options” (Stirling, 2001)

Having the potential of being abbreviated into plain concepts like “risk” or “uncertainty” of the above-mentioned classifications is acceptable just as in professional analysis which handles phenomena exhaustively and deeply, due to minimizing complications which are extremely comprised (Stirling, 2001). To prevent puzzling between exact descriptions of the concepts of risk and uncertainty, and weaker factual practices, the term “incertitude” can be treated comprehensively for embracing each situation (Stirling, 2001).

‘Risk’ is described as a circumstance where both outlining whole possible results exhaustively and determining a distinct group of probabilities through this range of possibilities, demonstrated in the top left-hand angel in Table 5 (Stirling, 2001).

“One of the problems in the scientific foundations of probability and rational choice theory is the ‘incommensurability’ (comparing apples and oranges) and ‘ignorance’ since “we do not know what we do not know” (Öner et al., 2019 pg. 78). Another fundamental problem underlying the social appraisal of technological risks concerns incomplete information, however, the risk is a domain under which the various techniques of risk assessment are applicable, permitting full characterization and order of the different options under appraisal (Öner et al., 2019 pg. 78).

Even were there to be complete certainty, in the quantification of all the various classes, and dimensions of risk, it is entirely reasonable that fundamentally different conclusions over environmental risk, might be drawn under different but, equally legitimate perspectives since different cultural groups, political constituencies, or economic interests attach different degrees of importance to the difference’s aspects of technological risk (Öner et al., 2019 pg.78).

According to the model of Stirling (2001), both risk and uncertainty, in the strict sense of the terms, require that the different possible outcomes be character sable or subject to measurement (Öner et al., 2019 pg. 79). This is often not the case, the complexity and scope of the different forms of environmental risk and the different ways of framing and prioritizing these, can all, too-easily render the definitive characterization of outcomes ambiguous (aka. poorly defined outcomes) (Öner et al., 2019 pg. 79). Where these problems are combined with the difficulties in applying the concept of probability, we face a condition which is formally defined as ignorance (Öner et al., 2019 pg. 79).

Ignorance applies in circumstances where there not only exists no basis for the assigning of probabilities (as under uncertainty) but where the definition of a complete

set of outcomes is also problematic (Öner et al., 2019 pg.79). Ignorance can operate as a factor dynamic to social change (Moore & Tumin, 1949). Therefore, recognition of the condition of ignorance is an acknowledgment of the possibility of surprise (Öner et al., 2019 pg. 79). Under such circumstances, not only is it impossible to rank the different options definitively, but even their full characterization is difficult. Under a state of ignorance, it is always possible that there are outcomes that have been entirely excluded from consideration (Öner et al., 2019 pg. 79).

In the energy sector, imponderables such as those associated with global climate change, geological diffusion models for high-level radioactive waste repositories, and even the long-term effects of major dependencies on renewables like biomass are all as many matters of ignorance and uncertainty as they are of risk in the strict sense (Öner et al., 2019 pg. 79). Even where there is some confidence over the broad likelihood of an overall phenomenon like global climate change, there are still crucial questions over the implications for any specific region or human activity, invoking the formal condition of ‘ambiguity’ (in the top right corner of Table 5) (Öner et al., 2019 pg. 80).

The curious thing is that these and other sources of intractable uncertainty and ignorance are routinely treated in the appraisal of technology by using the probabilistic techniques of risk assessment (Öner et al., 2019 pg. 80). Given the inapplicability of probabilistic techniques under conditions of uncertainty and ignorance, this is a serious and remarkable error (Öner et al., 2019 pg. 80). For all the seductive elegance and facility of probabilistic calculus, it remains the case that judgments concerning the extent to which “we do not know what we do not know”, no matter how well informed, are ultimately and unavoidably qualitative and subjective (Öner et al., 2019 pg. 80).

Different from showing regard for science in technology assessment, consequences of scientific generalization, are to disregard and weaken scientific values (Stirling, 2001). In multi-facet society, specific “sound scientific”, which is based on the domination of technologic risk, is a fundamental conflict, and considering risk evaluation, cost assessment, and benefits valuation, thoughtful questions rise on whether consequences of risk-centered approaches are applied on strategy utilize of any kind, or not. (Stirling, 2001).

3.2.3. Conceptual model III

According to Walley (1991; cited in Blockley, 2013), complete formalization of decision making may not be achievable due to having features of cleverness, instinct, involvement, and determination as being free. However, some formal techniques make an available assessment of stability, consistency, and logicity in decision-making (Blockley, 2013). One of the examples of those methods is (FIR) -fuzziness, incompleteness, and randomness- which is modeled by Blockley and Godfrey (Blockley & Godfrey, 2000).

Due to the insufficiency of the classification of uncertainty as epistemic and aleatoric in decision making, uncertainty is handled in the light of concepts that are unique and having orthogonal, discrete characteristics (Blockley, 2013)(see Figure 6). The categorization in uncertainty, for instance, fuzziness, ambiguity, and vagueness, are complex combinations of dealings in FIR, and those combinations may provide notifications to unpredicted threats in decision making (Blockley, 2013).

Zadeh (1996; cited in Blockley, 2013) specified that “complex systems cannot be dealt with effectively by the use of conventional approaches largely, because the description of languages, based on classical mathematics, are not sufficiently

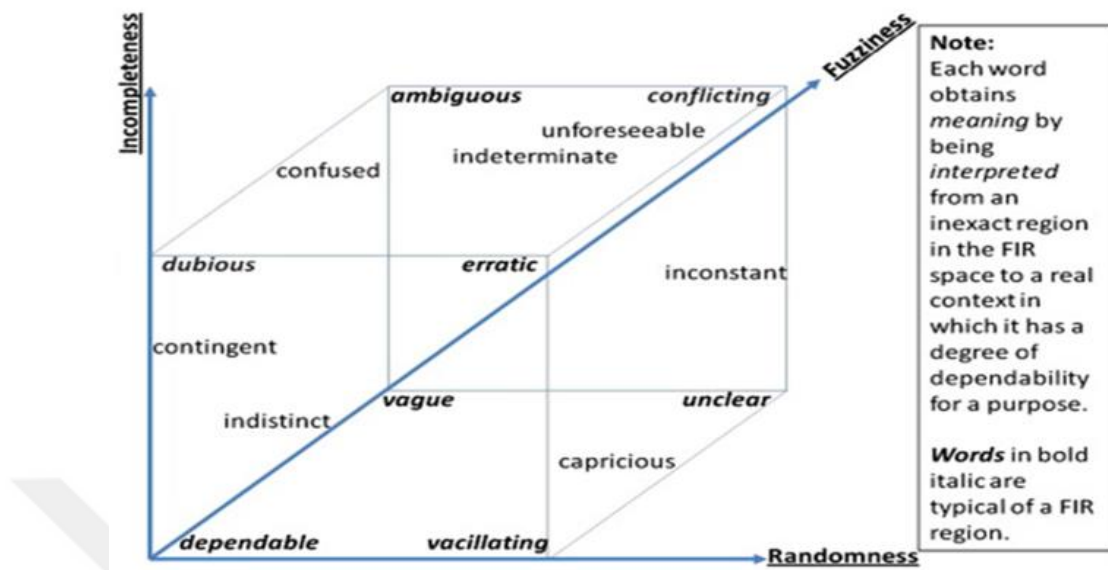
expressive as a means of characterization of input-output relations in terms of an environment of imprecision, uncertainty, and incompleteness of information”.

Blockley (2013) also argued that the classical probability theory is insufficient in terms of dealing with risk within complex systems. Therefore, uncertainty is handled, via deeper conceptual evaluation, in contrast to the usage of uncertainty in natural languages, in addition to comparison of classical probability theory, evidence theory, Bayesian, and interval methods in the afore-mentioned modeling.

However, Bayesian interpretation depends on the types of the problem area, the evidence theory distinguishes that constructing a model is too difficult in complex systems (Blockley D. , 2013). Therefore, the evidence theory method performs even though the domain is unfinished (Blockley D. , 2013). It is possible that to highlight evidence in decision-making is in different structures (Blockley, 2013). Therefore, Blockley (2013) stated that, the exactness of hypothesis may differ, in terms of the level of the demonstration in the FIR.

Figure 6

Some Interpretations in the FIR Space of Uncertainty



Notes. From “Analyzing uncertainties: Towards comparing Bayesian and interval probabilities” (Blockley, 2013)

According to the classification of Blockley (2013), incompleteness was handled, as one of the features of epistemic uncertainty, that signifies is not known. Incompleteness is probably, the most ignored and rejected features of epistemic uncertainty, due to the possibility of activities, events, hazards, and consequences, are completely known, and characterized in the classical probability theory (Blockley D. , 2013).

The other concept of the classification is fuzziness, which lexical meaning is “the quality of being not clear to see or hear, and not detailed or exact enough” (Cambridge, Cambridge Dictionary, 2020). Cambridge English Corpus (2020) exemplifies fuzziness as “the synthetic mode of thinking is closely associated with intuition and thinking in terms of images, and it’s synonymous with implicitness and fuzziness”. Fuzziness compromises inaccuracy, blurredness, and unclearness as a

concept, and prevalence of implicitness in assumptions (Blockley, 2013). (Blockley (2013) pointed out fuzziness as “an entire subject in the form of theories of approximate reasoning based on fuzzy set and fuzzy logic”.

However, fuzziness is agreed, as epistemic in terms of reduced by exact, clear, and accurate information as stated by Blockley (2013). Zadeh (1973) pointed out that characterization of fuzziness involves precision and significance to some extent which is a kind of edge showing up the increase in the level of complexity.

According to Zadeh (1973) the methods, which compromise tolerance about imprecision and non-mathematical formalism, are preferred instead of firmly insist on precision and classical mathematics, because of coping with efficiently inaccurate, uncertain, and incomplete patterns of complex systems. Therefore, “fuzziness is not modeled mathematically as in the theory of fuzzy sets and fuzzy logic” which are based on approximate reasoning (Blockley & Godfrey, 2000).

As the third characteristic of uncertainty, randomness means “the fact of being done, chosen, etc. without somebody deciding in advance what is going to happen, or without any regular pattern” (Oxford, 2020). Blockley (2013) accounts for randomness as “the lack of a specific pattern or purpose in some data and is explicit in probability theory and its derivatives such as reliability theory”. In addition to that randomness is accepted as aleatoric (Blockley, 2013). The other phenomenon about uncertainty is ambiguity, which is one of the compound combinations of FIR (Blockley, 2013).

Ambiguity is described as a criterion in the assessment of ignorance in an organization whether a variable is present (Zhang, Cao, & Doll, 2019). Ambiguity is sourced by various and inconsistent explanations of circumstances (Zhang, Cao, & Doll, 2019). Ambiguity occurs from interrelating of fuzziness and incompleteness

which enhances the capacity for the greater explanation of any content while changeable uncertainty may take place when factors of uncertainty (FIR) occur instantaneously where clarifications are diverging, and not stabilized (Blockley, 2013).

In summary of the mapping from the FIR model of Blockley (2013), an expression or conceptual interpretation of a term within the interval probability measure of a region in the space of the model can be associated as uncertain within variously fuzzy, incomplete, or random. Fig.6 is revealing one set of possible mixes of uncertainty in natural language where the meaning of each word will depend on the interpretation of the region of the fuzziness, incompleteness, and randomness mix (Blockley, 2013).

While manifesting uncertainty, the assessment of futures' decisions based on different courses of present actions and investments is the real deal. These actions/decisions may translate into possible, probable, preferred, and prospective futures (Saritas and Öner, 2004; Öner et al., 2013). Attention on the attitudes toward risk, displayed by individuals, and upon the social evaluation of long-term, uncertain, and irreversible actions must be given, as the expected social value of proposed activities must also reflect the uncertainty of future effects and future tastes (Haveman, 1977).

3.2.4. Conceptual model IV

Currently, the item for consumptions named as “utility product”, for example, “water, gas, electricity, sewage, refuse, telecommunications, and transport” are provided separately to final consumers of a product with different infrastructures which need vast investment and causes numerous complexity (Grubic, Varga, & Varga, 2013).

A project named as “All-in-One” (Varga et al., 2012; cited in Grubic et al., 2013) covers the assumption of reducing the different “utility products” to one, “all in one” with designing a diversity of future probabilities (Grubic et al., 2013). In the light of this approach, the structure is outlined for evaluating risk, ambiguity, uncertainty, and ignorance entitled with “Risk-Ambiguity-Uncertainty-Ignorance (RAUI) Matrix” (Grubic et al., 2013) (See Table 6)).

Table 6

Risk -Ambiguity – Uncertainty – Ignorance (RAUI) matrix

		Knowledge about possibilities (reach of the knowledge required)	
		unproblematic (reachable)	problematic (not in reach)
Knowledge about probabilities (existence of the knowledge required)	unproblematic (exists)	<i>RISK – Known Known’s</i> There is a relevant body of knowledge to make the assessment and we have complete access to it	<i>AMBIGUIY – Known Unknown’s</i> There is a relevant body of knowledge to make the assessment but we do not have access to it (someone else has ccess to it)
	problematic (does not exist)	<i>UNCERTAINTY – Unknown Unknown’s</i> A body of knowledge needed to make the assessment does not exist at the moment, but it could be developed to an extent. (There are limits to understanding.)	<i>IGNORANCE– Unknowable’s</i> There is nobody of knowledge needed to make the assessment and it is impossible to develop it.

Note. From “Future utility services’ (un)knowns framework: Knowledge existence and knowledge reach” (Grubic et al., 2013)

The (RAUI) matrix is a consolidation of the “Uncertainty Matrix” (Stirling, 2010) and “The Cynefin Framework” (Snowden & Boone, 2007) (Grubic et al., 2013). The matrix, which offers a way for taking into consideration a variety in the evaluation of phenomenon, has four parts, apportioned two aspects: (1) knowledge about possibilities (unproblematic and problematic), and (2) knowledge about probabilities (unproblematic and problematic) based on Knightian separation (Grubic et al., 2013).

“The Cynefin Framework”, which purposes to assist leaders in understanding that each circumstance involves a unique method in decision making, defines five setting area as based on “cause-and-effect relationship”: simple, complicated, complex, chaotic, and disorder (Snowden & Boone, 2007).

The “Knightian uncertainty” is described utilizing the relatively restricted choice of “Risk, Uncertainty, and Profit” in general (Knight [1921], 1985; cited in Nash, 2003). The Knightian difference, concerning uncertainty and risk, is based on a description in which probabilities are fewer surrounded with uncertainty in contrast to possibilities (Nash, 2003).

For Knight, “a measurable uncertainty, or ‘risk’ proper ... is so far different from an unmeasurable one that it is not in effect an uncertainty at all” (Knight, 1921; cited in Stirling, 2010). Stirling (2010) stated that an accurate description of uncertainty can be addressed to F. Knight.

According to Stirling (2010), a restricted emphasis regarding risk is insufficient answer to imperfect knowledge. Inherently, multiple, and provisional features of the knowledge are necessary for rigorousness (Stirling, 2010). Several methods, both quantitative and qualitative, are exist, as tools for rigorousness; the “uncertainty matrix” is one of them (Stirling, 2010).

Stirling (2010) stated that fine distinctions have significant consequences, in the multi-layered understanding of imperfect knowledge, on achieving rigorousness, which necessitates clearing any concept up in the “uncertainty matrix”. Thus, focusing on ignored spheres of uncertainty and other concepts: risk, ambiguity, and ignorance via different methods is important (Stirling, 2010).

Lowering unknown to quantifiable “risk” is a tendency that is defined as a restricted focus in several areas (Stirling, 2010). Stirling (2010) stated that handling each problem as a “risk” is a kind of obsession comprises refusing the interpretive approach and the multi-dimensional inherence of knowledge. Instead of handling each problem as a “risk”, focusing overlooked fields of “uncertainty, ambiguity, and ignorance” via multiple methods are effective for rigorousness (Stirling, 2010).

Karlsen et al. (2010; cited in Grubic et al., 2013) stated that differences should be determined between uncertainty, ambiguity, and complexity in futures studies. One of the quadrants in the (RAU) matrix (Grubic et al., 2013) is uncertainty, which is described with “problematic knowledge about probability, and unproblematic knowledge about possibilities respectively” (Grubic et al., 2013).

According to Knight (1921; cited in Grubic et al., 2013), uncertainty is handled in conditions in which probabilities are not appointed to future circumstances. Lack of knowledge is not just a reason in the process of uncertainty occurrence, increasing knowledge is not only an approach for decreasing uncertainty (Meijer et al., 2006; cited in Grubic et al., 2013).

There are some situations in which, increase in knowledge or information is occurred, but uncertainty continues, as well (Sollie, 2007). According to Sollie (2007),

predominance of uncertainty, insufficiency of knowledge in decreasing uncertainty, and indeterminacy of uncertainty are some examples of those situations.

One of the quadrants in the (RAU) matrix (Grubic et al.,2013) is the ambiguity which is described with “unproblematic knowledge about probability, and problematic knowledge about possibilities respectively” (Grubic et al., 2013). When “All-in-One Project” is taken into consideration, difficulties are not regard as strict in the “ambiguity quadrant” (Grubic et al., 2013).

Ambiguity can be observable in a situation that there are diverse interpretations of reality (Grubic et al., 2013). According to Courtney et al. (1997; cited in Grubic et al., 2013), ambiguity is one of the four types of residual uncertainty interrelate to build a kind of environs that is not possible to forecast. In addition to this, ambiguity handles circumstances that are not measured by means of probabilities (Smith & Stern, 1956; cited in Grubic et al., 2013).

One of the quadrants in the (RAU) matrix (Grubic et al.,2013) is ignorance which is described with “problematic knowledge about probability, and problematic knowledge about possibilities respectively” (Grubic et al., 2013). Ignorance and the other concepts in the matrix can be defined via two aspects: presence and achievement of knowledge (Grubic et al., 2013). In addition to that, when the range of diverse knowledge is taken into consideration, ignorance is assessed at one edge and full determinism at other (Grubic et al., 2013).

According to the result of this research, description, and categorization of concepts (uncertainty and risk) are controversial and approaches which include frameworks have typologies with no recommendation related with functional usage (Grubic et al., 2013).

4. RESEARCH METHODOLOGY

The main purpose of this thesis is to review uncertainty as a concept, through content analysis of previously published articles, and conceptual modeling aim to be the way for futures studies because the inherited unknown character of futures leads us to study uncertainty as a possible research theme in foresight. Keeping to this purpose, key concepts which are associated with uncertainty were analyzed and gathered into comprehensive themes related to uncertainty. These themes were then evaluated with the fundamental objective of generating intense clarity to the concept uncertainty by different qualitative methods as content analysis and conceptual modeling.

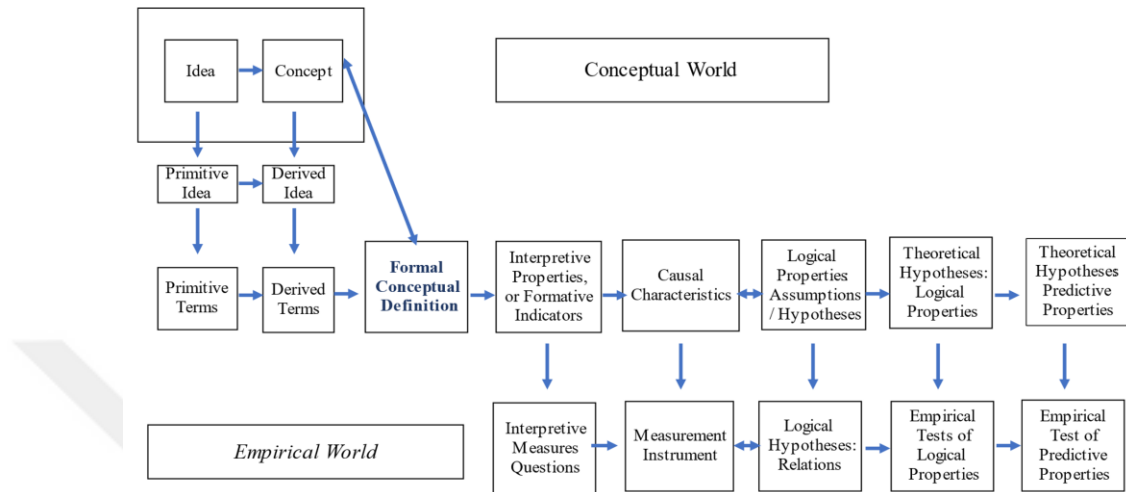
This chapter talks over methods that are used in the thesis to reach the objectives of this research. The section involves philosophy, ethical concern, approach, strategy, process, horizon, and instrument of research. In addition to these types, sampling, collection, and analysis of data are evaluated in this part.

4.1. Research Philosophy/Paradigm

The purpose of this thesis is to clarify the concept of uncertainty to provide the basis for reaching “good formal conceptual definitions”, which is essential for theory constructions (Wacker, 2004). According to Wacker (2004), “formal conceptual definitions” are necessary for whole empirical studies, which comprise theory-construction, due to “good formal conceptual definition” is the essential condition for “construct validity (content validity, criterion validity, convergent validity, and discriminant validity)”. Wacker’s (2004) approach is based on “a theory of formal conceptual definitions” which involves descriptions of terms, domains of theory, relationships of “good and formal conceptual” descriptions, and predictions. “Formal Conceptual Definition” is a kind of step in the whole theory-construction (Wacker, 2004).

Figure 7

A Graphical Overview of How Theory is Built Using Formal Conceptual Definitions



Note. From: “A theory of formal conceptual definitions: developing theory-building measurement (Wacker, 2004)

Wacker (2004) details that a “good” description is stated as a concentrated, pure verbal statement of a distinctive concept which is necessary for precise empirical analysis (Hempel, 1970; cited in Wacker, 2004). In addition to that, “formal” descriptions are present at an abstract point and “do not contain measurable attributes”; thus, “formal conceptual definitions” are utilized for “abstraction and theory building” (Wacker, 2004).

The philosophy of this research is outlined about clearness of uncertainty concerning “good and formal conceptual definition” as qualitative research. Generally, key research paradigms are classified into three categories, as positivist, interpretive, and critical paradigm, centered with ontological, epistemological, methodological focus, and methods, which are applied in the process of research (Scotland, 2012). The interpretive

paradigm, which is grounded on subjectivist epistemology, identifies concept from individual's (participants) assessment, utilizing gathered data through cultural and historical perspective is the benchmark of this study (Scotland, 2012).

Having concluding effects, which are about conceptual clarity, is overall goal of this research. Utilizing interpretive analysis comprises comprehending of phenomenon, that is based on perception of individuals, in the light of both cultural and historical background (Scotland, 2012). Therefore, uncertainty as a concept is analyzed in a great deal of academic data, formed with quoted potential studies (field) and specific topics (concept and description of uncertainty) to aim conceptual clarity.

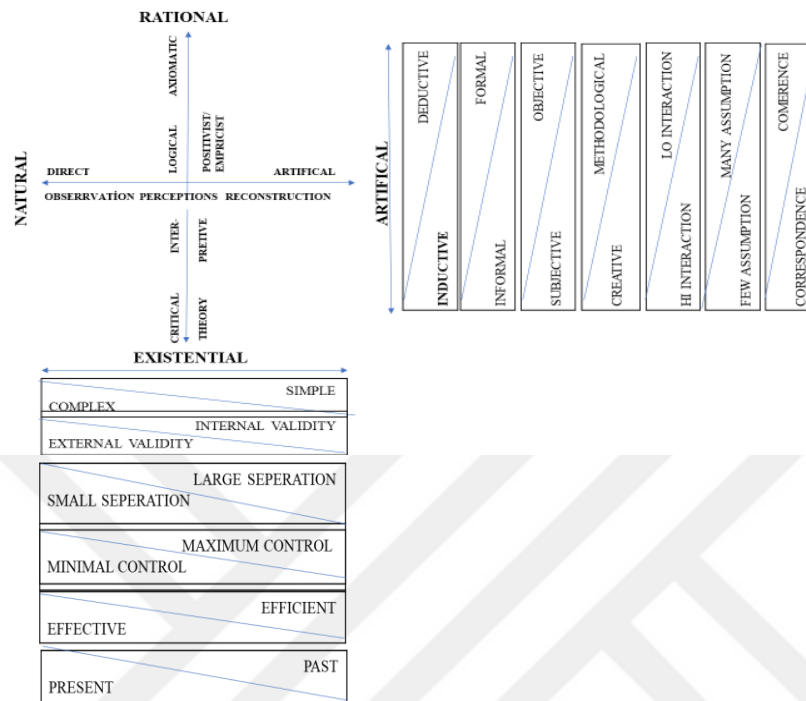
Lincoln (1995) stated that searching through the interpretive methodology comprises the superiority of essential social structures. Interpretivism points to take along awareness, which is unseen social structures (Scotland, 2012). As it should, utilization of the interpretive standpoint demanded the evaluation of the diversity of literature about uncertainty as a concept using multidisciplinary approach.

The interpretive standpoint, which comprises "the context of the phenomenon", in the role of being a vital part of the purpose of the study (Meredith et al., 1989). Meredith et al. (1989) stated that meanings and interpretations are the main criterions to understand the construing and conceptualizing of concepts and events by other researchers in interpretivism (See Table 2) The interpretive standpoint is based on the "people's perception of object reality" approach, which is handled through the personal point of view of other researchers; that is, the phenomenon is subject to the abstract conceptualization of an individual's reality cognition (Meredith et al., 1989). Meredith et al. (1989) stated that a related approach is a sort of the second source, named as a

technique to be used to achieve effectual knowledge and explanation about the phenomenon.

The philosophical point of view about “people’s perception of object reality” approach is dealt with the research through two fundamental dimensions, “rational-existential “and “natural-artificial”, which broadly structure the studies in business policy (Mitroff & Mason, 1984; cited in Meredith et al., 1989). Meredith et al. (1989) stated that the “rational-existential dimension” comprises the involvement of pure logic, which is unconnected with subjectivist standpoint or personal understanding, which is based on experience, while “natural-artificial dimension” is interested in type and resource of data, information and knowledge benefited from in research study (see Figure 8).

Figure 8
A Generic Research Framework



Note. From “Alternative research paradigms in operations” (Meredith et al., 1989).

According to Meredith et al. (1989), the “rational-existential dimension” is related to the epistemological feature of the research that shapes philosophical limitation to create knowledge that belongs to researcher. The aforementioned dimension has four generic approach as “axiomatic, logical positivist-empiricist, interpretive, and critical theory” which are various levels of formalism (Meredith et al., 1989).

“Natural-artificial dimension” is related to the type, and resource of data, information, and knowledge; empiricism affects the natural side, while subjectivist affects the artificial side (Meredith et al., 1989). Meredith et al. (1989) stated that scholar’s assessment of reality is formed, using instruments that ground on the

phenomenon. These instruments can be categorized as “object reality, people’s perceptions of object reality and artificial reconstruction of object reality” (Meredith et al., 1989).

Historical analysis, based on interpretivism, looks analysis the former documents or researches, to make comparison, finding similarities or differences, and examining a phenomenon from a specific approach (Meredith et al., 1989). In our work, we systematically reviewed the historical literature, to find unique definitions of the uncertainty concept to give an experiential sense of the past and provide an integrated framework.

We aim to have more knowledgeable options, which can be used for managing the development of uncertainty, through taxonomy and characterization. Conceptual modeling is utilized as a method for taxonomy and characterization of uncertainty in this study. “Conceptual modelling is a mental model of the suspected relationships which may be evaluated through a framework” (Meredith et al., 1989)

4.2. Qualitative Research

4.2.1. Qualitative content analysis

The method which is utilized to reach conceptual clarity is content analysis in this study. “Content analysis is a family of systematic, rule-guided techniques used to analyze the informational contents of textual data” (Mayring, 2000); that is, it is a form of conceptual analysis, whereby key concepts or terms are evaluated.

Content analysis is a kind of research method, which has the purpose of formulating repeated and applicable results from any transcript (Krippendorff, 2019). It is a grounded technique through empirical observation, exploratory in line with procedure, and focusing on forecasting or derivation (Krippendorff, 2019). And it goes

beyond the conception of old-style symbolizations, substances, and purposes with conceptualization and experiential settling (Krippendorff, 2019).

Besides, the system supports users to examine a huge amount of data with easiness in methodical approach (GAO, 1996; cited in Stemler, 2001) by squeezing several words of transcript into fewer content classifications grounded on specific ruling of coding (Brelson, 1952; GAO, 1996; Krippendorff, 1980; and Weber, 1990; cited in Stemler, 2001)

Content analysis, as a research method, is highly significant in social sciences (Krippendorff, 2019). Resettlement of content analysis into a range of theme and explanation of several methodological concerns (Krippendorff, 2019) caused wide-ranging transformations of content analysis from positivist paradigm to interpretive paradigm contained by qualitative research (Schreier, 2012; Egberg-Thyme et al., 2013; Lindgren et al., 2014; cited in Graneheim et al., 2017)

The process from planning to presentation is fundamental to elucidate “what the researcher want to find out, from whom, and how” in qualitative content analysis (Bengtsson, 2016). A summary of the content analysis research process, which is an example for this study, is seen in Appendix A (Bengtsson, 2016).

4.2.2. The Concept of uncertainty with content analysis

It is emphasized that ‘good ‘and ‘formal’ descriptions are grounded on clearness, which is stated as not to contain ambiguity, vagueness, confusion about any concept, and “overlapping definitional domains” (Wacker, 2004). However, clearness for having a “good formal conceptual definition” involves diverse, but interrelated processes (Wacker, 2004). First, scientific language is needed in this process. (Wacker, 2004). Then, the other stage is to have improved clarification of a concept via enhancing words or expressions

to the current concept for differentiating numerous kinds of main concepts (Wacker, 2004). The last phase is to provide ‘construct validity’ before statistical testing (Wacker, 2004).

The purpose of this research is to analyze concept of uncertainty, through content analysis of earlier published articles, which are related to unique definition and categorization of uncertainty. In the light of this approach, the concept uncertainty, within each definition and categorization, is identified and gathered into broader themes related with uncertainty. In addition to that, the second stage of Wacker’s (2004) process is the base of our study: detailed clarification of uncertainty via enhancing words as ignorance or expressions as the typology of uncertainty to the concept uncertainty for differentiating numerous kinds of uncertainty.

We do a literature review to clarify the conceptual definition and categorization of uncertainty based on methods of conceptual clarity reported in the literature. EBSCOhost database was examined for the concept uncertainty in this research. The outcomes of the first review, which comprises the term uncertainty, generated raw data with more than 20.000 articles and other references comprising the concept of uncertainty. Because qualitative research generally comprises a large number of raw data (Cassell & Symon, 2004).

The raw data is eliminated, considering the purpose of this research. First, we specify time intervals as between 1941- 2019 in the literature. Then quota is allocated for fields, due to the multidisciplinary approach of this research. Last, the unique definition and classification of uncertainty are grounded on the selection of data.

Each paper, covering the concept of uncertainty, was individually assessed to clarify the unique definition and categorization of uncertainty. Mainly, we documented

the sources as the basis of the unique definition and categorization of uncertainty, which was made available by the author(s). We are, Prof. Dr. Atilla Öner (1965-2018) who was the first advisor of this thesis, and the author of the thesis Pınar Şenoğlu assessed the articles for having unique definition and categorization of the concept uncertainty. However, we are aware of the bias assessment, and we used validated member checklists through continuous interaction with the supervisors.

Our first condition on literature review is the time interval, between 1941 and 2019, for content analysis due to the utilization of historical analysis for understanding the concept of uncertainty from the different periods. The period is started in the 1940s. The 1940s references to articles cover the end of the 19th and the beginning of the 20th century in general. We aim to see the effects of scientific revolution at the beginning of the 20th century.

Reviewing uncertainty in futures studies for conceptual clarity is the purpose of this study. However, uncertainty is handled in numerous disciplines due to having significant role as a concept. The second condition of the literature review is the quota of the fields concerning a multi-disciplinary approach. Moreover, other disciplines such as economics, management, sociology, and engineering, progress their methods about futures (Poli, 2014a; cited in Ahvenharju, Minkkinen, & Lalot, 2018). Thus, similar concepts are handled, via different fields, and scholarly overlaps or dialects are originated on the same phenomenon (Ahvenharju et al., 2018). As a result, the concept of uncertainty is analyzed in other disciplines as economics, business administration, engineering, sociology, psychology, ecology, and history, besides futures studies. The last condition comprises a unique description and classification of uncertainty.

After setting the three criteria, the results of literature review yielded over 1.000 articles containing the definition and classification of the concept of uncertainty. The literature is reviewed in terms of peer-reviewed, high ranked scholarly journals and decreased the results from 1.000 to 400 articles. Those 400 articles are eliminated concerning the repetitive covering of the concept of uncertainty and decreased to 101 articles for content analysis. The data is based on 101 published articles, related to the concept uncertainty (see Appendix C).

Lazarsfeld (1958) defines an approach that begins with an unclear concept, then follows a method concerning the description of the concept in terms of distinct components or dimensions. One of the steps is to take unique descriptions of any concept and then, to develop aspects, components, dimensions, or similar specifications of concept in the approach (Lazarsfeld, 1958). The concept is presented via a complex combination of phenomena, instead of a simple and directly observable item (Lazarsfeld, 1958).

The content analysis is used as method, from the standpoint of developing description, dimensions, or components of uncertainty, in this study. Therefore, peer-reviewed scholarly journals from different disciplines are grounded in this research. Table 7 exhibits a listing of the peer-reviewed journals, which comprise determining articles for content analysis (Weber, Current, & Benton, 1991).

Table 7*Journal Outlets of the Annotated Bibliography*

Journal	Number of Articles	(%)
Futures	32	31,68
The Quarterly Journal of Economics	13	12,87
Econometrica	6	5,94
Strategic Management Journal	5	4,94
Ecological Applications	4	3,97
Technological Forecasting & Social Change	4	3,97
American Journal of Sociology	2	1,98
The American Economic Review	2	1,98
Administrative Science Quarterly	2	1,98
American Sociological Review	1	0,99
Journal of Political Economy	1	0,99
Management Science	1	0,99
Economica	1	0,99
Journal of the Royal Statistical Society	1	0,99
Journal of Personality and Social Psychology	1	0,99
Social Studies of Science	1	0,99
Academy of Management Journal	1	0,99
The Journal of Business	1	0,99
Statistical Science	1	0,99
Academy of Management Review	1	0,99
Project Appraisal	1	0,99
Biometrics	1	0,99
The Antidote from CSBC	1	0,99
Journal of Health and Social Behavior	1	0,99
Foresight	1	0,99
Science, Technology & Human Values	1	0,99
Journal of Information, Communication & Ethics in Society	1	0,99
Journal of Economic Methodology	1	0,99
International Journal of Managing Projects in Business	1	0,99
History and Theory	1	0,99
Journal of Economic Theory	1	0,99
Psychology Press	1	0,99
Self and Identity	1	0,99
Journal of Cognitive Engineering and Decision Making	1	0,99
Mechanical Systems and Signal Processing	1	0,99
Journal of Applied Communication Research	1	0,99
International Journal of Geographical Information Science	1	0,99
Experts Systems with Applications	1	0,99
Erkenntnis / Springer	1	0,99
International Society of Manufacturing, Service and Management Engineering	1	0,99
TOTAL	101	100,00

We analyze the concept of uncertainty concerning different disciplines, besides futures. Since, assessing features, factors, or dimensions of concept require widespread analysis. Table 8 exhibits lists of fields handling in this research.

Table 8*List of Articles Fields*

Fields	Number of Articles
Futures	34
Economics	26
Business Administration	15
Sociology	10
Engineering	6
Ecology	4
Statistics	2
Psychology	2
Ethics	1
History	1
Total	101

Smithson (1988) handles ‘ignorance’ as a concept according to historical analysis and concludes as “broadly speaking, the trend involves recent changes in how we think about and respond to ignorance”. We intend to analyze trends in uncertainty as a concept regarding historical analysis within the limited time (1941-2019). The discourse, which is preferred, shows us “how we think about and respond” to uncertainty (Smithson, 1988) since discourse analysis is the “beyond the sentences”. Thus, discourse analysis is preferred, besides content analysis, in our research.

The concept of ignorance is exhibited in different discourses, for example, the concept should be reduced in terms of the positivist approach. On the other hand, ignorance should be managed in the contemporary approaches of management sciences (Smithson, 1988). These determinations made by Smithson (1988) about the concept of ignorance lead us to consider the issue of the concept of uncertainty from these perspectives. Therefore, ‘verb’, ‘adjective’, and ‘concept’ with uncertainty are evaluated to conclude “how we think about and respond” (Smithson, 1988) to

uncertainty. We search for any paradigmatic shift within the taxonomy of uncertainty, as well.

In addition to that, changing trends in the discourse of ignorance affect to form, dimensions, or features of ignorance, as well (Smithson, 1988). We aim to see the change in uncertainty using the verb, adjective, and within a concept in terms of the approached defined by Lagerfeld (1958) as from unclear concept to concept with distinct dimensions.

The data involves 101 articles, are manually analyzed in terms of the ‘verb’, ‘adjective’, and ‘concept’ with uncertainty within 19 tables (see Results). After setting mentioned tables, each of them listed in excel tables as ‘Verb Frequency List’ ‘Adjective Frequency List’ and ‘Concept Frequency List” to reach the most handled ones (see Appendix E).

We have 297 verbs with uncertainty in 101 defined articles, and a minimum of 4 times and more used 64 verbs are listed. The number of total adjectives with uncertainty is 251 in the data. 36 of total adjectives are a minimum of four times and more used. The total number of concepts with uncertainty is 448 in 101 defined articles. 70 of them are a minimum of 4 times and more users.

Content analysis is a family of systematic, rule-guided techniques used to analyze the informational contents of textual data (Mayring, 2000); that is, it is a form of conceptual analysis, whereby key concepts or terms are evaluated. The software NVivo 12 is used to make the analysis more manageable. The program facilitated and simplified the analysis by providing tools for the discovery of the underlying, and reoccurring themes.

4.2.3. Qualitative content analysis with NVivo

NVivo (QSR International, n.d.a) is developed by QSR International for qualitative assessment, for example, content and narrative analysis (Phillips & Lu, 2018), to make available instruments for managing data and supporting rigorousness via recording, ordering, corresponding, and connecting in the light of purpose – method corresponding, in examination, explanation, analogy, pattern assessment, theory construction, and experiment stages of research (Bazeley & Jackson, 2013).

NVivo 12, as a qualitative software package, is employed to analyze uncertainty in this research. The a priori coding scheme structure is used. 19 Tables (The Verb, Adjective, and Concept in terms of article coverage) obtained manually from 101 detailed articles (see Appendix C) are the basis of the NVivo in this research. The verbs, concepts, and adjectives were transferred in to the excel format to reach frequently used them. The frequent lists are created separately for verbs, adjectives, and concepts. Then these verbs, adjectives, and concepts are coded. We used the verbs, concepts, and adjectives coded by me in the NVivo program.

We do not use the bibliographic information, but the year and the author of articles are added as a case classification category. So, we can sort our data by the author as well if need be. The classification sheet is imported, and each column is transferred into Attributes.

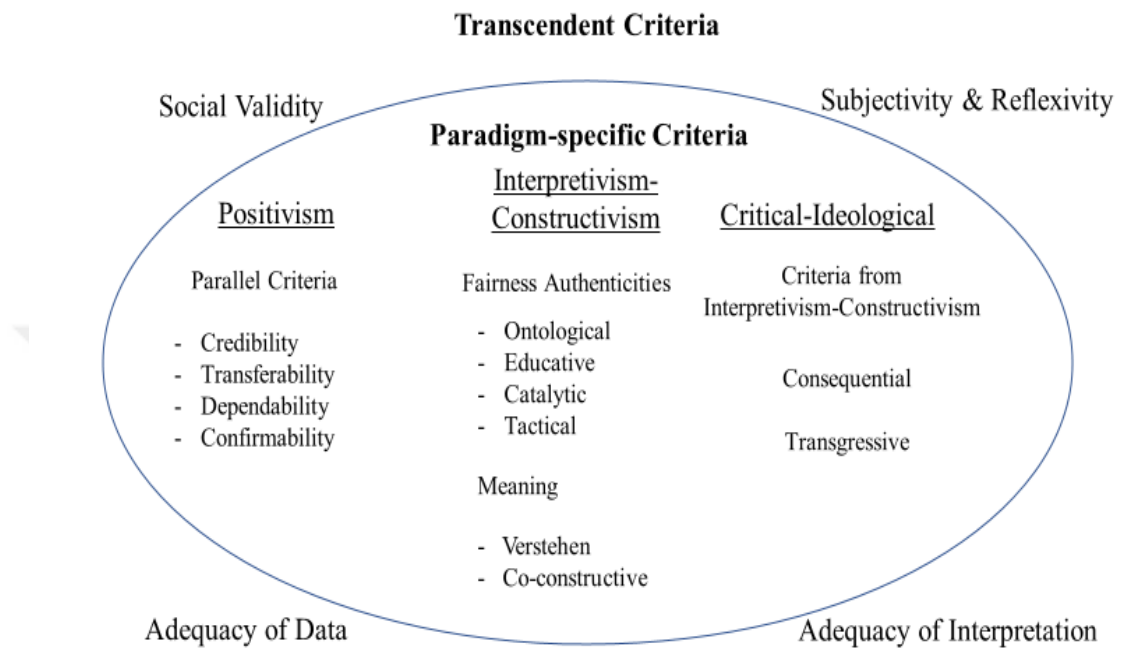
The coded verbs, adjectives, and concepts are analyzed in the data via a frequency approach. Our goal is to reach frequently used verbs, adjectives, and concepts in the specific data. Thus, our question is how often the determining verbs, adjectives, and concepts with uncertainty are utilized in the determined articles. We do not transitive analysis on the contrary we prefer a simple approach to support rigorousness.

4.3. Ethical Concern in Research

We handle the concept of uncertainty in different ways in addition to ethical consideration during the research process. The ethical concerns of participants in the process of any research are important (Ritchie et al., 2013). We seek to “stay true with text” (Bengtsson, 2016) and accomplish the below-mentioned principles in terms of ethical concern in this study.

The problem of reliability (Silverman, 2020) is one of the main concerns in qualitative research. Qualitative research, confirming from a diversity of fields, models, and/or epistemologies, comprises numerous basis for quality, identified as reliability, “trustworthiness, validity, credibility, or rigor” (Morrow, 2005). Trustworthiness is a predominant construct that covers numerous structures for determining characteristics of trustworthiness in qualitative approaches (Graneheim, Lindgren, & Ludman, 2017). These are “dependability”, “confirmability”, “transferability”, and “authenticity” (Graneheim, Lindgren, & Ludman, 2017).

According to Graneheim et al. (2017), it is necessary to identify the dominance of participant’ declaration or researcher’ analysis o provide the whole trustworthiness of a research. Morrow (2005) states, principles on “trustworthiness” are related to the groundwork of the linked paradigm of method in qualitative approach. Qualitative research is based on not only well-built theory construction concerning research questions, but also certain paradigm basis including superior principals for reliability (Morrow, 2005) (See Figure 9.).

Figure 9*Paradigm-specific and Transcendent Trustworthiness Criteria*

We take into consideration the interpretive paradigm as research philosophy in this research. The interpretive paradigm is based on subjectivist epistemology where understands concepts from individual's (participants) perceptions (Scotland, 2012). Principals for trustworthiness in the interpretive paradigm is based on "authenticity criteria" which "include fairness, ontological authenticity, educative authenticity, catalytic authenticity, tactical authenticity" (Guba & Lincoln, 1989; cited in Morrow, 2005) (See Table 9).

Table 9

A comparison of the Term Used by Guba and Lincoln (1989) and Nolan et al. (2003) in Relation to the Authenticity Criteria

Term used by Guba and Lincoln (1989)	Term used by Nolan et al. (2003)	Definition of term
Fairness	Equal Access	All viewpoints are represented even-handedly
Ontological authenticity	Enhanced awareness of the position of self	Participants understand their situation in more informed ways as a result of participation in the research
Educative authenticity	Enhanced awareness of the position of others	Participants understand the situations of others in more informed ways as a result of participation in the research
Catalytic authenticity	Encouraging action by providing a rationale or impetus for change	Participants have a greater insight into actions that they might take to change their situations as a result of participation in the research
Tactical authenticity	Encouraging action by providing the means to achieve change	Participants feel empowered and enabled to act as a result of participation in the research

Morrow (2005), fairness necessitates that different structures are asked and privileged. Participants' individualistic comprehension are progressed, experienced, enlarged, and complicated in ontological authenticity, whereas participants' perspective for other structures are enriched in educative authenticity (Morrow, 2005). A checklist is used as a guide for ethical concern in this study (See Appendix B).

4.4. Research Approach

In this study, the inductive research method is used via research questions aimed at assessment of the research scope. By preferring this method, we had an opportunity to improve our vision with new thoughts and approaches, because inductive research with qualitative approach comprises innovative and revelatory capacity to create new thought and conception (Gioia, Corley, & Hamilton, 2013).

Although this study was grounded on earlier established research, a wide-ranging evaluation and generating new perspective is aimed in the light of inductive research method for the related concept. Besides, going into detail and experiencing this method was a mode of interpretive approach together with qualitative research (Gioia, Corley, & Hamilton, 2013). For that reason, it is appropriate for researching conceptual clarity of uncertainty as a concept with conceptual modelling.

The inductive research method is supportive in restructuring the goals of this research through content analysis and NVivo 12, a commonly used qualitative software package. The reduced and categorized data, based on EBSCOhost database, is interpreted, and synthesized with content analysis via guidance of the inductive research method. Interpretive mode of the related method also supported to analyze the data according to fields and time periods in the process of content analysis (Gioia, Corley, & Hamilton, 2013).

4.5. Research Strategy

Strategy comprises proper planning and utilization of sources in the light of projection in general (Van Der Merwe, 2002). After setting the research subject as uncertain, a wide range of literature scanning is performed for understanding the covering of uncertainty as a concept in the literature.

After reviewing the literature, improvable areas in the subject of uncertainty are identified. These are conceptual analysis to reach clear formal definition (Wacker, 2004) and, redefining uncertainty in the light of new perspective.

Defining uncertainty is the most leading concern in several fields, and futures studies, as well. However, before defining the concept clearly in view of Wacker's (2004) approach, the conceptual analysis should be realized for contributing the clear

formal definition. Thus, we decided to construct the strategy and plan of research on conceptual analysis.

4.6. Research Process

After setting a general framework, the comprehensive literature review is utilized in terms of multidisciplinary approach. In addition, the research method is determined concerning rigorousness in qualitative research. Historical analysis and discourse analysis are realized in the execution stage. Content analysis and conceptual modeling for clear concept are utilized in execution stage, due to having determining effects of conceptual clarity is the focal point of this study. The whole knowledge and information which are obtained from previous stages are analyzed and interpreted during the last phrase of this research.

4.7. Research Horizon

Time-series research type is utilized in this study to examine how the concept of uncertainty is handled at different times. We analyze the literature published between 1941 and 2019 correspond to diverse domains in different disciplines such as economics, strategy, business administration.

4.8. Data Collection

Methods of qualitative data collection are preferred in this research. In addition, secondary sources are selected as related data. The secondary source to use for literature review is the scholarly journal which is named peer-reviewed scholarly journal (Neuman, 2014).

4.8.1. Type of data

Following the purpose of this study, uncertainty as a concept is analyzed in academic data formed with quoted potential studies (field and time period) and specific topics (description, and categorization of uncertainty) in terms of conceptual clarity.

The data which is handled in this research is categorized as qualitative. Qualitative data are brought together practicing qualitative research through various disciplines in social science (Cassell & Symon, 2004). EBSCOhost database was examined for the concept of uncertainty in this research. Qualitative research comprises a large number of raw data (Cassell & Symon, 2004). Therefore, the data reduced to 101 articles for content analysis. We analyze the literature published between 1941 and 2019 correspond to diverse domains in different disciplines such as economics, engineering, business administration.

4.8.2. Quota for fields

Due to the study of uncertainty is not confined to any single discipline, the concept is analyzed in a great deal of data which are peer-reviewed scholarly journals, books, and other kinds of sources (Neuman, 2014). Therefore, there is a need for a strategy and planning for restriction of data sources. Uncertainty, as a concept, is analyzed in fields of foresight, business administration, economics, engineering, sociology, psychology, statistics, history, and ecology in this research.

4.9. Data Analysis

Meta-analysis, context and historical analysis are used in the role of methods of data analysis in this research (Neuman, 2014).

4.9.1. Meta-analysis

A meta-analysis is utilized to integrate the verification on behalf of questions in different fields as social science (Borenstein, Hedges, Higgins, & Rothstein, 2009). The meta-analysis is the statistical analysis of the results included studies from a systematic review where all available relevant evidence to answer a pre-defined question/s (University of Calgary Libraries and Cultural Resources, 2021).

In our thesis, our systematic review – also known as evidence summaries and integrative reviews- focused specifically on the concept of uncertainty, whilst providing a quantitative assessment on the issue through the use of meta-analysis. We have created *a priori* in selection (i.e., unique definition) in order to review the literature, and reported the reasons for inclusion or exclusion.

The large number of raw data about the concept of uncertainty is eliminated in the light of our purpose of this research. First, we specify time intervals in literature between 1941 and 2019 for content analysis. Then, the quota for fields is allocated, concerning the multidisciplinary approach of this research. Last, the unique definition and classification of uncertainty are grounded on the selection of literature. However, we are aware of the bias assessment and in order to overcome those barriers, we used validated checklists through continues interactions, with the supervisors.

4.9.2. Context review

Uncertainty as a concept is linked to a larger body of knowledge within a broader framework via context review (Neuman, 2014). Secondary data researchers, who deal with qualitative approach, search for a perspective on, how primary researchers are positioned inside the data samples, in terms of understanding the

contexts which support diversity, and thus visions interested in settings and bases (Irwin, 2013).

4.9.3. Historical analysis

Qualitative data is reviewed to analyze how uncertainty is a concept developed over time. Historical analysis, which is based on interpretivism, looks into the former documents or researches to make comparison, finding similarities or differences, and examining a phenomenon from a specific approach (Meredith et al., 1989). Historical analysis is utilized in this thesis concerning the concept of uncertainty from different time period and field perspective.

4.9.4. Positionality in Research

The future inside us

Radiohead / The Numbers

Positionality affects both how research is directed and the results (Ashford-Rowe, Herrington, & Brown, 2014). Positionality in this research should be considered both in terms of the period of completion and the researchers themselves. The situation I am in as the author of this thesis is parallel to the subject of my thesis. The most effective situation is the death of first supervisor of this thesis, Prof. Dr. Atilla Öner (1965-2018) Then, Covid 19 epidemic affects the process in terms of living with uncertainty. I experienced the facts about uncertainty with the death of first supervisor and in the Covid 19 epidemic.

On the other hand, my personal history affects the research process as well. Although I have a bachelor's degree in a different field -law, and work experience in banking sector, I write a thesis related to futurism in business administration. We were aware of my barriers with my first supervisor. We talked for the thesis for at least 20 minutes a week. The first five minutes of our weekly meetings started with free speech

of mine about the articles belong our data. Then, each article was examined within the framework of thesis. We prefer to “stay true with text” in terms of trustworthiness in the process. We used validated checklist through continues interactions with Prof. Dr. Atilla Öner a as supervisor. These studies improved my thinking skills and were important steps in overcoming my barriers.

In my opinion, the whole process involves uncertainty in every step. We managed the uncertainty throughout the process together with Prof. Dr. Atilla Öner (1965-2018) and Assoc. Prof. Dr. Hayriye Senem Göl Beşer.



5. RESULTS

5.1. Content Analysis Results by Manually

Trying to refine uncertainty is the most leading concern in futures studies. “How we think about and respond” ((Smithson, 1988) to uncertainty, if there is any paradigmatic shift within the taxonomy of uncertainty, or not as research questions are the questions that are with us throughout the research process concerning foresight as futures study

First, we try to find the answers to these question with a historical analysis (Meredith at al., 1989) and discourse analysis throughout the qualitative content analysis. The data is discussed manually within seven decades to understand the tendency in handling the uncertainty. Then, content analysis is done in terms of all data via NVivo 12 to support rigorousness and compare the result between manual and software usage.

5.1.1. The first decade analysis (1941-1951)

The first decade is settled years between 1941 and 1951 which cover the World II war and post-war periods. Technological studies and operational research (OR), related to war periods, were improved in those days (Clarke, 1996)

In the development of information and communication technologies, the fourth wave, including the aviation industry, petrol-chemicals, and electronics, started in the 1950s and continuing for 40 years, and is defined as the electronic age (FOCUS, 2005). Concerning futures studies, the first try belongs to Ossip K. Flechtheim in terms of “academic approach” and, he used the concept “futurology” in the studying future during the post-second World War (Gidley, 2017).

According to Smithson (1988) increasing in complexity and paradigm shift about technologies and organizations ever since World War II have given rise to concern about the concept of uncertainty. Although, technological studies were improved in those days (Clarke, 1996), articles were chosen to analyze due to having significant progress from the 1920s in the field of economics on basis of the social science.

This decade's analysis of uncertainty handling covers six articles (see Appendix C numbered as 1-6). Field division in the first decade as follows: "Economics" with five articles, "Sociology" with one article belongs to Moore and Tumin (1949) (See Table 10). Analysis of related articles is done manually and resulted in one table.

Table 10*Verb, Adjective, and Concept Analysis between 1941 and 1951*

Author	Date	Verb	Adjective	Concept
Tintner	1941	to introduce uncertainty	subjective uncertainty	choice under uncertainty assumption of uncertainty uncertainty preference
Tintner	1942	to maximize uncertainty	subjective uncertainty	case of uncertainty uncertainty preference
Simpson	1949	to exclude uncertainty to construct uncertainty to suppress uncertainty to represent uncertainty to interpret uncertainty	technological uncertainty treacherous uncertainty basic uncertainty prominent uncertainty	conditions of uncertainty actions under uncertainty behavior under uncertainty assumptions under uncertainty position relative to uncertainty economics of uncertainty disturbed by uncertainty. inclusion of uncertainty creation of uncertainty systems developing uncertainty elements decision-making under uncertainty theoretical uncertainty systems system of uncertainty choice under uncertainty difficulties of uncertainty problems of uncertainty
Moore, Tumin	1949			uncertainty of outcome
Alchian	1950	to define uncertainty to direct uncertainty to regard uncertainty to start with uncertainty	complete uncertainty attaching uncertainty recognized uncertainty.	pervasiveness of uncertainty because of uncertainty implicit in uncertainty presence of uncertainty question of uncertainty existence of uncertainty
Arrow	1951	to concern uncertainty to relate uncertainty to describe uncertainty to regard uncertainty to reduce uncertainty to consider uncertainty to appear uncertainty to express uncertainty to produce uncertainty	subjective uncertainty objective uncertainty unmeasurable uncertainty technological uncertainty relative uncertainty double uncertainty true uncertainty possible uncertainty given uncertainty.	describing uncertainty. absence of uncertainty choice under uncertainty behavior under uncertainty uncertainty of consequences conditions of uncertainty existence of uncertainty theory of uncertainty history of uncertainty phenomenon of uncertainty consequences about uncertainty uncertainty of a situation functional view of uncertainty degree of uncertainty case of uncertainty concept of uncertainty types of uncertainty formulation of uncertainty uncertainty situations knowledge of uncertainty discussion of uncertainty uncertainty situation. preference for uncertainty assets under uncertainty description of uncertainty reaction to uncertainty evaluation of uncertainty

After creating the above-mentioned table, “verb”, “adjective”, and “concept” with uncertainty transferred to excel program and obtained “verb”, “adjective”, and “concept” lists in excel format (see APPENDIX E Tables 53). 20 verbs with uncertainty, 18 adjectives with uncertainty, and 55 concepts with uncertainty are obtained. Then repeated two times and more verbs, adjective, and concepts are determined among them and listed as frequency list of first decade between 1941 and 1951 as below.

Table 11

First Decade (1941-1951) Verb, Adjective, and Concept Frequency List

	Verb	Frequency	Adjective	Frequency	Concept	Frequency
1	to regard uncertainty	2	subjective uncertainty	3	choice under uncertainty	2
2			technological uncertainty	2	uncertainty preference	2
3					case of uncertainty	2
4					conditions of uncertainty	2
5					behavior under uncertainty	2
6					existence of uncertainty	2
7					uncertainty situation.	2

The results of frequency list show us that the subjectivity in the uncertainty is highlighted in this decade. Subjective uncertainty is discussed, in addition to that choice and behavior under uncertainty are analyzed. Tinter (1942) defined the subjective uncertainty as follows: if the individuals think that they are not certain about their judgment of anticipated price, interest rate or income which will be present in the future, however only involved with definite *a priori* probabilities to the probability distribution (pg. 301), the subjective uncertainty becomes a current issue in that case.

Simpson (1949) puts the relation between uncertainty and “economic behaviors under uncertainty” as follows: inadequacies in any uncertainty systems are an obstacle

for “the deductive consequences of any assumed formulation of economic behavior under uncertainty”.

5.1.2. The second decade analysis (1954 -1968)

Technological improvements continue in this decade. Leonard Kleinrock, PhD Student at MIT, published the thesis description of the invention that later named package exchange technology in 1962 (FOCUS, 2005). With the establishment of Advanced Research Agency in the same year, the first step was taken for the internet dream that everyone with a computer and a phone in the universe can access (FOCUS, 2005 pg. 44).

Hippies were known as” Flower Children” began to appear in the 1960s and after, there has been a movement that has affected the life of thought and the behavior of people (WIKIPEDI, 2021). When examined as a movement, hippies are regarded as the most consistent movement ever, especially by psychoanalyst Erich Fromm (WIKIPEDI, 2021).

At the beginning of the 20th century, the concept” forecast” was usually utilized to define every type of writing regarding the future (Gidley, 2017). Forecasting revamped in the 1960s and is still preferred today by those who consider their approach to be scientific (Gidley, 2017 pg. 5). Forecasting is the closest to ‘prediction’ of the terms we are considering, and it is often linked to technological developments, as in ‘technological forecasting’ (Gidley, 2017 pg. 5). 1960s was important in terms of institutionalization of futures studies; institutions called think-tanks were established in this decade, for example The RAND Cooperation in USA (Clarke, 1996).

The second decade analysis of uncertainty handling covers years between 1954 and 1968 with eight articles in this study (see Appendix C numbered as 7-14). Field

division in the second decade as follows: “Economics” with seven articles, and “Sociology” with one article. Analysis of related articles is done manually and resulted with one table in the second decade (see Table 12).



Table 12*Verb, Adjective, and Concept Analysis between 1954 and 1972*

Author	Date	Verb	Adjective	Concept
Roegen	1954	to involve uncertainty to introduce uncertainty to examine uncertainty to treat uncertainty to represent uncertainty to compose uncertainty to make uncertainty to argue uncertainty to order uncertainty to consider uncertainty	measurable uncertainty complete uncertainty neutral uncertainty unwarranted uncertainty distinct uncertainty purest uncertainty identical uncertainty superimposing uncertainty indifferent uncertainties	choice and uncertainty example of uncertainty choice among uncertainties uncertainty and probability treatment of uncertainty form of uncertainty ordering of uncertainty
Davis	1960	to cope with uncertainty to do with uncertainty to concede uncertainty to interpret uncertainty to state uncertainty	diagnostic uncertainty prognostic uncertainty real uncertainty pretended uncertainty. functional uncertainty great uncertainty clinical uncertainty	communication of uncertainty influence of uncertainty scope of uncertainty significance of uncertainty duration of uncertainty measure of uncertainty degree of uncertainty perpetuation of uncertainty pretense of uncertainty admission of uncertainty range of uncertainty intolerance of uncertainty issue of uncertainty
Fellner	1961	to get used to uncertainty. to relate uncertainty to reduce uncertainty to eliminate uncertainty to entail uncertainty		reaction to uncertainty problem of uncertainty degree of uncertainty acceptance of uncertainty concept of uncertainty theory of uncertainty decision making under uncertainty.
Brewer	1963			decision under uncertainty
Marris	1963			fraught with uncertainty
Hirshleifer	1965	to associate with uncertainty	two-state uncertainty	decision under uncertainty existence under uncertainty form of uncertainty domain of uncertainty portraying of uncertainty
Hirshleifer	1966	to associate with uncertainty		decision under uncertainty domain of uncertainty
Leland	1968	to increase uncertainty	present uncertainty introduced uncertainty	saving and uncertainty effect of uncertainty degree of uncertainty function of uncertainty
Weitzman	1971			under uncertainty effect of uncertainty norm uncertainty introduction of uncertainty presence of uncertainty
Kamien, Schwartz	1972			choice under uncertainty decision making under uncertainty

After creating the above-mentioned table, “verb”, “adjective”, and “concept” with uncertainty transferred to excel program and obtained “verb”, “adjective”, and “concept” lists in excel format (see APPENDIX E Table 54). 23 verbs with uncertainty, 19 adjectives with uncertainty, and 40 concepts with uncertainty are achieved. Then repeated verbs, adjective, and concepts are determined among them and listed as frequency list of second decade between 1954 and 1968 as below (see Table 13).

Table 13

Second Decade (1954-1968) Verb, Adjective, and Concept Frequency List

	Verb	Frequency	Adjective	Frequency	Concept	Frequency
1	to associate with uncertainty	2		no	decision under uncertainty	3
2					degree of uncertainty	3
3					domain of uncertainty	2
4					form of uncertainty	2

The awareness of handling uncertainty continues concerning the results of verbs, adjectives, and concepts with uncertainty in this decade. There is no frequent adjective in this section, and all adjectives are distributed equally. The decision under uncertainty is one of the frequent concepts. This concept is analyzed in the field of economics and described in subjective probabilities. Hirshleifer (1965) discussed “investment decision under uncertainty” and according to him it comprises “purchase of assets – more or less complex claims or titles to present and the future incomes”.

The “degree of uncertainty” is another frequent concept. Fellner (1961) states that even where this can be made vaguely analogous to the acquisition of knowledge about the process of real life, the fact still remains that observing the individual’s reaction to some degree of uncertainty to which he has gotten used is a different task from observing his reaction to rapidly changing degrees of uncertainty (pg. 679).

5.1.3. The third decade analysis (1971 -1979)

The third decade is settled between 1971 and 1979 that is the period of important invention. Starting to study on applied mathematics and theoretical physics in 1973, Stephen W. Hawking received a title given to Newton for the first time after 1979 and became a “Lucasian Professor” of the department of mathematics (FOCUS, 2005). Ray Tomlinson wrote the code for the first e- mail operator via ARPANET (Advanced Research Agency) (FOCUS, 2005 pg. 44). The symbol of “at” in the first message he sent himself went down in history (FOCUS, 2005 pg. 44). The computer -assisted tomography (1972), Atari (1972), the short visit to the red planet, Mars (1975), and the first personal computer (1977) are among the inventions of this period (FOCUS, 2005).

After “the birth of futures studies” in the late 1960s, “the pluralization of futures studies” was made official via the establishment of the “World futures Studies Federation” in 1973 (Gidley, 2017). The future-thinking started to be an academic discipline by the 1970s (Clarke, 1996).

The third -decade analysis of uncertainty handling covers years between 1971 and 1979 with eight articles in this study (see Appendix C numbered as 15-22). Field division in the third decade as follows: “Economics” with five articles, “Business Administration” with two articles, and “Statistics” with one article. Analysis of related articles is done manually and resulted in two tables in the third last decade. One of these tables is in the second decade analysis part, due to Table 12 covers articles both the second and the third decades and one table subject to third decade are below.

Table 14*Verb, Adjective, and Concept Analysis between 1972 and 1979*

Author	Date	Verb	Adjective	Concept
Duncan	1972	to experience uncertainty to cope with uncertainty to place uncertainty to predict uncertainty to explain uncertainty to lead uncertainty	perceived uncertainty environmental uncertainty little uncertainty low uncertainty high uncertainty	contributor to uncertainty decision-making under uncertainty perception of uncertainty level of uncertainty concept of uncertainty uncertainty of event measures of uncertainty aspect of uncertainty definition of uncertainty view of uncertainty. component of uncertainty degree of uncertainty amount of uncertainty variance in uncertainty tolerance for uncertainty
Yarrow	1973	to introduce uncertainty		maximization under uncertainty decision-making under uncertainty effect of uncertainty type of uncertainty uncertainty about
Edwards, Heggestad	1973	to avoid uncertainty	conventional uncertainty	uncertainty avoidance measure of uncertainty theory under uncertainty uncertainty theory uncertainty literature decision-making under uncertainty uncertainty regarding impact of uncertainty under uncertainty
Musgrave	1974			role of uncertainty maximization under uncertainty under uncertainty uncertainty model
Moore	1977	to struggle with uncertainty to encourage uncertainty to quantify uncertainty to reflect uncertainty to describe uncertainty to involve uncertainty to build uncertainty to face uncertainty to concern uncertainty to model uncertainty to eliminate uncertainty to treat uncertainty to contain uncertainty to change uncertainty	pertinent uncertainty perceived uncertainty considerable uncertainty	representation of uncertainty recognition of uncertainty decision-making under uncertainty uncertainty information measuring uncertainty uncertainty expression treatment of uncertainty degree of uncertainty uncertainty regarding effect of uncertainty separation of uncertainty experts in uncertainty uncertainty component area of uncertainty under uncertainty aspect of uncertainty measurement of uncertainty assessment of uncertainty situation of uncertainty quantification of uncertainty decision under uncertainty face of uncertainty enhancement of uncertainty
Kahneman, Tversky	1979	to reflect uncertainty		aversion for uncertainty attitude toward uncertainty

After creating the above-mentioned table, “verb”, “adjective”, and “concept” with uncertainty transferred to excel program and obtained “verb”, “adjective”, and “concept” lists in excel format (see APPENDIX E Table 55). 23 verbs with uncertainty, 49 adjectives with uncertainty, and 65 concepts with uncertainty are achieved. Then repeated verbs, adjective, and concepts are determined among them and listed as frequency list of second decade between 1971 and 1979 as below.

Table 15

Third Decade (1971-1979) Verb, Adjective, and Concept Frequency List

	Verb	Frequency	Adjective	Frequency	Concept	Frequency
1	to reflect uncertainty	2	environmental uncertainty	4	decision-making under uncertainty	4
2			perceived uncertainty	3	under uncertainty	4
3			considerable uncertainty	3	effect of uncertainty	3
4			conventional uncertainty	2	degree of uncertainty	2
5			great uncertainty	2	aspect of uncertainty	2
6			technical uncertainty	2		

Perception and consideration of uncertainty stand out concerning the results of verbs, adjectives, and concepts with uncertainty in this decade. Duncan (1972) explains it as follows: Given the role individual differences play in one’s reaction to events, consideration will be given in this research to the differences among individuals in their perception of uncertainty and environmental dimensions before aggregate measures are constructed (pg. 314). The “to reflect uncertainty” gain importance in this situation, Moore (1977) states that “probabilities reflect a person’s uncertainties about the external world and describe a relationship between that person and his environment”.

5.1.4. The Fourth-decade analysis (1980 -1987)

The fourth decade is settled between 1980 and 1987 that is the period of globalization and the introduction of the internet into our lives. Since the 1980s, contemporary globalization has extended fast in the course of the growth of capitalism.

Significant technological developments were obtained in terms of the internet in the fourth decade. TCP/IP as communication standard (1980), Domain name service utilization (1984), CD-ROM (1984), Windows 1.0 (1985), and legislation for the use of fiber optics (1986) are among the developments in the fourth decade (FOCUS, 2005).

After the pluralization of the futures approach, scenario planning, gain importance in terms of futures studies in the fourth decade. Scenario planning is a comprehensive method that is utilized within numerous approaches in the futures studies (Gidley, 2017).

The fourth-decade analysis of uncertainty handling covers years between 1980 and 1987 with thirteen articles in this study (see Appendix C numbered as 23-35). Field division in the fourth decade as follows: “Business Administration” with five articles, “Futures” with four articles, “Sociology” with one article “Economics” with one article, “Statistics” with one article, and “Psychology” with one article. “Verb”, ‘Adjective’, and ‘Concept’ which are used with uncertainty are evaluated for coming to the result as “how we think about and respond” ((Smithson, 1988) to uncertainty and if there is a paradigmatic shift, or not, in thirteen articles. Analysis of related articles is done manually and resulted in two tables in the fourth decade.

Table 16*Verb, Adjective, and Concept Analysis between 1980 and 1985*

Author	Date	Verb	Adjective	Concept
Hall	1980	to recognize uncertainty	conventional uncertainty environmental uncertainty	location for uncertainty kind of uncertainty type of uncertainty uncertainty in system
Ramage	1980	to measure uncertainty		
Prior	1980	to arise uncertainty to cope with uncertainty to focus uncertainty to incorporate uncertainty to impose uncertainty to increase uncertainty to respect uncertainty to absorb uncertainty to underly uncertainties	great uncertainty technological uncertainty economic uncertainty double uncertainty considerable uncertainty geological uncertainty technical uncertainty dual uncertainty	under uncertainty area of uncertainty condition of uncertainty future uncertainty analysis of uncertainty implication of uncertainty system uncertainty context of uncertainty problem of uncertainty accumulation of uncertainty area of uncertainty effect of uncertainty uncertainty in demand fact of uncertainty
Sharp	1980	to face uncertainty to add uncertainty to increase uncertainty to counter uncertainty to emphasize uncertainty to cope with uncertainty to prevent uncertainty	considerable uncertainty increasing uncertainty environmental uncertainty	uncertainty created by future of uncertainty role of uncertainty method of uncertainty
Dess, Beard	1984	to heighten uncertainty to cope with uncertainty to deal with uncertainty to perceive uncertainty	greater uncertainty	
Vandell	1984	to possess uncertainty to exist uncertainty		under uncertainty existence of uncertainty sense of uncertainty condition of uncertainty
Star	1985	to transform uncertainty to face uncertainty to make uncertainty to manage uncertainty to write about uncertainty to elaborate uncertainty to deal with uncertainty to describe uncertainty to experience uncertainty to handle uncertainty to contribute uncertainty to sift uncertainty to address uncertainty to present uncertainty to resolve uncertainty to emphasize uncertainty to bury uncertainty to subsume uncertainty to define uncertainty to deal with uncertainty	local uncertainty monolithic uncertainty daily uncertainty political uncertainty diagnostic uncertainty constant uncertainty severe uncertainty great uncertainty taxonomic uncertainty technical uncertainty interactive uncertainty immediate uncertainty increased uncertainty major uncertainty clinical uncertainty high-level uncertainty subsumed uncertainty epistemological uncertainty inescapable uncertainty basic uncertainty	transformation of uncertainty deletion of uncertainty reduction of uncertainty variety of uncertainty focus of uncertainty. Uncertainty resolution sociology of uncertainty management of uncertainty kind of uncertainty type of uncertainty source of uncertainty segmentation of uncertainty path of uncertainty management of uncertainty training for uncertainty in light of uncertainty taxonomy of uncertainty discussion of uncertainty training for uncertainty decision-making under uncertainty under uncertainty typology of uncertainty
Bourgeois	1985	to avoid uncertainty to respond uncertainty to measure uncertainty to eliminate uncertainty to cope with uncertainty to ignore uncertainty to recognize uncertainty to reduce uncertainty to seek uncertainty	perceived uncertainty environmental uncertainty total uncertainty functional uncertainty confronted uncertainty high-degree uncertainty	level of uncertainty perception of uncertainty management of uncertainty homogeneity of uncertainty attribute of uncertainty magnitude of uncertainty uncertainty of outcome variance in uncertainty uncertainty reduction uncertainty avoidance measure of uncertainty

Table 17*Verb, Adjective, and Concept Analysis between 1986 and 1987*

Author	Date	Verb	Adjective	Concept
Tversky, Kahneman	1986			decision making under uncertainty
Hodges	1987	to diminish uncertainty to characterize uncertainty to consider uncertainty to describe uncertainty to entail uncertainty to assess uncertainty to weigh uncertainty to account uncertainty to understate uncertainty to discuss uncertainty to take uncertainty to handle uncertainty to understand uncertainty to concern uncertainty to propagate uncertainty to take account of uncertainty to formulate uncertainty to incorporate uncertainty to account for uncertainty to manifest uncertainty to capture uncertainty to ignore uncertainty to introduce uncertainty to decrease uncertainty to reduce uncertainty to convert uncertainty to treat uncertainty to distinguish uncertainty to embody of uncertainty to omit uncertainty	structural uncertainty technical uncertainty greater uncertainty parameter uncertainty subjective uncertainty perceived uncertainty remaining uncertainty plausible uncertainty model uncertainty more uncertainty less uncertainty predictive uncertainty uncounted uncertainty	type of uncertainty various uncertainty accounting for uncertainty form of uncertainty. regarding uncertainty modelling uncertainty completeness uncertainty involving uncertainty. representation of uncertainty kind of uncertainty characterizing uncertainty reducing uncertainty pervasiveness of uncertainty discussion about uncertainty uncertainty in loss function experiment for uncertainty. analysing uncertainty measure of uncertainty awareness of uncertainty catalogue of uncertainty effect of uncertainty treatment of uncertainty area of uncertainty range of uncertainty concept of uncertainty importance of uncertainty assessment of uncertainty assembling uncertainty estimation of uncertainty account of uncertainty scheme of uncertainty
Ireland, Hitt, Bettis, Porras	1987	to deal with uncertainty to cope with uncertainty to find uncertainty to measure uncertainty to influence uncertainty	environmental uncertainty high-degree uncertainty perceived uncertainty significant uncertainty lower uncertainty	degree of uncertainty perception of uncertainty amount of uncertainty management level in uncertainty
Milliken	1987	to define uncertainty to specify uncertainty to measure uncertainty to create uncertainty to experience uncertainty to focus uncertainty to describe uncertainty to perceive uncertainty	environmental uncertainty state uncertainty great deal of uncertainty high level of uncertainty lingering uncertainty	type of uncertainty state uncertainty effect uncertainty response uncertainty confusion about uncertainty concept of uncertainty construct of uncertainty. perception of uncertainty re-examining uncertainty definition of uncertainty operationalization of uncertainty nature of uncertainty measure of uncertainty research on uncertainty measuring of uncertainty indicator of uncertainty source of uncertainty conceptualization of uncertainty manifestation of uncertainty experience of uncertainty case of uncertainty uncertainty scale amount of uncertainty focus of uncertainty. consequence of uncertainty

After creating the above-mentioned tables, “verb”, “adjective”, and “concept” with uncertainty transferred to excel program and obtained “verb”, “adjective”, and “concept” lists in excel format (see APPENDIX E Table 56). 96 verbs with uncertainty, 63 adjectives with uncertainty, and 120 concepts with uncertainty are achieved. Then repeated verbs, adjective, and concepts are determined among them and listed as frequency list of second decade between 1980 and 1987 as below.

Table 18

Fourth Decade (1980-1987) Verb, Adjective, and Concept Frequency List

	Verb	Frequency	Adjective	Frequency	Concept	Frequency
1	to cope with uncertainty	5	environmental uncertainty	5	type of uncertainty	4
2	to deal with uncertainty	4	perceived uncertainty	3	area of uncertainty	3
3	to measure uncertainty	4	technical uncertainty	3	measure of uncertainty	3
4	to describe uncertainty	3	considerable uncertainty	2	perception of uncertainty	3
5	to define uncertainty	2	great uncertainty	2	under uncertainty	3
6	to emphasize uncertainty	2	greater uncertainty	2	amount of uncertainty	2
7	to experience uncertainty	2	high-degree uncertainty	2	concept of uncertainty	2
8	to face uncertainty	2			condition of uncertainty	2
9	to focus uncertainty	2			decision making under uncertainty	2
10	to handle uncertainty	2			effect of uncertainty	2
11	to ignore uncertainty	2			focus of uncertainty.	2
12	to incorporate uncertainty	2			kind of uncertainty	2
13	to increase uncertainty	2			management of uncertainty	2
14	to perceive uncertainty	2			source of uncertainty	2
15	to recognize uncertainty	2			training for uncertainty	2
16	to reduce uncertainty	2				

It is observed that the tendency, to understand and deal with uncertainty, continues to increase in the fourth decade, as well. It is seen that the concept of uncertainty is discussed more frequently in terms of psychology and behavioral science in the fourth decade, Tversky and Kahneman offer effective approaches about the decision making under uncertainty.

Ireland et al. (1987) state that coping with high degrees of uncertainty is essential in inefficient markets which necessitate strategic planning. Bourgeois (1985) defines the cope with uncertainty as “the essence of the administrative process” as well. The “environmental uncertainty” is often used to define “the state of organizational environments” and uncertainty about it shows us the incomprehension of the change in factors of the environment (Milliken, 1987).

5.1.5. The Fifth decade analysis (1991-1999)

The fifth decade is settled between 1991 and 1999, which is the beginning of the fifth way of information and communication technologies. The fifth wave includes software, the new media, digital networks, micro-nano technologies (FOCUS, 2005).

The foresight, as a futures study, gains importance in 1990s (Gidley, 2017). The foresight defines as “a systemic, participatory, future intelligence gathering and medium-to-long-term vision-building process ... aimed at present-day decisions and mobilizing joint actions” in by “The High-Level Expert Group for Foresight in the European Commission (Gidley, 2017).

The fifth-decade analysis of uncertainty handling covers years between 1991 and 1999 with fifteen articles in this study (see Appendix C numbered as 36-50). Field division in last decade as follows: “Business Administration” with five articles, Futures” with three articles, “Ecology” with three articles, “Sociology” with one article, and “Engineering” with one article. “Verb”, ‘Adjective’, and ‘Concept’ which are used with uncertainty are evaluated for coming to result as “how we think about and respond” ((Smithson, 1988) to uncertainty in fifteen articles. Analysis of related articles is done manually and resulted in four tables in the fifth decade.

Table 19*Verb, Adjective, and Concept Analysis between 1991 and 1992*

Author	Date	Verb	Adjective	Concept
Tversky, Kahneman	1991			under uncertainty
Machina, Schmeidler	1992	to represent uncertainty to involve uncertainty to arise uncertainty to work with uncertainty to resolve uncertainty	subjective uncertainty objective uncertainty mixed uncertainty	setting of uncertainty choice under uncertainty representation of uncertainty real-world uncertainty in terms of uncertainty well-defined uncertainty resolution of uncertainty case of uncertainty framework of uncertainty decision-making under uncertainty
Gerrity, Earp De Vellis, Light	1992	to minimize uncertainty to accentuate uncertainty to understand uncertainty to define uncertainty to address uncertainty to react to uncertainty to apply to uncertainty to prevent uncertainty to cope with uncertainty to delineate uncertainty to make uncertainty to accept uncertainty to describe uncertainty to appreciate uncertainty to control uncertainty to resolve uncertainty to manage uncertainty to reduce uncertainty to perpetuate uncertainty to reshape uncertainty to heighten uncertainty to express uncertainty to focus on uncertainty to face with uncertainty to think uncertainty to mention uncertainty to create uncertainty to include uncertainty to rate uncertainty to encounter uncertainty to disclose uncertainty to share uncertainty to cope with uncertainty to fill with uncertainty to perceive uncertainty to handle uncertainty to experience uncertainty to convey uncertainty to eschew uncertainty to use uncertainty to discuss uncertainty to acknowledge uncertainty to minimize uncertainty to be acquainted with uncertainty to eliminate uncertainty to indicate uncertainty to find uncertainty	acknowledged uncertainty. experienced uncertainty painful uncertainty more uncertainty clinical uncertainty genuine uncertainty scientific uncertainty less uncertainty greater uncertainty greatest uncertainty little uncertainty perceived uncertainty predictable uncertainty diagnostic uncertainty minimum uncertainty	awareness of uncertainty measure of uncertainty increase in uncertainty. aspect of uncertainty experience of uncertainty sociology of uncertainty uncertainty about uncertainty of life amount of uncertainty uncertainty of medicine element of uncertainty class of uncertainty study of uncertainty type of uncertainty reaction to uncertainty research on uncertainty kind of uncertainty bundle of uncertainty uncertainty of knowledge source of uncertainty uncertainty of subordination uncertainty of treatment uncertainty of response effect of uncertainty resolution of uncertainty denial of uncertainty disregard of uncertainty adoption to uncertainty preoccupation with uncertainty pattern of uncertainty tolerance of uncertainty consequence of uncertainty set of uncertainty level of uncertainty response to uncertainty sharing of uncertainty uncertainty outcome perception of uncertainty assessment of uncertainty stress from uncertainty implication of uncertainty condition of uncertainty nature of uncertainty degree of uncertainty be comfortable with the uncertainty. perturbed by uncertainty. bothered by uncertainty

Table 20*Verb, Adjective, and Concept Analysis between 1993 and 1997*

Author	Date	Verb	Adjective	Concept
Schoemaker	1993	to examine uncertainty to understand uncertainty to deal with uncertainty to specify uncertainty to identify uncertainty to obtain uncertainty to place uncertainty to inject uncertainty to introduce uncertainty to experience uncertainty to handle uncertainty to reduce uncertainty to handle uncertainty to cover uncertainty to feel uncertainty to analyze uncertainty to struggle with uncertainty to perceive uncertainty to provide uncertainty to concern uncertainty	increased uncertainty fundamental uncertainty perceived uncertainty future uncertainty subjective uncertainty low uncertainty high uncertainty deep uncertainty external uncertainty great uncertainty more uncertainty technological uncertainty less uncertainty political uncertainty economic uncertainty strategic uncertainty	response to uncertainty key uncertainty measure of uncertainty combination of uncertainty uncertainty bounding treatment of uncertainty with uncertainty uncertainty range degree of uncertainty outcome of uncertainty range of uncertainty decision-making under uncertainty incorporation of uncertainty level of uncertainty value of uncertainty sense of uncertainty uncertainty reduction uncomfortable with uncertainty consisting of uncertainty structure uncertainty
Howell Laufer Ballard	1993	to classify uncertainty to consider uncertainty to summarize uncertainty to show uncertainty to face uncertainty to resolve uncertainty to eliminate uncertainty to respond to uncertainty	significant uncertainty high uncertainty low uncertainty objective uncertainty maximum uncertainty considerable uncertainty initial uncertainty remaining uncertainty	degree of uncertainty uncertainty data uncertainty matrix level of uncertainty uncertainty of project uncertainty level range of uncertainty magnitude of uncertainty source of uncertainty response to uncertainty
Ellison	1996	to quantify uncertainty to ignore uncertainty to incorporate uncertainty to reflect uncertainty	quantifiable uncertainty ecological uncertainty little uncertainty initial uncertainty	amount of uncertainty lack of uncertainty decision based on uncertainty.
Wolfson, Kadane, Small	1996	to incorporate uncertainty	present uncertainty considerable uncertainty	decision-making under uncertainty presence of uncertainty
Ludwig	1996	to ignore uncertainty to take uncertainty into account to take account of uncertainty to account for uncertainty to characterize uncertainty to describe uncertainty	large uncertainty	consideration of uncertainty importance of uncertainty assessment of uncertainty consequence of uncertainty component of uncertainty decision-making under uncertainty underestimation of uncertainty
Healy	1997	to view uncertainty to define uncertainty to relegate uncertainty to capture uncertainty to focus on uncertainty to express uncertainty to convey uncertainty	major uncertainty pervasive uncertainty contextual uncertainty technical uncertainty manageable uncertainty conventional uncertainty	including uncertainty characterization of uncertainty representation of uncertainty scale uncertainty measure of uncertainty conception of uncertainty management of uncertainty regarding uncertainty conceptualization of uncertainty research on uncertainty framing of uncertainty interpretation of uncertainty diagnosis of uncertainty communication of uncertainty expression of uncertainty nature of uncertainty indication of uncertainty surrounding uncertainty use of uncertainty managing under uncertainty characterizing uncertainty parameter of uncertainty role of uncertainty

Table 21*Verb, Adjective, and Concept Analysis between 1998 and 1999*

Author	Date	Verb	Adjective	Concept
Sutcliffe, Zaheer	1998	to identify uncertainty to consider uncertainty to face uncertainty to view uncertainty to differentiate uncertainty to respond uncertainty to operationalize uncertainty to capture uncertainty to examine uncertainty to investigate uncertainty to conceptualize uncertainty to measure uncertainty to classify uncertainty to theorize uncertainty to focus on uncertainty to include uncertainty to eliminate uncertainty to take uncertainty into account to describe uncertainty to show uncertainty to indicate uncertainty to increase uncertainty to propose uncertainty to treat uncertainty to collapse uncertainty to decompose uncertainty to bear uncertainty to reduce uncertainty to distinguish uncertainty to develop uncertainty to enhance uncertainty to reflect uncertainty	primary uncertainty competitive uncertainty environmental uncertainty technological uncertainty increased uncertainty perceived uncertainty behavioral uncertainty secondary uncertainty high uncertainty exogenous uncertainty objective uncertainty much uncertainty low uncertainty	uncertainty in environment form of uncertainty supplier uncertainty concept of uncertainty response to uncertainty influence of uncertainty effect of uncertainty type of uncertainty source of uncertainty dimension of uncertainty multidimensionality of uncertainty prominence of uncertainty construct of uncertainty typology of uncertainty state uncertainty effect uncertainty response uncertainty related to uncertainty question of uncertainty definition of uncertainty operationalization of uncertainty uncertainty regarding problem of uncertainty customer uncertainty demand uncertainty level of uncertainty notion of uncertainty uncertainty regarding uncertainty information uncertainty conditions study of uncertainty uncertainty interaction measure of uncertainty regarding uncertainty volume uncertainty scope of uncertainty category of uncertainty continuum of uncertainty face of uncertainty construct of uncertainty understanding of uncertainty obverse of uncertainty
Engen, Bakke,Islam	1998	to take uncertainty into account		source of uncertainty estimate of uncertainty
Folta	1998	to distinguish uncertainty to decrease uncertainty to affect uncertainty to resolve uncertainty to reduce uncertainty to cope with uncertainty to expect uncertainty to create uncertainty to escalate uncertainty to capture uncertainty to convert uncertainty	technological uncertainty exogenous uncertainty endogenous uncertainty greater uncertainty high uncertainty	governance and uncertainty face of uncertainty increase in uncertainty kind of uncertainty degree of uncertainty case of uncertainty type of uncertainty resolution of uncertainty presence of uncertainty degree of uncertainty importance of uncertainty impact of uncertainty uncertainty surrounding measure of uncertainty effect of uncertainty period of uncertainty uncertainty measure controlling for uncertainty
Strand	1999	to illustrate uncertainty to disregard uncertainty to demonstrate uncertainty to put uncertainty into perspective to achieve uncertainty to control uncertainty to tolerate uncertainty	terminological uncertainty inherent uncertainty severe uncertainty minimal uncertainty permissible uncertainty present uncertainty constructive uncertainty total uncertainty	controlling for uncertainty source of uncertainty measurement uncertainty level of uncertainty element of uncertainty specification uncertainty converting uncertainty

Table 22*Verb, Adjective, and Concept Analysis between 1999 and 2002*

Author	Date	Verb	Adjective	Concept
Rappert	1999	to embrace uncertainty to shift uncertainty to face uncertainty to minimize uncertainty to cope with uncertainty to recognize uncertainty	basic uncertainty unavoidable uncertainty future uncertainty presented uncertainty	level of uncertainty condition of uncertainty circle of uncertainty uncertainty surrounding sand of uncertainty condition of uncertainty reduction of uncertainty rationality-in-uncertainty in relation to uncertainty set of uncertainty pervasiveness of uncertainty unavoidability of uncertainty situation of uncertainty negotiation of uncertainty emphasis on uncertainty
The Antidote	1999	to handle uncertainty	much uncertainty growing uncertainty	living with uncertainty face of uncertainty
Tirole	200	to show uncertainty		uncertainty about
Hughes	2001	to act in uncertainty to suggest uncertainty		face of uncertainty recognition of uncertainty
Gyawali, Dixit	2001	to discuss uncertainty to recognize uncertainty to cope with uncertainty to fear uncertainty	hydrological uncertainty associated uncertainty high uncertainty inherent uncertainty	uncertainty regarding scale of uncertainty source of uncertainty uncertainty in assumption replete with uncertainty multiplication of uncertainty nature of uncertainty condition of uncertainty
Timmermans, Angell	2001	to generate uncertainty to reduce uncertainty to alleviate uncertainty to control uncertainty to argue uncertainty to emphasize uncertainty to cope with uncertainty to avoid uncertainty to disregard uncertainty to create uncertainty to incorporate uncertainty to be disappointed with uncertainty to produce uncertainty to adopt uncertainty to dominate uncertainty to deal with uncertainty to diminish uncertainty to view uncertainty to move from uncertainty to experience uncertainty to manage uncertainty to engage with uncertainty	clinical uncertainty medical uncertainty various uncertainties many uncertainties specific uncertainty residual uncertainty real uncertainty grounded uncertainty novel uncertainty	updating of uncertainty management of uncertainty managing uncertainty study of uncertainty impact of uncertainty definition of uncertainty training for uncertainty problem of uncertainty writing on uncertainty update of uncertainty concept of uncertainty culture of uncertainty primacy of uncertainty source of uncertainty emphasis on uncertainty dominance of uncertainty research-based uncertainty form of uncertainty dealing with uncertainty understanding uncertainty uncertainty attitude discussion of uncertainty about uncertainty politics of uncertainty subset of uncertainty research on uncertainty uncertainty concept retooling of uncertainty
Regan, Colyvan, Burgman	2002	to classify uncertainty to include uncertainty to deal with uncertainty	pervasive uncertainty epistemic uncertainty linguistic uncertainty compounding uncertainty categorized uncertainty numerical uncertainty compounded uncertainty	treatment of uncertainty source of uncertainty type of uncertainty spectrum of uncertainty nature of uncertainty taxonomy of uncertainty kind of uncertainty uncertainty principle model uncertainty criteria of uncertainty

After creating the above-mentioned tables, “verb”, “adjective”, and “concept” with uncertainty transferred to excel program and obtained “verb”, “adjective”, and “concept” lists in excel format (see APPENDIX E Table57). 157 verbs with uncertainty, 87 adjectives with uncertainty, and 207 concepts with uncertainty are achieved. Then repeated verbs, adjective, and concepts are determined among them and listed as frequency list of the fifth decade between 1991 and 1999 as below (see Table 23).



Table 23*The Fifth Decade (1991-1999) Verb, Adjective, and Concept Frequency List*

	Verb	*Freq.	Adjective	*Freq.	Concept	*Freq.
1	to cope with uncertainty	4	high uncertainty	4	level of uncertainty	6
2	to face uncertainty	4	low uncertainty	3	degree of uncertainty	5
3	to handle uncertainty	4	objective uncertainty	3	measure of uncertainty	5
4	to reduce uncertainty	4	perceived uncertainty	3	response to uncertainty	5
5	to resolve uncertainty	4	technological uncertainty	3	source of uncertainty	5
6	to capture uncertainty	3	considerable uncertainty	2	decision-making under uncertainty	4
7	to describe uncertainty	3	exogenous uncertainty	2	condition of uncertainty	3
8	to eliminate uncertainty	3	future uncertainty	2	effect of uncertainty	3
9	to focus on uncertainty	3	greater uncertainty	2	resolution of uncertainty	3
10	to minimize uncertainty	3	increased uncertainty	2	type of uncertainty	3
11	to respond to uncertainty	3	initial uncertainty	2	amount of uncertainty	2
12	to take uncertainty into account	3	less uncertainty	2	assessment of uncertainty	2
13	to classify uncertainty	2	little uncertainty	2	case of uncertainty	2
14	to consider uncertainty	2	more uncertainty	2	consequence of uncertainty	2
15	to control uncertainty	2	much uncertainty	2	construct of uncertainty	2
16	to convey uncertainty	2	present uncertainty	2	controlling for uncertainty	2
17	to create uncertainty	2	subjective uncertainty	2	element of uncertainty	2
18	to define uncertainty	2			face of uncertainty	2
19	to distinguish uncertainty	2			importance of uncertainty	2
20	to examine uncertainty	2			increase in uncertainty	2
21	to experience uncertainty	2			kind of uncertainty	2
22	to express uncertainty	2			nature of uncertainty	2
23	to identify uncertainty	2			presence of uncertainty	2
24	to ignore uncertainty	2			range of uncertainty	2
25	to include uncertainty	2			regarding uncertainty	2
26	to incorporate uncertainty	2			representation of uncertainty	2
27	to indicate uncertainty	2			research on uncertainty	2
28	to perceive uncertainty	2			study of uncertainty	2
29	to understand uncertainty	2			uncertainty regarding	2
30	to view uncertainty	2			uncertainty surrounding	2

Note: *Frequency

The trend in handling uncertainty is parallel with the former decade in the fifth decade of analysis. The frequent usage of the level of uncertainty, the degree of uncertainty, and the type of uncertainty shows us trends in the handling of the taxonomy of uncertainty in different disciplines. The concept of uncertainty is coped with or

managed instead of ignored. Thus, the acceptance of the concept increases the possibilities of elimination by managing the concept.

5.1.6. The sixth decade analysis (2001-2010)

The sixth decade is settled between 2001 and 2010, which is the beginning of the new era. The internet, which connects millions of networks on our planet, has settled in every part of our lives, from fiber cables and satellites to our mobile phone at the beginning of the sixth decade (FOCUS, 2005). From the beginning of the 21st century, “with the exponential rate of technological change, time itself seems to be speeding up, bringing ‘the future’ ever close” (Gidley, 2017 pg.3). The increasing awareness about the concept of ‘futures’ direct to a global multiplication of departments in governments, corporate firms, and agencies with futures -oriented approach (Gidley, 2017). According to Sardar (2010), improvement of futures discourse on “conceptual methodological, and academic aspects” should be treated in a comprehensive way.

The sixth decade analysis of uncertainty handling covers years between 2001 and 2010 with twenty-three articles in this study (see Appendix C numbered as 51-73). Field division in the sixth decade as follows: “Futures” with thirteen articles, “Economics” with four articles, “Sociology” with three articles “Business Administration” with one article, “Ecology” with one article, and “Ethic” with one article. Analysis of related articles is done manually and resulted with four in last decade. One of these tables is in the sixth fifth decade analysis part, due to Table 22 covers articles both fifth and sixth decades and three tables subject to the sixth decade are below.

Table 24*Verb, Adjective, and Concept Analysis between 2002 and 2007*

Author	Date	Verb	Adjective	Concept
Mercer Wilter	2002			fear of uncertainty
Morgan	2002	to compound uncertainty to gauge uncertainty to understand uncertainty to reduce uncertainty to create uncertainty to show uncertainty to admit uncertainty to suggest uncertainty to mitigate uncertainty	greater uncertainty more uncertainty additional uncertainty increased uncertainty heightened uncertainty inherent uncertainty fundamental uncertainty attendant uncertainty less uncertainty	risk and uncertainty proxy for uncertainty source of uncertainty range of uncertainty under uncertainty uncertainty surrounding response to uncertainty onset of uncertainty regulatory uncertainty some of uncertainty degree of uncertainty resolving uncertainty
Cantin, Michel	2003	to treat uncertainty to use uncertainty to create uncertainty	strong uncertainty	uncertainty of data uncertainty in system category of uncertainty uncertainty concerning
Bedsworth, Lowenthal, Kastenberg	2004	to respond uncertainty to use uncertainty to highlight uncertainty to suppress uncertainty to ignore uncertainty to manage uncertainty to interpret uncertainty to maintain uncertainty to interpret uncertainty	fundamental uncertainty technical uncertainty primary uncertainty critical uncertainty	uncertainty in regulation interpretation of uncertainty attitude toward uncertainty uncertainty about future use of uncertainty
Artigiani	2005	to face uncertainty	inevitable uncertainty environmental uncertainty	leadership and uncertainty
Bradfield, Wright, Burt, Caims, Heijden	2005	to create uncertainty	significant uncertainty	degree of uncertainty state of uncertainty uncertainty around
Macgill, Sui	2005	to cope with uncertainty	methodological uncertainty statistical uncertainty personal uncertainty acknowledged uncertainty low uncertainty high uncertainty	quality of uncertainty presence of uncertainty openness to uncertainty degree of uncertainty decision under uncertainty situation of uncertainty management under uncertainty
Newman	2006	to face with uncertainty to address uncertainty	incredible uncertainty strong uncertainty inherent uncertainty	system uncertainty uncertainty in process
Börgeson, Höjer, Dreborg, Ekvall, Finnveden	2006	to cope with uncertainty to specify uncertainty	structural uncertainty quantified uncertainty	quantification of uncertainty uncertainty in data
Peat	2007			level of uncertainty
Hoffman	2007	to master uncertainty to exhibit uncertainty to overcome uncertainty to consider uncertainty to reduce uncertainty to shape uncertainty to face uncertainty to resolve uncertainty to minimize uncertainty	exogenous uncertainty strategic uncertainty environmental uncertainty high uncertainty technological uncertainty accompanying uncertainty regulative uncertainty competitive uncertainty perceived uncertainty endogenous uncertainty less uncertainty low uncertainty potential uncertainty increasing uncertainty diminishing uncertainty	state of uncertainty problem of uncertainty market uncertainty extent of uncertainty amount of uncertainty condition of uncertainty influence of uncertainty degree of uncertainty decrease of uncertainty increase in uncertainty change in uncertainty dimension of uncertainty

Table 25*Verb, Adjective, and Concept Analysis between 2007 and 2009*

Author	Date	Verb	Adjective	Concept
Sollie	2007	to study uncertainty to reflect upon uncertainty to concern with uncertainty to trig uncertainty to incorporate uncertainty to account for uncertainty to take up uncertainty to come with uncertainty to conceptualize uncertainty to recognize uncertainty to understand uncertainty to take uncertainty to augment uncertainty to assess uncertainty to reduce uncertainty to contribute to uncertainty to entail uncertainty to involve uncertainty to yield to uncertainty to manifest uncertainty to identify uncertainty to deal with uncertainty to explicate uncertainty to clarify uncertainty to prevent uncertainty to investigate uncertainty to perceive uncertainty to take uncertainty	distinguished uncertainty paramount uncertainty reducible uncertainty inherent uncertainty epistemological uncertainty ontological uncertainty substantive uncertainty weak uncertainty internal uncertainty secondary uncertainty external uncertainty stochastic uncertainty fundamental uncertainty strong uncertainty random uncertainty primary uncertainty aleatory uncertainty procedural uncertainty statistical uncertainty technical uncertainty accumulated uncertainty technological uncertainty competitive uncertainty political uncertainty greater uncertainty underappreciated uncertainty unproblematic uncertainty	focus on uncertainty concept of uncertainty typology of uncertainty analysis of uncertainty incorporation of uncertainty under uncertainty uncertainty management issue of uncertainty conceptualization of uncertainty uncertainty surrounding fact of uncertainty class of uncertainty nature of uncertainty level of uncertainty source of uncertainty location of uncertainty picture of uncertainty factor of uncertainty example of uncertainty fraught with uncertainty surrounded by uncertainty study of uncertainty importance of uncertainty relevance of uncertainty uncertainty of development dimension of uncertainty presence of uncertainty situation of uncertainty type of uncertainty knowledge uncertainty variability uncertainty uncertainty of something scenario uncertainty identification of uncertainty uncertainty in system locus of uncertainty uncertainty in theory model uncertainty structure uncertainty parameter uncertainty outcome uncertainty resource uncertainty uncertainty regarding consumer uncertainty supplier uncertainty uncertainty about uncertainty of ethics uncertainty of future feature of uncertainty nuances of uncertainty role of uncertainty evaluation of uncertainty
Bloom	2009	to analyze uncertainty to introduce uncertainty to evaluate uncertainty to separate out uncertainty to underly uncertainty to measure uncertainty	higher uncertainty time-varying uncertainty increased uncertainty macro uncertainty total uncertainty low uncertainty high uncertainty time changing uncertainty current uncertainty long-run uncertainty constant uncertainty pure uncertainty falling uncertainty distinct uncertainty estimated uncertainty larger uncertainty high-level of uncertainty micro uncertainty	uncertainty shock proxy of uncertainty burst of uncertainty measure of uncertainty increase in uncertainty uncertainty about introducing uncertainty example of uncertainty policy uncertainty consumption uncertainty key uncertainty period of uncertainty uncertainty approach impact of uncertainty demand uncertainty productivity uncertainty effect of uncertainty baseline uncertainty uncertainty process

Table 26*Verb, Adjective, and Concept Analysis between 2009 and 2011*

Author	Date	Verb	Adjective	Concept
Wilson	2009	to dissipate uncertainty to argue uncertainty to discuss uncertainty to conceptualize uncertainty to face uncertainty to treat uncertainty to interpret uncertainty to distinguish uncertainty to stem from uncertainty	fundamental uncertainty low uncertainty high uncertainty procedural uncertainty substantive uncertainty strong uncertainty weak uncertainty epistemological uncertainty ontological uncertainty epistemic uncertainty	concept of uncertainty condition of uncertainty kind of uncertainty uncertainty theory source of uncertainty uncertainty concept inverse of uncertainty degree of uncertainty about uncertainty aspect of uncertainty definition of uncertainty case of uncertainty under uncertainty
Walker, Marchau, Swanson	2010	to define uncertainty to associate with uncertainty to take uncertainty into account to ignore uncertainty to accept uncertainty to understand uncertainty to manage uncertainty to eliminate uncertainty to deal with uncertainty to capture of uncertainty to model uncertainty to involve uncertainty to represent uncertainty to navigate uncertainty to face uncertainty to underly uncertainty to cope with uncertainty	deep uncertainty recognized uncertainty unknowable uncertainty inadequate uncertainty major uncertainty	about uncertainty range of uncertainty level of uncertainty case of uncertainty measurement uncertainty scale of uncertainty emphasis on uncertainty higher level of uncertainty condition of uncertainty approach to uncertainty allowance for uncertainty acceptance of uncertainty handling uncertainty making decision under uncertainty
Swanson et al.	2010	to cope with uncertainty to live with uncertainty to deal with uncertainty to introduce uncertainty to underly uncertainty	deep uncertainty inevitable uncertainty relative uncertainty anticipated uncertainty inherent uncertainty	context of uncertainty uncertainty surrounding management under uncertainty under uncertainty condition of uncertainty type of uncertainty level of uncertainty
Varum, Melo	2010	to deal with uncertainty to recognize uncertainty to consider uncertainty to face uncertainty	high uncertainty critical uncertainty	identifying uncertainty uncertainty surrounding decision-making under uncertainty uncertainty of future
Elahi	2011	to denote uncertainty to manage uncertainty to display uncertainty to assess uncertainty to quantify uncertainty to recognize uncertainty to explore uncertainty	intractable uncertainty indeterminate uncertainty inherent uncertainty institutional uncertainty scientific uncertainty future uncertainty	aware of uncertainty managing uncertainty face of uncertainty level of uncertainty response to uncertainty acknowledgement of uncertainty admitting uncertainty opt for uncertainty denial of uncertainty nature of uncertainty issue of uncertainty uncertainty analysis approach to uncertainty extent of uncertainty context of uncertainty
Hall, Matas, Silvestre, Martin	2011	to struggle with uncertainty to explore uncertainty to solve uncertainty to create uncertainty to categorize uncertainty to focus on uncertainty to summarize uncertainty to reduce uncertainty to deal with uncertainty to overcome uncertainty to understand uncertainty	social uncertainty commercial uncertainty innovative uncertainty technological uncertainty major uncertainty political uncertainty economic uncertainty organizational uncertainty cognitive uncertainty considerable uncertainty	managing uncertainty literature on uncertainty discussion of uncertainty degree of uncertainty type of uncertainty innovation uncertainty market uncertainty dimension of uncertainty emphasis on uncertainty legitimacy uncertainty response to uncertainty prompting for uncertainty uncertainty analysis

After creating the above-mentioned tables, “verb”, “adjective”, and “concept” with uncertainty transferred to excel program and obtained “verb”, “adjective”, and “concept” lists in excel format (see APPENDIX E Tables). 138 verbs with uncertainty, 130 adjectives with uncertainty, and 225 concepts with uncertainty are obtained. Then repeated verbs, adjective, and concepts are determined among them and listed as frequency list of the sixth decade between 2001 and 2010 as below (see Table 27).

Table 27

The Sixth Decade (2001-2010) Verb, Adjective, and Concept Frequency List

	Verb	Freq.	Adjective	Freq.	Concept	Freq.
1	to cope with uncertainty	6	high uncertainty	6	condition of uncertainty	7
2	to deal with uncertainty	6	inherent uncertainty	5	source of uncertainty	6
3	to face uncertainty	6	fundamental uncertainty	4	degree of uncertainty	5
4	to create uncertainty	4	low uncertainty	4	level of uncertainty	5
5	to reduce uncertainty	4	strong uncertainty	4	uncertainty surrounding	5
6	to interpret uncertainty	3	competitive uncertainty	2	uncertainty about	4
7	to manage uncertainty	3	critical uncertainty	2	under uncertainty	4
8	to recognize uncertainty	3	deep uncertainty	2	about uncertainty	3
9	to take uncertainty	3	epistemological uncertainty	2	concept of uncertainty	3
10	to underly uncertainty	3	greater uncertainty	2	emphasis on uncertainty	3
11	to understand uncertainty	3	increased uncertainty	2	situation of uncertainty	3
12	to argue uncertainty	2	ontological uncertainty	2	type of uncertainty	3
13	to conceptualize uncertainty	2	statistical uncertainty	2	case of uncertainty	2
14	to consider uncertainty	2	technical uncertainty	2	definition of uncertainty	2
15	to discuss uncertainty	2	technological uncertainty	2	dimension of uncertainty	2
16	to ignore uncertainty	2	weak uncertainty	2	example of uncertainty	2
17	to incorporate uncertainty	2			face of uncertainty	2
18	to introduce uncertainty	2			impact of uncertainty	2
19	to involve uncertainty	2			increase in uncertainty	2
20	to show uncertainty	2			kind of uncertainty	2
21	to suggest uncertainty	2			management under uncertainty	2
22	to treat uncertainty	2			model uncertainty	2
23	to use uncertainty	2			nature of uncertainty	2
24					presence of uncertainty	2
25					problem of uncertainty	2
26					range of uncertainty	2
27					scale of uncertainty	2
28					state of uncertainty	2
29					study of uncertainty	2
30					uncertainty in system	2
31					uncertainty of future	2
32					uncertainty regarding	2

Note: *Frequency

Timmermans & Angel (2001) state that, the approaches the physicians progress for “coping with uncertainty” shows the ways to them, to ignore and avoid uncertainty. Walker et al. (2010) explain that ignoring uncertainty can have huge negative results for people, countries, or policymakers who have an advantage in reducing such possibilities. Because, ignoring uncertainty causes limited corrective achievements in the future, due to weak policies, skipped opportunities, unproductive utilization of sources (Walker et al., 2010).

5.1.7. Seventh decade analysis (2011-2019)

The period which we live in is crucial, and the experiences and practices we deal with are multipart, difficult, and global (Gidley, 2017). Scientific and technological transformations are among the main issues in this period. Developments in “Artificial Intelligence” (AI) is the center piece of advances in technology. An interview is conducted with an AI, called GPT 2 which is an “unsupervised language model”, by Tom Standage, deputy editor, *The World in 2020* (The Economist, 2020). One of the questions by Tom Standage and answers by GPT 2 is below:

“Q: Which technologies are worth watching in 2020? A: I would say it is hard to narrow down the list. The world is full of disruptive technologies with real and potentially huge global impacts. The most important is artificial intelligence, which is becoming exponentially more powerful. There is also the development of self-driving cars. There is a lot that we can do with artificial intelligence to improve the world (The Economist, *The World in 2020*, pg. 133).

However, artificial intelligence studies were started with smart robots’ studies in 1950’s, whereas “Industry 4.0” is put forward as a concept expressing the fourth industrial revolution in Germany as of 2011 (Öztemel, 2018). Industry 4.0 is defined as

a functioning digitalization progress today, due to having purpose on succeeding every step of production with digital systems (Öztemel, 2018).

“Augmented Reality” (AR), “Big Data”, Cloud Computing”, “Deep Learning”, “Machine Learning” and “Internet of Things” are concepts which are involved in Industry 4.0 and being heard more in recent years, as well. “Internet of Things” (IOT), as an example, is anticipated in terms of business as: “With ubiquitous sensors and universal connectivity, punters have been told, the IOT will transform ordinary workshops into smart factories” (The Economist, The World in 2020, pg. 109). “The two essential technologies speeding the IOT’s arrival, inexpensive sensors and super-fast networking kit, are advancing fast” (The Economist, The World in 2020, pg. 109).

How the future can be predicted while all this is happening, is the critical point in terms of forward thinking. “The future, by definition, cannot be experienced directly, but only through images, thought, feelings, and the multiple ways these are subsequently expressed in outer world” (Slaughter, 2018 pg.444). Consequently, main issue is making observable the concealed phenomenon regarding futures (Candy & Kornet, 2019).

In today’s futures studies, tendency to pluralize the futures results as expanding the future perception for anticipating and creating optional futures (Gidley, 2017). For that reason, different scenarios planning according to anticipations of alternative futures are noticed in terms of foresight studies. Anticipating futures under uncertainty is significant phenomena in decision making management and therefore changes in handling uncertainty become critical.

The Contemporary business faces complex tasks described with a “high degree of uncertainty” in terms of the latest technologies, environmental issues, and global

epidemics (Hauge & Barwell, 2017). Funtowicz and Ravetz (1993; cited in Hauge & Barwell, 2017) discuss that these complex issues need “post-normal science” characterized with resolving puzzling issues in terms of “high degree certainty”.

The Last decade analysis of uncertainty handling covers years between 2011 and 2019 with twenty-eight articles in this study (see Appendix C numbered as 74-101). Field division in last decade as follows: “Futures” with fourteen articles, “Engineering” with five articles, “Sociology” with three articles “Business Administration” with two articles, “Economics” with two articles, “History” with one article, and “Psychology” with one article. “Verb”, ‘Adjective’, and ‘Concept’ which are used with uncertainty are evaluated for coming to result as “how we think about and respond” ((Smithson, 1988) to uncertainty and if there is a paradigmatic shift, or not in twenty-eight articles. Analysis of related articles is done manually and resulted with eight tables in last decade. One of these tables is in the sixth decade analysis part, due to table 26 covers articles both sixth and seventh decades and seven tables subject to last decade are below.

Table 28*Verb, Adjective, and Concept Analysis between 2011 and 2012*

Author	Date	Verb	Adjective	Concept
Fox	2011	to reduce uncertainty to mediate uncertainty	ontological uncertainty	factor to uncertainty uncertainty management significance of uncertainty scope of uncertainty
Cerreia-Vioglio et al.,	2011	to characterize uncertainty to take into account uncertainty to clarify uncertainty	more uncertainty minimal uncertainty maximal uncertainty prior uncertainty subjective uncertainty separable uncertainty most uncertainty	uncertainty aversion choice under uncertainty decision making under uncertainty presence of uncertainty representation for uncertainty degree of uncertainty under uncertainty specification of uncertainty form of uncertainty toward uncertainty sources of uncertainty state uncertainty
Tapinos	2011	to address uncertainty to cluster uncertainty to reduce uncertainty to deal with uncertainty to conceptualize uncertainty to explain uncertainty to consider uncertainty to minimize uncertainty	macro uncertainty environmental uncertainty perceived uncertainty external uncertainty social uncertainty natural uncertainty internal uncertainty	assessment of uncertainty source of uncertainty factor of uncertainty background of uncertainty framework for uncertainty market uncertainty industry uncertainty credit uncertainty definition of uncertainty identification of uncertainty level of uncertainty
Blau	2011	to reduce uncertainty to report uncertainty to highlight uncertainty to see uncertainty to entail uncertainty to tackle uncertainty to address uncertainty to deal with uncertainty to denote uncertainty to contain uncertainty to criticize uncertainty to express uncertainty to voice uncertainty to indicate uncertainty to take uncertainty	inevitable uncertainty subjective uncertainty objective uncertainty historical uncertainty statistical uncertainty	basis of uncertainty account of uncertainty cause of uncertainty accepting uncertainty level of uncertainty estimate of uncertainty degree of uncertainty indication of uncertainty uncertainty about precision of uncertainty room for uncertainty idea of uncertainty uncertainty of conclusion ignoring uncertainty
Dong, Hayes	2012	to provide uncertainty to recognize uncertainty to manage uncertainty to evaluate uncertainty to describe uncertainty to contribute to uncertainty to express uncertainty to improve uncertainty	more uncertainty high uncertainty	uncertainty visualization decision making under uncertainty impact of uncertainty representation of uncertainty awareness of uncertainty uncertainty overlaps identification of uncertainty degree of uncertainty sense of uncertainty value of uncertainty
Rast, Hogg, Giessner	2012	to show uncertainty to motivate uncertainty to reduce uncertainty to predict uncertainty to focus on uncertainty	conceptual uncertainty low uncertainty high uncertainty increasing uncertainty political uncertainty economic uncertainty social uncertainty	self-uncertainty role of uncertainty time of uncertainty uncertainty of struggle task uncertainty impact of uncertainty effect of uncertainty function of uncertainty

Table 29*Verb, Adjective, and Concept Analysis between 2012 and 2013*

Author	Date	Verb	Adjective	Concept
Hayes	2012	to provide uncertainty to recognize uncertainty to manage uncertainty to propose uncertainty to call uncertainty to respect to uncertainty to represent uncertainty to visualize uncertainty to show uncertainty to resolve uncertainty to display uncertainty to draw uncertainty to describe uncertainty to weigh uncertainty to contribute uncertainty to demonstrate uncertainty to express uncertainty to improve uncertainty	relative uncertainty high uncertainty	uncertainty visualization aware of uncertainty decision making under uncertainty aspect of uncertainty impact of uncertainty version of uncertainty uncertainty representation representation of uncertainty awareness of uncertainty uncertainty overlaps identification of uncertainty evaluation of uncertainty degree of uncertainty sense of uncertainty value of uncertainty effect of uncertainty
Blockley	2013	to express uncertainty to remark uncertainty to include uncertainty to admit uncertainty	aleatoric uncertainty epistemic uncertainty random uncertainty residual uncertainty erratic uncertainty	analyzing uncertainty analysis of uncertainty categorization of uncertainty uncertainty measure characterization of uncertainty meaning of uncertainty parameter of uncertainty characteristic of uncertainty aspect of uncertainty expression of uncertainty kind of uncertainty
Kramer, Meisenbach, Hansen	2013	to face uncertainty to manage uncertainty to experience uncertainty to examine uncertainty to influence uncertainty to respond to uncertainty to reduce uncertainty to increase uncertainty to explore uncertainty to role uncertainty to include uncertainty to facilitate uncertainty	organizational uncertainty	uncertainty management uncomfortable with uncertainty type of uncertainty target of uncertainty managing uncertainty level of uncertainty outcome of uncertainty conceptualization of uncertainty implication for uncertainty
Wallentin, Car	2013	to focus uncertainty to interpret uncertainty to handle uncertainty to identify uncertainty to assess uncertainty to understand uncertainty to discuss uncertainty to define uncertainty to decompose uncertainty to measure uncertainty to overcome uncertainty to quantify uncertainty to address uncertainty to determine uncertainty to reduce uncertainty to estimate uncertainty	unknown uncertainty epistemic uncertainty spatial uncertainty conceptual uncertainty high uncertainty parameter uncertainty small uncertainty	framework for uncertainty source of uncertainty typology of uncertainty concept of uncertainty factor of uncertainty amount of uncertainty approach for uncertainty aspect of uncertainty quantification of uncertainty consideration of uncertainty range of uncertainty analysis uncertainty degree of uncertainty formalization uncertainty parameterization uncertainty validation uncertainty model uncertainty conceptualization uncertainty uncertainty awareness

Table 30*Verb, Adjective, and Concept Analysis 2013*

Author	Date	Verb	Adjective	Concept
Grubic, Varga &Varga	2013	to assess uncertainty to deal with uncertainty to differentiate uncertainty to reduce uncertainty to increase uncertainty to reveal uncertainty to understand uncertainty to conceptualize uncertainty to determine uncertainty to take uncertainty to ignore uncertainty to identify uncertainty to map onto uncertainty to evaluate uncertainty	indeterminable uncertainty intractable uncertainty parameter uncertainty epistemic uncertainty variability uncertainty residual uncertainty potential uncertainty	feature of uncertainty dimension of uncertainty behind uncertainty wealth of uncertainty location of uncertainty level of uncertainty nature of uncertainty improvement in uncertainty reduction in uncertainty measure of uncertainty variety of uncertainty uncertainty analysis identification of uncertainty placement of uncertainty typology of uncertainty definition of uncertainty classification of uncertainty
Ross, Booker, Montoya	2013	to identify uncertainty to combine uncertainty to classify uncertainty to characterize uncertainty to quantify uncertainty to manage uncertainty to understand uncertainty, to address uncertainty to assess uncertainty to describe uncertainty to consider uncertainty to think about uncertainty to impute uncertainty to produce uncertainty to manifest uncertainty to associate with uncertainty to involve uncertainty to reduce uncertainty to express uncertainty to choose uncertainty to affect uncertainty to suppose uncertainty to arise uncertainty to measure uncertainty to determine uncertainty to robust uncertainty to contribute uncertainty to generate uncertainty to call uncertainty	total uncertainty relevant uncertainty mathematical uncertainty inference uncertainty less uncertainty parametric uncertainty quantified uncertainty compared uncertainty all uncertainty no uncertainty maximum uncertainty probabilistic uncertainty scaling uncertainty proxy uncertainty analogical uncertainty non-numeric uncertainty largest uncertainty	development in uncertainty uncertainty assessment uncertainty management uncertainty quantification managing uncertainty kind of uncertainty description of uncertainty assessment of uncertainty form of uncertainty quantification of uncertainty characterization of uncertainty critical thinking about uncertainty history of uncertainty issue of uncertainty influence of uncertainty amount of uncertainty expression of uncertainty source of uncertainty standardization of uncertainty about uncertainty uncertainty inventory degree of uncertainty stage of uncertainty format of uncertainty construction of uncertainty under uncertainty uncertainty combination level of uncertainty condition on uncertainty extreme of uncertainty case of uncertainty measure of uncertainty type of uncertainty aware of uncertainty change in uncertainty region of uncertainty area of uncertainty thought of uncertainty
Haegeman, Marinelli, Scapolo, Ricci, Sokolov	2013	to address uncertainty to understand uncertainty to deal with uncertainty to constrain uncertainty to pay attention uncertainty to assess uncertainty	less uncertainty intrinsic uncertainty reduced uncertainty	level of uncertainty

Table 31*Verb, Adjective, and Concept Analysis between 2014-2015*

Author	Date	Verb	Adjective	Concept
Tonn, Stiefel	2014	to detail uncertainty to estimate uncertainty to vary uncertainty to react to uncertainty to confuse uncertainty to see uncertainty to increase uncertainty	represented uncertainty low uncertainty large uncertainty inherent uncertainty much uncertainty more uncertainty high uncertainty bad uncertainty good uncertainty little uncertainty	pattern of uncertainty magnitude of uncertainty modelling uncertainty uncertainty representation uncertainty situations level of uncertainty degree of uncertainty amount of uncertainty
Bradley, Drechsler	2014	to characterize uncertainty to reduce uncertainty to express uncertainty to capture uncertainty to face uncertainty to enumerate uncertainty to classify uncertainty to consider uncertainty to transform uncertainty to investigate uncertainty to decompose uncertainty to decide uncertainty to call uncertainty to present uncertainty to resolve uncertainty to apply uncertainty to reflect uncertainty to recognize uncertainty to claim uncertainty to correspond uncertainty to examine uncertainty to increase uncertainty to eliminate uncertainty to take on uncertainty to convert uncertainty to represent uncertainty to quantify uncertainty to suppose uncertainty to ignore uncertainty to strip uncertainty to experience uncertainty to name uncertainty to view uncertainty to treat uncertainty to measure uncertainty to handle uncertainty to embody uncertainty to term uncertainty to rise uncertainty to capture uncertainty to understand uncertainty	ethical uncertainty empirical uncertainty great uncertainty reducible uncertainty basic uncertainty high uncertainty modal uncertainty normative uncertainty factual uncertainty counterfactual uncertainty severe uncertainty mild uncertainty total uncertainty subjective uncertainty pure uncertainty high uncertainty irreducible uncertainty	type of uncertainty form of uncertainty nature of uncertainty measuring uncertainty managing uncertainty concept of uncertainty view on uncertainty severity of uncertainty kind of uncertainty treatment of uncertainty taxonomy of uncertainty resolution of uncertainty reduction of uncertainty property of uncertainty classification of uncertainty dimension to uncertainty object of uncertainty case of uncertainty role of uncertainty element of uncertainty uncertainty aversion presence of uncertainty measure of uncertainty value uncertainty state uncertainty deal of uncertainty
Parker, Risbey	2015	to indicate uncertainty to assess uncertainty to report uncertainty to discuss uncertainty to mean uncertainty to concern with uncertainty to estimate uncertainty to consider uncertainty to focus on uncertainty to represent uncertainty to quantify uncertainty to recognize uncertainty to judge uncertainty to characterize uncertainty	negligible uncertainty non-negligible uncertainty current uncertainty greater uncertainty less uncertainty total uncertainty parameter uncertainty structural uncertainty produced uncertainty deeper uncertainty probabilistic uncertainty estimated uncertainty reduced uncertainty second-order uncertainty	uncertainty assessment requirement for uncertainty pitfall of uncertainty representation of uncertainty source of uncertainty scenario uncertainty condition uncertainty

Table 32*Verb, Adjective, and Concept Analysis 2016*

Author	Date	Verb	Adjective	Concept
Derbyshire	2016	to increase uncertainty to understand uncertainty to conceptualize uncertainty to recognize uncertainty to deal with uncertainty to consider uncertainty to reconfirm uncertainty to face uncertainty to ameliorate uncertainty to arise uncertainty to imply uncertainty to bring about uncertainty to lead uncertainty to mitigate uncertainty	fundamental uncertainty double uncertainty compounded uncertainty absolute uncertainty irremediable uncertainty inherent uncertainty radical uncertainty real uncertainty	origin of uncertainty decision making under uncertainty circumstance of uncertainty awareness of uncertainty degree of uncertainty
Veenman, Leroy	2016	to handle uncertainty to deal with uncertainty to ignore uncertainty to mention uncertainty to decrease uncertainty to reduce uncertainty to embrace uncertainty to range uncertainty to address uncertainty to argue uncertainty to lay out uncertainty to accept uncertainty to acknowledge uncertainty to avoid uncertainty to limit uncertainty to stress uncertainty to point at uncertainty to resolve uncertainty to eclipse uncertainty to open up for uncertainty to discuss uncertainty to reference to uncertainty to consider uncertainty to refer uncertainty to introduce uncertainty to emphasize uncertainty to present uncertainty	long term uncertainty continued uncertainty temporary uncertainty intrinsic uncertainty cognitive uncertainty normative uncertainty considerable uncertainty large uncertainty associated uncertainty key uncertainty major uncertainty	concept of uncertainty uncertainty debate level of uncertainty attitude towards uncertainty in terms of uncertainty discussion on uncertainty room for uncertainty
Hauge, Barwell	2016	to focus on uncertainty to deal with uncertainty to discuss uncertainty to consider uncertainty to examine uncertainty to associate with uncertainty to open to uncertainty to embed uncertainty to arise uncertainty to handle uncertainty to distinguish uncertainty to illustrate uncertainty to discuss uncertainty to engage with uncertainty to characterize uncertainty to perceive uncertainty to cope with uncertainty to introduce uncertainty to construct uncertainty to highlight uncertainty to understand uncertainty to recognize uncertainty to present uncertainty to be aware of uncertainty to define uncertainty	low uncertainty technological uncertainty methodological uncertainty epistemic uncertainty specific uncertainty technical uncertainty large uncertainty small uncertainty associated uncertainty irreducible uncertainty dimensional uncertainty	characteristic of uncertainty issue of uncertainty degree of uncertainty treatment of uncertainty place of uncertainty understanding of uncertainty topic of uncertainty emphasis on uncertainty attention to uncertainty sort of uncertainty dimension of uncertainty quantification of uncertainty uncertainty measurement significance of uncertainty aspect of uncertainty image of uncertainty importance of uncertainty impact of uncertainty negotiation on uncertainty type of uncertainty quality of uncertainty awareness of uncertainty

Table 33*Verb, Adjective, and Concept Analysis between 2016-2017*

Author	Date	Verb	Adjective	Concept
Sardar, Sweeney	2016	to cope with uncertainty to model uncertainty to manage uncertainty to striate uncertainty to present uncertainty to reduce uncertainty to generate uncertainty to transform into uncertainty to situate uncertainty to increase uncertainty to deal with uncertainty to grasp uncertainty to add uncertainty to entrench uncertainty to understand uncertainty to neglect uncertainty to highlight uncertainty to analyze uncertainty to frame uncertainty to map uncertainty to draw attention to uncertainty	surface uncertainty resultant uncertainty shallow uncertainty deep uncertainty unique uncertainty	result uncertainty away with uncertainty force of uncertainty appreciation of uncertainty type of uncertainty variety of uncertainty typology of uncertainty level of uncertainty
Magruk	2017	to reduce uncertainty to increase uncertainty to minimize uncertainty to take into account uncertainty to reflect uncertainty to anticipate uncertainty to manage uncertainty to show uncertainty to distinguish uncertainty to test uncertainty to deal with uncertainty to assume uncertainty	inherent uncertainty accompanying uncertainty low uncertainty high uncertainty interpreted uncertainty future uncertainty greater uncertainty residual uncertainty simple uncertainty accumulated uncertainty independent uncertainty	concept of uncertainty degree of uncertainty study of uncertainty research of uncertainty feeling of uncertainty situation of uncertainty barrier of uncertainty phenomenon of uncertainty uncertainty of management occurrence of uncertainty significance of uncertainty term of uncertainty problem of uncertainty cone of uncertainty condition of uncertainty state of uncertainty scope of uncertainty type of uncertainty process of uncertainty effect of uncertainty identification of uncertainty analysis of uncertainty aspect of uncertainty context of uncertainty definition of uncertainty
Kovacic	2017	to include uncertainty to communicate uncertainty to assess uncertainty to reduce uncertainty to adapt to uncertainty to create uncertainty	low uncertainty high uncertainty irreducible uncertainty epistemological uncertainty	level of uncertainty uncertainty assessment source of uncertainty mismanagement of uncertainty
Derbyshire	2017	to estimate uncertainty to understate uncertainty to take account of uncertainty to reduce uncertainty to deal with uncertainty to consider uncertainty to refer uncertainty to engage with uncertainty to discuss uncertainty to underplay uncertainty to face uncertainty to recognize uncertainty to allocate uncertainty to exacerbate uncertainty to tame uncertainty	irreducible uncertainty fundamental uncertainty tamable uncertainty non-probabilistic uncertainty indistinguishable uncertainty heightened uncertainty increased uncertainty intrinsic uncertainty full uncertainty radical uncertainty deep uncertainty genuine uncertainty	downplaying of uncertainty characteristic of uncertainty reduction of uncertainty uncertainty of future importance of uncertainty theme of uncertainty denial of uncertainty acknowledgement of uncertainty absence of uncertainty realm of uncertainty form of uncertainty decision making under uncertainty

Table 34*Verb, Adjective, and Concept Analysis between 2018-2019*

Author	Date	Verb	Adjective	Concept
Van Dorsser, Walker, Taneja, Marchau	2018	to use uncertainty to address uncertainty to reduce uncertainty to deal with uncertainty to describe uncertainty to arise uncertainty to classify uncertainty to define uncertainty to represent uncertainty to categorize uncertainty to handle uncertainty	important uncertainty perceived uncertainty certain uncertainty stochastic uncertainty real uncertainty epistemic uncertainty complete uncertainty total uncertainty recognized uncertainty deep uncertainty surface uncertainty shallow uncertainty	uncertainty typology level of uncertainty uncertainty regarding uncertainty surrounding treatment of uncertainty notion of uncertainty decision making under uncertainty face of uncertainty aspect of uncertainty nature of uncertainty location of uncertainty scale of uncertainty view of uncertainty
Andersson, Tornberg	2018	to grow uncertainty to shroud uncertainty to deal with uncertainty to rise uncertainty to minimize uncertainty to characterize uncertainty	ontological uncertainty deep uncertainty substantial uncertainty intrinsic uncertainty multi-faceted uncertainty	sources of uncertainty
Sykes, Bell, Dissanayake	2019	to drive uncertainty to analyze uncertainty to review uncertainty to identify uncertainty to plan uncertainty to discuss uncertainty to describe uncertainty to quantify uncertainty to investigate uncertainty to contribute uncertainty to reduce uncertainty to determine uncertainty to define uncertainty to manage uncertainty to perform uncertainty to uncover uncertainty to contribute uncertainty	structural uncertainty stochastic uncertainty technical uncertainty multi-faceted uncertainty critical uncertainty major uncertainty significant uncertainty generic uncertainty	result of uncertainty cause of uncertainty finding from uncertainty understanding of uncertainty review of uncertainty managing uncertainty nature of uncertainty class of uncertainty taxonomy of uncertainty comment on uncertainty category of uncertainty scope of uncertainty driver of uncertainty component of uncertainty source of uncertainty uncertainty analysis view of uncertainty planning uncertainty
Meyer	2019	to reduce uncertainty to exist uncertainty		

After creating the above mentioned eight tables, “verb”, “adjective”, and “concept” with uncertainty transferred to excel program and obtained “verb”, “adjective”, and “concept” lists in excel format (see APPENDIX E Tables ...). 376 verbs with uncertainty, 215 adjectives with uncertainty, and 354 concepts with uncertainty are obtained. Then repeated minimum 4 times and more verbs, adjective, and concepts are determined among them and listed as frequency list of seventh decade between 2011 and 2019 as below (see Table 35).

Table 35*The Seventh Decade (2011-2019) Verb, Adjective, and Concept Frequency List*

	Verb	Freq.	Adjective	Freq.	Concept	Freq.
1	to reduce uncertainty	18	high uncertainty	9	level of uncertainty	12
2	to deal with uncertainty	13	deep uncertainty	5	degree of uncertainty	11
3	to understand uncertainty	9	epistemic uncertainty	5	source of uncertainty	8
4	to consider uncertainty	8	low uncertainty	5	type of uncertainty	7
5	to manage uncertainty	8	inherent uncertainty	4	aspect of uncertainty decision making under uncertainty	6
6	to recognize uncertainty	8	intrinsic uncertainty irreducible uncertainty	4	managing uncertainty	6
7	to address uncertainty	7		4	analysis of uncertainty	5
8	to assess uncertainty	7	large uncertainty	4	identification of uncertainty	5
9	to discuss uncertainty	7	total uncertainty	4	nature of uncertainty	5
10	to increase uncertainty	7			uncertainty management	5
11	to characterize uncertainty	6			awareness of uncertainty	4
12	to express uncertainty	6			concept of uncertainty	4
13	to quantify uncertainty	6			dimension of uncertainty	4
14	to contribute uncertainty	5			form of uncertainty	4
15	to describe uncertainty	5			impact of uncertainty	4
16	to focus on uncertainty	5			meaning of uncertainty	4
17	to handle uncertainty	5			representation for uncertainty	4
18	to arise uncertainty	4			uncertainty analysis	4
19	to define uncertainty	4				
20	to determine uncertainty	4				
21	to estimate uncertainty	4				
22	to face uncertainty	4				
23	to identify uncertainty	4				
24	to present uncertainty	4				
25	to represent uncertainty	4				

*Note: *Frequency*

According to the frequency approach, awareness of uncertainty is quite high in the last decade. To reduce uncertainty is discussed intensely with 18 times on the one hand and to deal with uncertainty, to understand uncertainty, and to manage uncertainty is argued with 13, 9, 8 times respectively on the other hand. This situation shows that, although there is a tendency to decrease the uncertainty, it is assessed that how to manage the uncertainty by understanding the concept in the last decade.

The trends in adjective and concept with uncertainty are parallel. Level, degree, and type of uncertainty take place 12, 11, and 7 times respectively in this decade. This tendency reveals that the taxonomy of uncertainty in the foreground as can be seen from the adjective frequency with high, deep, and low uncertainty.

We search for the answers to our research questions: (1) How do we think about and respond to uncertainty? (2) Is there any paradigmatic shift within the taxonomy of uncertainty? Thus, we decide to integrate the previous decades analysis to see the trends in handling uncertainty.

Figure 10

Integrated Decade Analysis of Uncertainty

		Probabilistic Approach	Non-probabilistic Approach	
1941 - 1999	Verb	to ignore uncertainty, to reduce uncertainty to eliminate uncertainty, to describe uncertainty	to cope with uncertainty, to deal with uncertainty, to face with uncertainty, to describe uncertainty	
	Adj	technical uncertainty, technological uncertainty objective uncertainty	high-degree uncertainty, environmental uncertainty, subjective uncertainty	
	Concept	existence of uncertainty	decision under uncertainty, degree of uncertainty, management of uncertainty	
2000 - 2019	Verb	to reduce uncertainty, to ignore uncertainty, to define uncertainty	to deal with uncertainty, to manage uncertainty, to understand uncertainty, to describe uncertainty	
	Adj	high uncertainty, low uncertainty, technical uncertainty	technological uncertainty, deep uncertainty, epistemological/epistemic uncertainty	
	Concept	definition of uncertainty, increase in uncertainty	decision-making under uncertainty, source of uncertainty, degree of uncertainty	

Note. Division of approaches as probabilistic and non-probabilistic from “Ignorance and Uncertainty” (Smithson, 1988)

The period, previously analyzed in seven decades, is divided into two parts as 1941-1999 and 2000-2019. This division is based on the trends which are determined with historical and discourse analysis in terms of foresight. The beginning of the 21st is the basis for related segmentation. From the beginning of the 21st century, “with the exponential rate of technological change, time itself seems to be speeding up, bringing ‘the future’ ever close” (Gidley, 2017 pg.3). Thus, the period before the 21st century is handled by combining. The segmentation as probabilistic and non-probabilistic approaches are based on Smithson’s (1988) treatment of the theoretical study of uncertainty.

There is a change in handling uncertainty over years. First, approaches to uncertainty change from ignoring and reducing uncertainty to managing and understanding uncertainty in general. There is a paradigmatic shift in handling uncertainty from this point. Triggers to ignore, eliminate, and reduce uncertainty are based on a normative framework, mainly a probabilistic approach. On the other hand, triggers to deal with uncertainty, manage uncertainty, and understand uncertainty are based on a non-probabilistic approach. We can make the inference that there is a paradigm shift by systematic literature review in handling uncertainty. The reason for the shift is generally described with scientific, social, political, and cultural factors (Smithson, 1988).

Second, there is a linear development over the years in handling uncertainty. Historical and discourse analysis enables us to be aware of the development. The degree of uncertainty, deep uncertainty, and epistemological uncertainty are examples of this development. It should be noted that, although there are improvements in dealing with uncertainty, ignoring uncertainty, as an extreme approach, continues to exist together with managing uncertainty.

Finally, it is possible to conclude that technical and technological uncertainty is a common point in the matter of uncertainty. Technological change makes us face uncertainty often. The other prominent point in handling uncertainty is the definition, description of uncertainty. To define uncertainty is discussed in every approach and period. We analyze conceptual clarity of uncertainty which serves to better define uncertainty, as well.

5.2. Content Analysis Results by NVivo 12

Due to common judgment about qualitative research for the shortage of scholarly rigor (Gioia, Corley, & Hamilton, 2013), in this research, the concept, uncertainty, is placed into free-standing nodes and subsequently used to build broader themes or sets by NVivo 12. Societal issues are predictably complicated and necessitate multidimensional solutions (Jick 1979, Patton 1990, Datta 1997; cited in Bezeley, 2002). Thus, NVivo 12, as a digital tool, is used to support an improved analytical approach in the analysis of the concept of uncertainty.

It should be stated that I have limited information about utilization the data via NVivo program. I need support to get accurate and effective results via NVivo. Thus, Assoc. Prof. Dr. Cemre Jade supports us about using NVivo program. The NVivo results are analyzed with basic approach in parallel with my limited information in this study.

In our research, 101 defined articles (see Appendix C) are analyzed with the heading of ‘verb’, ‘adjective’, and ‘concept’ by manually within 19 tables, which are handled in the “Results” section with the heading of “Content Analysis Results by Manually”, to discuss the concept of uncertainty. After setting 19 tables, each heading is listed in excel tables as ‘Verb Frequency List’, ‘Adjective Frequency List’, and

‘Concept Frequency List’ with the aim of reaching the most handled ones (see Appendix E).

Totally, we have 297 verbs, 251 adjectives, and 448 concepts with uncertainty in 101 defined articles (see Appendix E). Then, minimum 4 of times and more used 64 verbs, 36 adjectives, and 70 concepts with uncertainty in 101 articles are selected and listed in excel formats to analyze with NVivo 12 (respectively see Table 36, Table 37, and Table 38).

We have a minimum 4 of times and more used 64 verbs obtained from manually studied tables and excels (see Table 36). According to the frequency approach, we aim to reach the analysis of general usage of a verb in 101 articles rather than to determine how many times it is used in total. Thus, even if, any verb is used more than once in an article, it is written once in the related part of the verb, adjective, and concept tables. Frequency list of verbs with uncertainty is created from 19 verb, adjective, and concept tables which are analyzed in “Content Analysis Results by Manually (5.1.)”.

“To reduce uncertainty” is discussed 30 times which means that the verb “to reduce uncertainty” is in the 30 of 101 articles. A general tendency to reduce uncertainty is observed in the data subject to our research. Smithson (1988) explains this trend based on positivism. “To eliminate uncertainty” (8/101), “to minimize uncertainty” (7/101), and “to distinguish uncertainty” (7/101) are utilized based on positivist and deterministic approaches.

However, “to deal with uncertainty” (24/101), “to cope with uncertainty” (18/101), “to understand uncertainty” (15/101), and “to manage uncertainty” (13/101) are utilized based on the trend which is seen in parallel with the development of uncertainty awareness in business administration studies (Smithson, 1988). According

to this approach, the process of uncertainty should be conducted effectively by adding a new option to directly eliminate the concept (Smithson, 1988).

Table 36

Frequency List of Verb with Uncertainty

Verb	Frequency	Verb	Frequency
1 reduce uncertainty	30	32 treat uncertainty	7
2 deal with uncertainty	24	33 arise uncertainty	6
3 cope with uncertainty	18	34 classify uncertainty	6
4 face uncertainty	16	35 conceptualize uncertainty	6
5 understand uncertainty	15	36 focus uncertainty	6
6 consider uncertainty	14	37 incorporate uncertainty	6
7 recognize uncertainty	14	38 interpret uncertainty	6
8 describe uncertainty	13	39 involve uncertainty	6
9 manage uncertainty	13	40 reflect uncertainty	6
10 handle uncertainty	11	41 associate with uncertainty	5
11 increase uncertainty	11	42 concern uncertainty	5
12 define uncertainty	10	43 contribute to uncertainty	5
13 address uncertainty	9	44 examine uncertainty	5
14 assess uncertainty	9	45 include uncertainty	5
15 create uncertainty	9	46 respond uncertainty	5
16 discuss uncertainty	9	47 take uncertainty	5
17 express uncertainty	9	48 analyze uncertainty	4
18 ignore uncertainty	9	49 argue uncertainty	4
19 measure uncertainty	9	50 avoid uncertainty	4
20 resolve uncertainty	9	51 capture uncertainty	4
characterize			
21 uncertainty	8	52 determine uncertainty	4
22 eliminate uncertainty	8	53 entail uncertainty	4
23 experience uncertainty	8	54 estimate uncertainty	4
24 introduce uncertainty	8	55 highlight uncertainty	4
25 quantify uncertainty	8	56 indicate uncertainty	4
26 represent uncertainty	8	57 investigate uncertainty	4
27 distinguish uncertainty	7	58 present uncertainty	4
		take uncertainty into	
28 identify uncertainty	7	59 account	4
29 minimize uncertainty	7	60 underly uncertainty	4
30 perceive uncertainty	7	61 use uncertainty	4
31 show uncertainty	7	62 view uncertainty	4

Note. Minimum four times and more used verbs with uncertainty in frequency list.

When we compare the manual (see Table 36) and NVivo results (see Figure 11), it is seen that results are taken from both versions are coherent (see APPENDIX F Table 60).



Figure 11

Frequent Verbs Analysis by NVivo

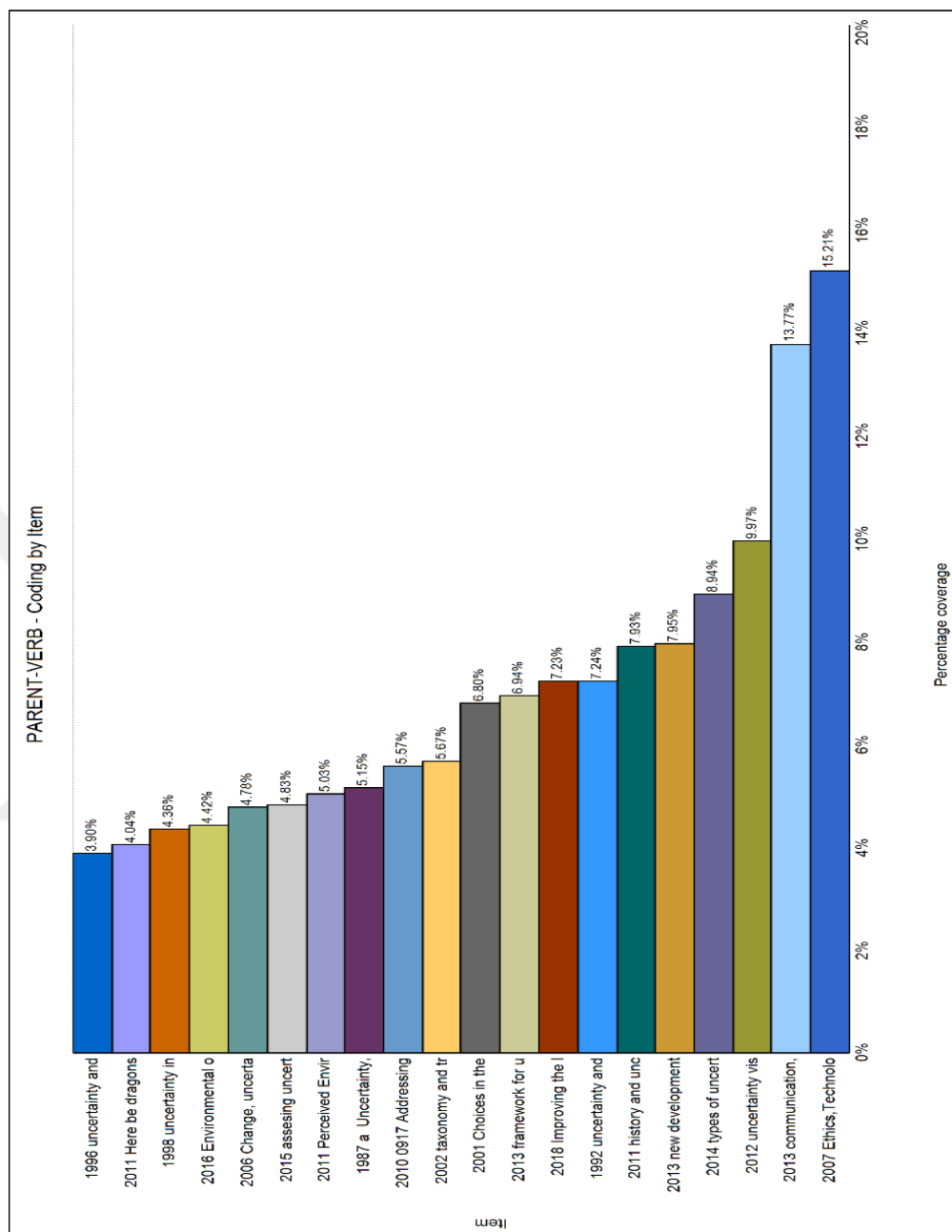
PARENT-VERB											
distinguish uncertainty	concern uncertainty	manage uncertainty	underly...	take unc...	respond...	quantify...	experien...	eliminate...	define u...		
	view uncertainty	deal with uncertainty	cope with uncertain...	express...	describe...	consider...	concept...	character...	assess u...		
			treat uncertainty								
reduce uncertainty	face uncertainty	focus uncertainty	resolve uncertainty		argue uncertain...	reflect...	prese...	minimi...	investi...	indica...	
			perceive uncertainty		address uncerta...			res...	inv...	inc...	inc...
		represent uncertainty			understand u...	estimate unc...		identify u...	con...	clas...	
			introduce uncertainty		take uncertain...	determine u...		highlight...			
examine uncertainty	measure uncertainty	increase uncertainty	handle uncertainty		show uncertain...	capture uncert...		entail...	avoid u...		
								discuss u...	associat...		

Note. Minimum four times and more used verbs with uncertainty in frequency list

“To distinguish uncertainty”, “to reduce uncertainty”, “to deal with uncertainty” and “to manage uncertainty” are four of the coherent results as examples. The frequent verb analysis via NVivo in excel format is in Appendix E.

In addition to verb-by-verb analysis, we would like to see articles that covers frequent verbs via the NVivo program. The articles with the most frequent verbs are below (see APPENDIX G detailed articles list)



Figure 12*Frequent Verbs Coverage of Articles by NVivo*

Note. Minimum four times and more used verbs.

We have a minimum 4 of times and more used 36 adjectives obtained from manually studied tables and excels (see Table 37). According to the frequency approach, we aim to reach the analysis of general usage of an adjective in 101 articles rather than to determine how many times it is used in total. Thus, even if, any adjective is used more than once in an article, it is written once in the related part of the verb, adjective, and concept tables. Frequency list of adjectives with uncertainty is created from 19 verb, adjective, and concept tables which are analyzed in “Content Analysis Results by Manually (5.1.)”.

Table 37

Frequency List of Adjective with Uncertainty

Adjective		Frequency	Adjective		Frequency
1	high uncertainty	20	19	epistemological uncertainty	5
2	low uncertainty	14	20	great uncertainty	5
3	perceived uncertainty	11	21	objective uncertainty	5
4	environmental uncertainty	10	22	political uncertainty	5
5	inherent uncertainty	10	23	basic uncertainty	4
6	technological uncertainty	10	24	clinical uncertainty	4
7	subjective uncertainty	9	25	economic uncertainty	4
8	greater uncertainty	8	26	future uncertainty	4
9	less uncertainty	8	27	intrinsic uncertainty	4
10	technical uncertainty	8	28	irreducible uncertainty	4
11	considerable uncertainty	7	29	large uncertainty	4
12	deep uncertainty	7	30	ontological uncertainty	4
13	epistemic uncertainty	7	31	parameter uncertainty	4
14	fundamental uncertainty	7	32	real uncertainty	4
15	more uncertainty	7	33	residual uncertainty	4
16	total uncertainty	7	34	significant uncertainty	4
17	increased uncertainty	6	35	strong uncertainty	4
18	major uncertainty	6	36	structural uncertainty	4

Note. Minimum four times and more used adjectives with uncertainty in frequency list.

“High uncertainty” is discussed 20 times, which means that the adjective “high uncertainty” is in the 20 of 101 articles. A general tendency is to face “high uncertainty” in post-normal times due to having a complex environment in terms of decision-making. “low uncertainty” (14/101), “perceived uncertainty” (10/101), and “environmental uncertainty” (10/101) are utilized in accordance with the nature of period.

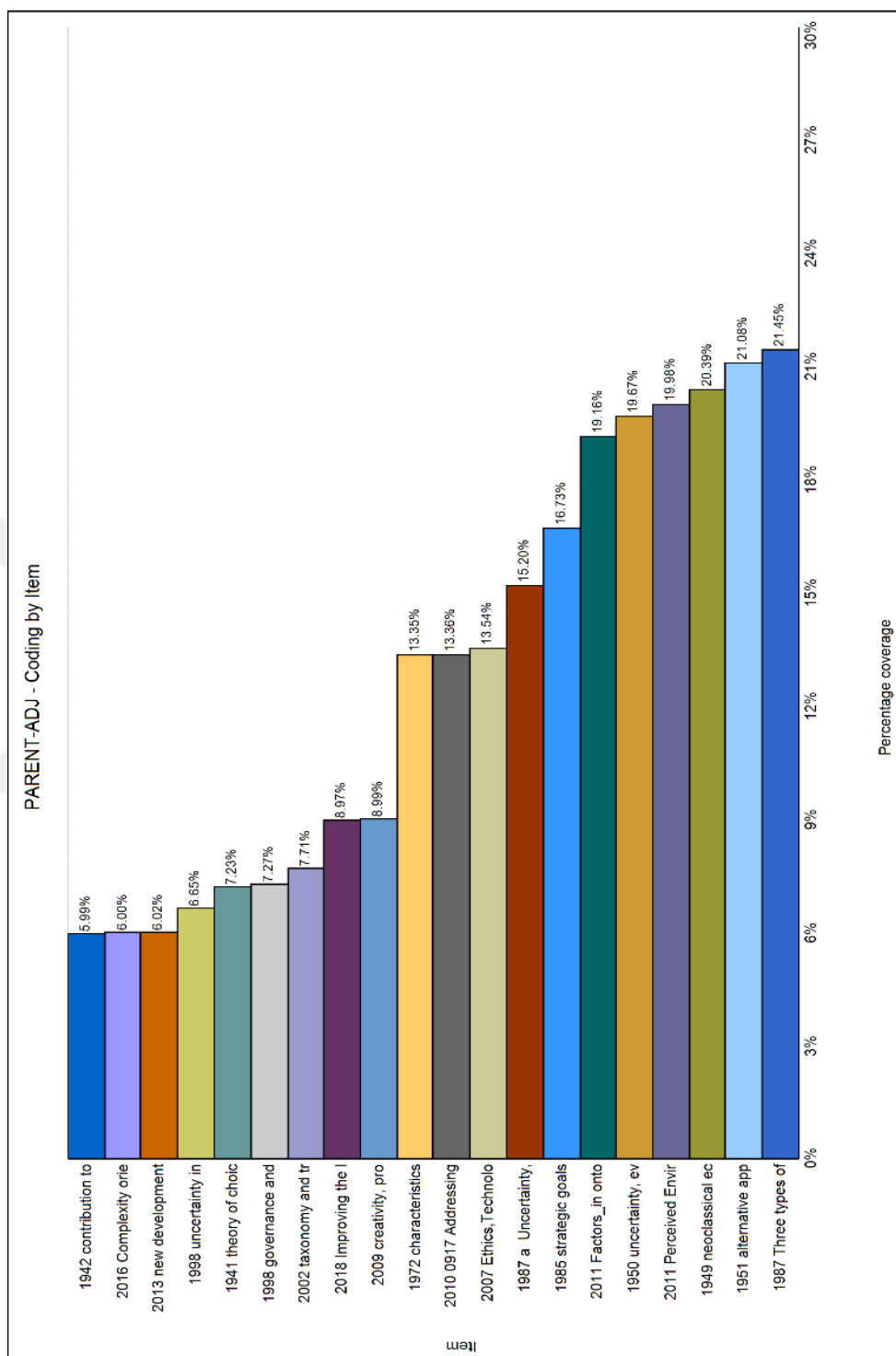
However, “technological uncertainty” (10/101), and “technical uncertainty” (8/101) is taken together make sense in terms of scientific and technological revolutions. When we compare the manual (see Table 38) and NVivo results (see Figure 13), it is seen that results are taken from both versions are coherent.(see APPENDIX F Table 61).

Figure 13*Frequent Adjectives Analysis by NVivo*

PARENT-ADJ	perceived uncertainty	subjective uncertainty	major uncertainty	technological uncertainty	technical uncertainty	future uncertainty	fundamental uncertainty
	high uncertainty	environmental uncertainty	low uncertainty	parameter uncertainty	epistemological uncertainty	considerable uncertainty	structural uncertainty
	greater uncertainty	objective uncertainty	inherent uncertainty	ontological uncertainty	residual uncertainty	economic uncertainty	significant uncertainty
	total uncertainty	more uncertainty	epistemic uncertainty	less uncertainty	irreducible uncertainty	political uncertainty	clinical uncertainty
			deep uncertainty	increased uncertainty	great uncertainty	large uncertainty	situation uncertainty
							intrinsic uncertainty

Note. Minimum four times and more used adjectives with uncertainty in frequency list.

In addition to adjective-by-adjective analysis, we would like to see articles that covers frequent adjectives via the NVivo program. The articles with the most frequent adjectives are below (also see APPENDIX G detailed articles list)

Figure 14*Frequent Adjectives Coverage of Articles*

Note. Minimum four times and more used adjectives with uncertainty.

We have a minimum 4 of times and more 70 used concepts obtained from manually studied tables and excels (see Table 38). According to the frequency approach, we aim to reach the analysis of general usage of a concept in 101 articles rather than to determine how many times it is used in total. Thus, even if, any concept is used more than once in an article, it is written once in the related part of the verb, adjective, and concept tables. Frequency list of concepts with uncertainty is created from 19 the verb, adjective, and concept tables which are analyzed in “Content Analysis Results by Manually (5.1.)”.



Table 38*Frequency List of Concept with Uncertainty*

	Concept	Frequency		Concept	Frequency
1	degree of uncertainty	26	36	typology of uncertainty	6
2	level of uncertainty	25	37	area of uncertainty	5
3	source of uncertainty	21	38	conceptualization of uncertainty	5
4	decision-making under uncertainty	20	39	decision under uncertainty	5
5	measure of uncertainty	18	40	emphasis on uncertainty	5
6	type of uncertainty	17	41	issue of uncertainty	5
7	under uncertainty	14	42	management of uncertainty	5
8	condition of uncertainty	13	43	perception of uncertainty	5
9	effect of uncertainty	13	44	scope of uncertainty	5
10	concept of uncertainty	12	45	significance of uncertainty	5
11	nature of uncertainty	11	46	situation of uncertainty	5
12	aspect of uncertainty	10	47	study of uncertainty	5
13	amount of uncertainty	9	48	about uncertainty	4
14	form of uncertainty	9	49	analysis of uncertainty	4
15	kind of uncertainty	9	50	characterization of uncertainty	4
16	case of uncertainty	8	51	choice under uncertainty	4
17	definition of uncertainty	8	52	context of uncertainty	4
18	dimension of uncertainty	8	53	discussion of uncertainty	4
19	impact of uncertainty	8	54	factor of uncertainty	4
20	problem of uncertainty	8	55	increase in uncertainty	4
21	response to uncertainty	8	56	influence of uncertainty	4
22	treatment of uncertainty	8	57	location of uncertainty	4
23	face of uncertainty	7	58	parameter of uncertainty	4
24	managing uncertainty	7	59	quantification of uncertainty	4
25	presence of uncertainty	7	60	reduction of uncertainty	4
26	range of uncertainty	7	61	research on uncertainty	4
27	representation of uncertainty	7	62	resolution of uncertainty	4
28	uncertainty about	7	63	scale uncertainty	4
29	uncertainty regarding	7	64	sense of uncertainty	4
30	uncertainty surrounding	7	65	state uncertainty	4
31	assessment of uncertainty	6	66	uncertainty analysis	4
32	awareness of uncertainty	6	67	uncertainty assessment	4
33	identification of uncertainty	6	68	uncertainty management	4
34	importance of uncertainty	6	69	value of uncertainty	4
35	role of uncertainty	6	70	variety of uncertainty	4

Note. Minimum four times and more used concepts with uncertainty in frequency list.

“Degree of uncertainty” is discussed 26 times which means that the concept “degree of uncertainty” is in 30 of 101 articles. Understanding uncertainty via taxonomy is observed in all decades that we analyze. “level of uncertainty” (25/101), “type of uncertainty” (17/101), and “form of uncertainty” (9/101) are utilized based on handling via taxonomy. However, taking together of “decision-making under uncertainty” (20/101), and “decision under uncertainty” (5/101) make sense in terms of decision-making.

When we compare the manual (see Table 38) and NVivo results (see Figure 15.), it is seen that results are taken from both versions are coherent (see APPENDIX F Table 62).

Figure 15

Frequent Concepts Analysis by NVivo

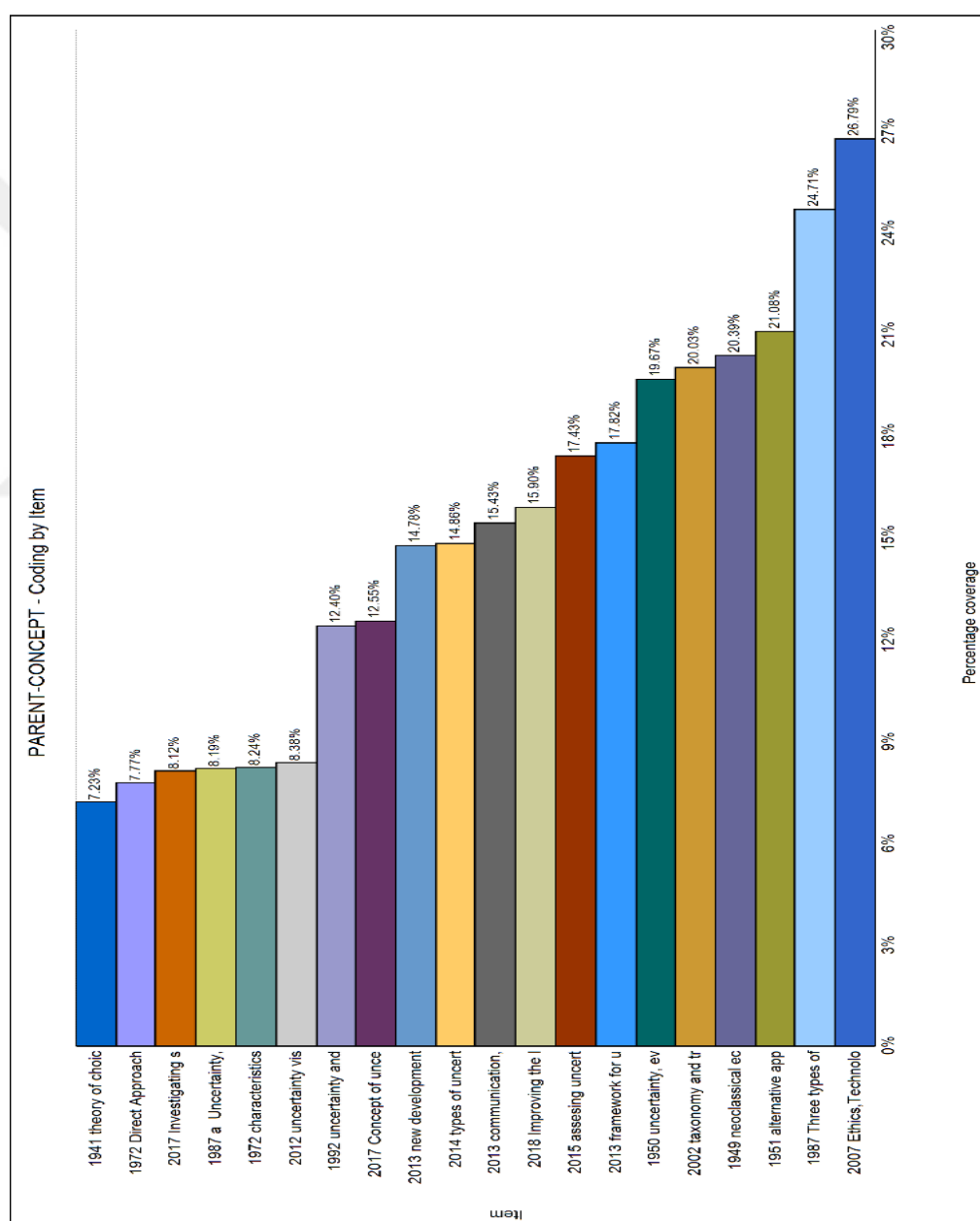
PARENT-CONCEPT									
degree of uncertainty	uncertainty management	representation of uncertainty...	uncertainty assess...	response t...	reduction ...	form of u...	effect of u...	amount of...	about unc...
	face of uncertainty	measure of uncertainty	nature of uncertainty	treatment of unc...	increase ...	Impact ...	decision...	case of u...	assessm...
		uncertainty regarding	choices under uncertainty						
level of uncertainty	uncertainty analysis	analysis of uncertainty	under uncertainty	uncertainty surro...	scale uncerta...	typol...	scop...	resol...	perce...
	source of uncertainty	type of uncertainty	management of uncertainty	uncertainty about					
decision-making under uncertainty...					state uncertainty	concept of uncertainty	sense of uncertainty	problem of uncert...	parameter of...
	definition of u...	awareness of...	area of...	import...					
									kind of uncertainty
variety ...	cline...								

Note. Minimum four times and more used concepts with uncertainty in frequency list.

In addition to concept-by-concept analysis, we would like to see articles that covers frequent concepts via the NVivo program. The articles with the most frequent verbs are below. (see APPENDIX G detailed articles list).

Figure 16

Frequent Concepts Coverage of Articles



Note. Minimum four times and more used concepts with uncertainty.

5.3. Conceptual Modelling Analysis by NVivo 12

Conceptual modeling in uncertainty (Section 3.1.) is analyzed only four conceptual models in-depth with their attributes, definitions, as well as taxonomies and categorizations. We aim to have more knowledgeable options which can be used for managing the development of uncertainty through taxonomy and characterization.

Uncertainty and some concepts as ignorance and ambiguity take their sources from the unknown feature of foresight (Öner et al., 2019), thus, utilized together or interchangeably. We integrated those four conceptual models as integrated concepts (see figure x) in terms of frequency in our data.

First, we made a list comprise all concepts in the four conceptual modeling (see Table 39). We have a total of 48 concepts.

Table 39

Conceptual Modeling Integrated Concept List

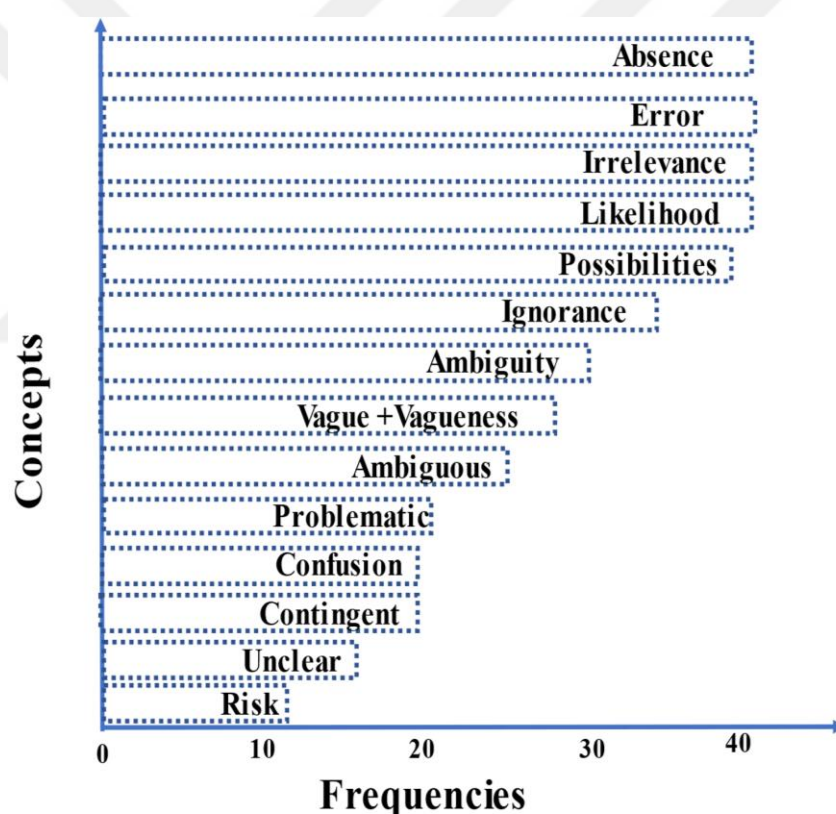
Concept	Concept	Concept	Concept	Concept
ignorance	uncertainty	incertitude	problematic	contingent
error	absence	risk	randomness	indistinct
irrelevance	vagueness	frequentist	fuzziness	dependable
untopicality	probability	Bayesian	ambiguous	vacillating
taboo	ambiguity	fuzzy logic	conflicting	vague
undecidability	fuzziness	sensitivity analysis	unforeseeable	capricious
distortion	Non-specificity	scenario analysis	indeterminate	unclear
incompleteness	likelihoods	precaution	confused	inconstant
confusion	probabilities	possibilities	dubious	
inaccuracy	outcomes	unproblematic	erratic	

Then, we analyzed the “Conceptual Modeling Integrated Concept List” in terms of frequency approach in the data (101 Articles) by NVivo 12. You may see the result of frequency analysis by NVivo 12 in Figure 17; for integrated concepts list (see APPENDIX Table 63).

We made an integrated analysis to understand the position of concepts in our data based on the frequency approach. When we analyze the four conceptual models, and review the literature, we see that some concepts are mentioned with uncertainty since they are considered to have close meaning or meaning confusion. We try to understand how these concepts are handled in the data. These concepts are integrated according to results obtained from NVivo results (see Appendix F Table 3). Integrated conceptual modeling concepts are figured as follows:

Figure 18

Integrated Conceptual Framework



Note. Integrated Figure from: “Taxonomy of Ignorance” (Smithson, 1988), “The Formal Definition of Risk, Uncertainty, Ambiguity, and Ignorance” (Stirling, 2001), “Some Interpretations in the FIR Space of Uncertainty” (Blockley, 2013) and “Risk-Ambiguity-Uncertainty-Ignorance (RAUI) Matrix” (Grubic et al., 2013).

Smithson (1988) states “the absence of some information” has negative effects as the impossibility of “point-estimates” in probability theory. However, newer perspectives in the normative paradigm enable to analyze in spite of the absence of knowledge (Smithson, 1988). For example, “Fuzzy Set Theory” deals with “vagueness and ambiguity “on the one hand, “Probability Theory” analyzes indeterminacy on the other hand (Smithson, 1988). The new approaches about absence cause extensive handling in uncertainty as “uncertainty about uncertainty” (Smithson, 1988).

Smithson (1988) stated that cognitive researches, which are related to thinking under uncertainty, have mainly centered on “judgmental errors”. In addition, focusing on errors may allow understanding the cognitive shortcomings of the decision-making process (Kahneman & Tversky, 1982a). According to the Smithson (1988) “the act of ignoring is a declaration of irrelevance”. The “values, motivations, rules, and norms” that create ignorance “in any society” refer to “irrelevancy and deliberate incompleteness” rather than “unconscious error” (Smithson, 1988).

The interpretation of probability as propensity leads people to base their judgements of likelihood primarily on causal considerations, and to ignore information that does not have causal interpretation produces characteristic errors in judgements of probability (Tversky & Kahneman, 1977 pg. iii).

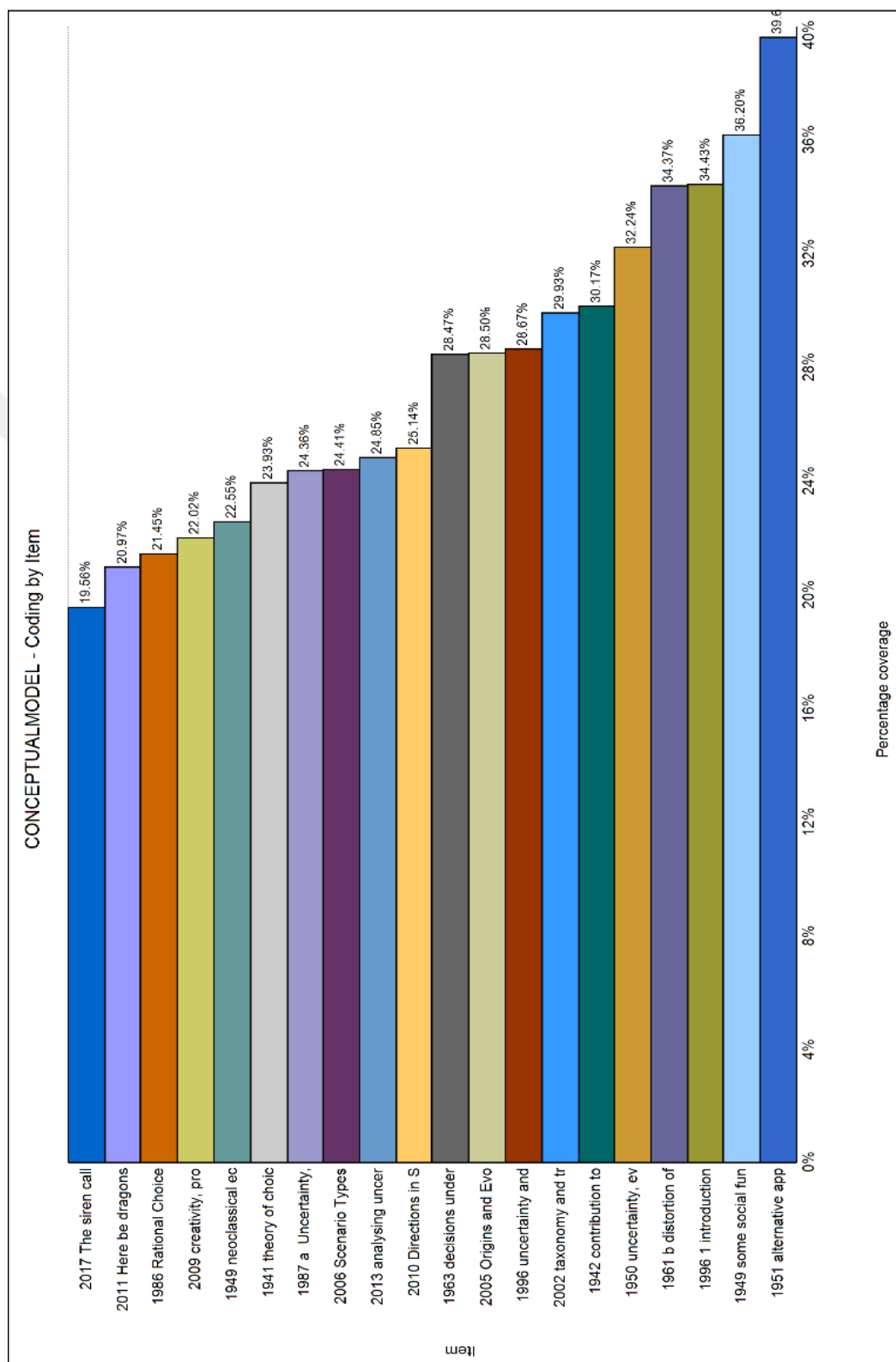
On the other hand, there is a question about the type of ignorance in an organization: “Is the kind of ignorance a matter of strategic choice? “and this question comes up in the sequel: “How do organizations operate under ignorance?” (Smithson, 1988). The difference between “irrelevance” and “error” is strategically important (Smithson, 1988). According to Smithson (1988), the tactical approaches are based on the planning about the utilization of the type of ignorance. “Incompleteness” is as a

clear choice besides “vagueness””, “ambiguity”, and “absence” involving possibilities (Smithson, 1988).

Our mental model of the suspected relationships was posited and evaluated by means of a framework that captures the essence of the system through the literature review. Our conceptual modeling was based on the taxonomies and categorizations. Thus, it aimed to enhance the Integrated Conceptual Framework by integrating uncertainty to foresight studies. Table depicts the general model for our study.

In addition to integrated concept analysis, we would like to see articles that covers frequent concepts via the NVivo program. The articles with the most frequent concepts are below (see Figure 19) (see APPENDIX G detailed articles list).

Figure 19
Conceptual Modeling Concepts Coverage of Articles



6. DISCUSSION

“The only certainty for the future, we are assured, is that it will be very different from today.”

Frank Webster, 2000

This thesis is an approach to make uncertainty, as a concept, clear via conceptual models and content analysis and guides decision-makers to better assess the risks and opportunities which they encounter while making decisions for futures.

Futures studies support improving the further course of actions, which need interrelations among natural, social, and cultural sciences, that is named a multidisciplinary approach. Whilst, perceiving futures studies, uncertainty is to have the highest effect in several fields of social and natural sciences, remarkably in economic and other societal disciplines in social sciences.

Conventional economics, predominantly formal models, persists in ignoring the importance of uncertainty in the perception of economic methods; where several types of uncertainty contend for awareness in literature (Lawson, 1994).

Apart from being chosen positive or negative as a concept, it is essential to attempt to respond to the connection between uncertainty and futures studies. Even if, this connection takes place in several cases, contemplation of just as a subsection of the complete range of uncertainty is diminished (Beissinger & Westphal, 1998).

While decision-making procedures are being taken into consideration, it is not possible to see the wide-ranging assessment of the significance of the complete range of uncertainty (Regan et al., 2002). Strand (1999) for instance, commented on problems of having got a simulation with an essence via asking various questions the same as: “do decision-makers decline certainty? Or when ‘muddling through’ solutions good

enough and best solutions given the costs involved in reducing uncertainties below a certain level?”. Stirling (2001) stated this situation close to a vital problem in the light of incomplete knowledge matter.

We will state our concluding conceptual observations focused on some areas of the disciplines of social science and their interrelations with the concept of uncertainty:

In the works of Marx and Engels (1848) – referring to the Marxist economic theory – accumulation and annihilation of wealth under capitalism has “undoubtedly exacerbated widespread feelings of apprehension and uncertainty” (Webster, 2000) in the society (Öner et al., 2019 pg.89). Consumers - the single most powerful driving force in this economic system- who use information far more intensively to meet their economic needs are creating considerable uncertainty in the marketplace along with technological innovations, digitization, unfettered capital markets, and globalization (Shaw, 2002; cited in Öner et al., 2019 pg.89).

According to Smithson (1988), the modern impulse with regard to uncertainty (if not all other kinds of ignorance) is managerial rather than limiting where much of the contemporary debate over uncertainty concerns how far the managerial impulse should or can be extended and what other kinds of ignorance must still be excluded from normative theories (Öner et al., 2019 pg.89).

Depending on the level and nature of the uncertainty, a company faces, shapers attempt, to get ahead of uncertainty, by driving industry change their way whilst, adapters, take existing and future industry structure and conduct as given and attempt to win through speed and agility, i.e., some adapters manage uncertainty by building flexible organizations designed to respond to changing market needs (Shaw, 2002; cited in Öner et al., 2019 pg.).

However, when it comes to managing and steering uncertainty, remarkably interesting and important questions arise (Öner et al., 2019):

- i. Is there one method capable of dealing with all sources of uncertainty?
- ii. How do we think about and respond to uncertainty during the decision-making process?
- iii. Is there any paradigmatic shift within the taxonomy of uncertainty? Since every paradigm includes and transcends previous how revolutionary is, they?
- iv. What are the developments in measurement of uncertainty in decision making? (pg. 90).

To realize the possible significance of uncertainty in terms of explaining social systems, Knight (1913b) emphasizes that Human organisms are subjects as well as objects and the limits to their objectification are limits to their conformity to fixed laws. Whether an enormous complex and unstable organization of atoms which individually obey these laws ... can theoretically account for the phenomenal uncertainty of organic and human behavior ... must probably remain an open question (Knight 1913b: 50; cited Öner et al., 2019 pg. 90). Thus, a final emphasis on the concept of uncertainty must also be placed on multidisciplinary practice whilst considering the challenge of predicting human behavior and future society's values (Öner et al., 2019 pg. 90). As Magruk (2017) puts it, "the logic of human behavior involves actual indefiniteness, real change, and lack of continuity" (Öner et al., 2019 pg. 90).

There is difference between intuitive judgements under uncertainty and the normative theory of subjective probability (Öner et al., 2019 pg. 90). As Tversky and Kahneman (1980) states that, "people have several different ways of thinking about probability, and their approach to the combination of probabilistic data depends on the

manner in which those data are interpreted (Öner et al., 2019 pg. 90). This difference presents a major educational challenge: to help people achieve a synthesis between their natural modes of judgment and the logic of probability (Tversky and Kahneman 1980; cited in Öner et al., 2019 pg. 90).

As a result, uncertainties are critical on condition that they are overlooked since they are there, and at all times consequently: “thus, what we see is inevitably distorted, in some way and to some degree, in the process of seeing” (Cartwright, 1991; cited in Strand 1999).

6.1. Managerial Implication

The demonstration of uncertainty in an explicit way is not promoted in different cultures (Moore, 1977). On the contrary, it is remarked that the general language routines have a habit of support on chaos “between certainty and belief” (Savage, 1971; cited in Moore, 1977). Management mainly, faced with matters, which involve uncertain consequences, in spite of trends in handling uncertainty (Moore, 1977).

Moore (1977) states that managerial issues are based “between two extremes of complete rationality and complete pragmatism”. Ideally, setting objectives, formulating, evaluating alternatives, and choosing from among the alternatives, and implementing the one in the light of objectives are in the process of management which comprise certainty and specificity (Moore, 1977). The other extreme approach includes progressing with instinctive acting in a puzzling managerial world. Managers feel secure throughout processes that are clear, definite, and ad hoc which is expressed verbally (Mintzberg, 1971; cited in Moore, 1977).

However, the contemporary business world includes complexity, that is a confluence of technological, economic, political, and socio-cultural transform, which

leads to having high management capacity under uncertainty (Magruk, 2017). Managing under uncertainty compromises heterogeneous approaches which are based on pluralistic perspectives in contemporary business, as well (Gyawali & Dixit, 2001). In addition to that, managers are not mainly good at noticing and analyzing their uncertainty and its degrees (Moore, 1977). Because probabilities indicate one's uncertainties concerning the exterior world and explain the connection between persona and his/her environment (Moore, 1977).

On the other hand, having understandable, representable, estimated, reducible, acceptable, or manageable uncertainty is link with the management strategies for managing under uncertainty (Smithson, 1988). In the light of pluralistic management and science approaches, each management type with different duties at different levels has a space to solve problems and decrease uncertainties (Gyawali & Dixit, 2001).

6.2. Limitation due to the Use of Interpretive Paradigm

Epistemological source of qualitative content analysis is centered on the data point or interpretation which is constructed collectively with researchers and the text (Graneheim, Lindgren, & Ludman, 2017). Utilizing interpretive analysis comprises comprehending of phenomenon which is based on perception of individuals in the light of both cultural and historical background (Scotland, 2012).

We are aware that, the limitations of this study are the interpretation which is the basis for qualitative content analysis, and the use of the interpretive paradigm itself. Thus, all stages of the research were carried out with the limitations of interpretation in mind. NVivo 12 was used alongside a manual study to overcome this kind of limitations.

NVivo 12, as a qualitative software system, is employed to analyze uncertainty in this research. Our goal is to reach frequently used verbs, adjectives, and concepts in the specific data. Thus, our question is how often the determined verbs, adjectives, and concepts with uncertainty is utilized in the determined articles. We do not transitive analysis on the contrary we prefer simple approach to support rigorousness.

When we compare the manual studies and NVivo results it is seen that results are taken from both versions are coherent. Even though results are coherent, detailed comparison needed between the results. We believe this research proposes some effective awareness for futures studies, despite the limitations we have.

6.3. Suggestions for Future Research

6.3.1. Possible contributory factors in an Uncertainty context

The momentum of change in the socio-cultural, economic, political, and technological areas and the high complexity of the contemporary business world is ascendent in boosting the necessity to cope with the related changes and the associated uncertainty to improve quality of life (Magruk, 2017). Human strategies for managing under uncertainty are typically oriented towards the issues of how uncertainty can be (Smithson, 2008):

1. Understood.
2. Represented, quantified, or estimated, and communicated.
3. Eliminated or reduced.
4. Accepted or tolerated, and
5. Controlled, harnessed, or exploited.

Several types of researches aim to contribute to advancement in this field. Dynamics that play a role in ontological uncertainty are defined in the direction of differentiation that is based on gender, personality, culture, and experience (Fox, 2011).

Minkov and Hofstede (2014) stated that the impetus of uncertainty might not be as prevailing in countries where the trends to take avoiding action for uncertainty is minor e.g., Scandinavian countries.

Göl (2008) studied the effects of femininity/masculinity, happiness, and space/time perspectives of individuals on the assessment of mega-trends and corporate foresight projects. She defined some indices for describing how a human's decisions or anticipation behavior changes (Göl, 2008). Although these indices might bring different approaches, perspectives, and priorities to foresight studies under uncertainty, further research needs to be carried on organizational and/or cultural orientation towards the future (Göl, 2008). Even more importantly, the research results also supported that there was a relationship between the future orientation and happiness index of individuals (Göl, 2008).

Milburn (1978) also recommended the hopefulness effect, which should also be regarded as a supporting factor with groups of superior background differentiations since when somebody thinks that issues are connected to get better later, no crucial force is felt to work out for problems which possibly will take place later.

6.3.2. Measurability issues

As it can be seen that the explanation of uncertainty, is extra challenging than its analysis. However, the most accepted supporting strategy is “quantification of uncertainty and imposition of a logical calculus “for directing those quantities (Smithson, 1988).

There is an effective catalyst towards integration on setting up normative principals, and validation that having a preference one evaluate over others; however, in terms of typology given in Model 1, the normative proper paradigms have transferred into vagueness, no specificity, and ambiguity; in addition to these, those paradigms have moved into unreliability, undecidability, distortion, and conflict of opinion (Smithson, 1988).

The uncertainty that keeps to the complexity of the analyzed phenomena generates a room, which one can define the limitations of computability (Magruk, 2017). Fuzzy set and possibility theory have displayed an ambiguity concerning quantification, and additional qualitative analysis has originated from three concepts regarding ordinary rationalizing “under uncertainty: endorsements, defaults, and circumscription” (Smithson, 1988).

Furthermore, the previous practice of concepts that are not completely explained and agreed upon is the basis for difficulties in the future handling of theoretic concepts. For example, some of our theoretical terms although not uncertain now have the potential for uncertainty. Briefly, alterations in the conception and quantification of uncertainty, have caused the coming out of new approaches on uncertainty management, which supports decision-makers despite the continuity of uncertainty. Improved uncertainty assessment in turn would contribute to improved decision making.

REFERENCES

- Ahvenharju, S., Minkkinen, M., & Lalot, F. (2018). The five dimensions of futures consciousness. *Futures*(104), 1-13.
- Alchian, A. A. (1950). Uncertainty, evolution, and economic theory . *The Journal of Political Economy*, 211-221.
- Andersson, C., & Törnberg, P. (2018). Wickedness and the anatomy of complexity. *Futures*(96), 118-138.
- Appadurai, A. (2013). *The Future as Cultural Fact*. London: Verso.
- Arrow, K. J. (1951). Alternative approaches to the theory of choice in risk-taking situations. *Econometrica*, 19(4), 404-437.
- Artigiani, R. (2005). Leadership and uncertainty: Complexity and the lessons of history. *Futures*(37), 585-603.
- Ashford-Rowe, K., Herrington, J., & Brown, C. (2014). Establishing the critical elements that determine authentic assessments. *Assessment and Evaluation in Higher Education*, 39(2), 205-222.
- Asselt, M. B. (2005). The complex significance of uncertainty in a risk era: logic, manner and strategies in use. *International Journal of Risk Assessment and Management*, pp. Vol 5 2- 4.
- Bagarello, F., Basieva, I., & Khrennikov, A. (2018). Quantum field inspired model of decision making: Asymptotic stabilization of belief state via interaction with surrounding mental environment. *Journal of Mathematical Psychology*, 82, 159-168.

- Bazeley, P., & Jackson, K. (2013). *Qualitative data analysis with NVIVO*. London: SAGE.
- Bedsworth, L. W., Lowenthal, M. D., & Kastenber, W. E. (2004). Uncertainty and regulation: The rhetoric of risk in the california low-level radioactive waste debate. *Science, Technology, & Human Values*, 29(3), 406-427.
- Beissinger, S. R., & Westphal, M. (1998). On the use of demographic models of population viability in endangered species management. *The Journal of Wildlife Management*, 821-841.
- Bengtsson, M. (2016). How to plan and perform a qualitative study using content analysis. *NursingPlus Open* 2, 8-14.
- Bezeley, P. (2002). The evolution of a project involving an integrated analysis of structured qualitative and quantitative data: from N3 to NVivo. *Social Research Methodology*(5), 229-243.
- Black, M. (1937). Vagueness. An exercise in logical analysis. *Philosophy of Science*, 4(4), 427-455.
- Blau, A. (2011). Uncertainty and the history of ideas. *History and Theory*, 50(3), 358-372.
- Blockley. (2013). Analysing uncertainties: towards comparing bayesian and interval probabilities. *Mechanical systems and signal processing*, 30-42.
- Blockley, D. (2013). Analysing uncertainties: towards comparing bayesian and interval probabilities. *Mechanical systems and signal processing*, 30-42.
- Blockley, D. I., & Godfrey, P. S. (2000). *Doing it differently*. London: Thomas Telford.

- Bloom, N. (2009). The impact of uncertainty shock. *Econometrica*, 623-685.
- Borenstein, M., Hedges, L., Higgins, J., & Rothstein, H. (2009). *Introduction to Meta-Analysis*. West Sussex: WILEY.
- Bourgeois, J. (1985). Strategic goals, perceived uncertainty, and economic performance in volatile environments. *Academy of Management Journal*, 28(3), 548-573.
- Börjeson, L., Höjer, M., Dreborg, K. H., Ekvall, T., & Finnveden, G. (2006). Scenario types and techniques: Towards a user's guide. *Futures*, 723-739.
- Bradfield, R., Wright, G., Brut, G., Cairns, G., & Heijden, K. V. (2005). The origins and evolution of scenario techniques in long range business planning. *Futures*(37), 795-812.
- Bradley, R., & Drechsler, M. (2013). Types of uncertainty. *Erkenntnis*, 1-29.
doi:10.1007/s10670-013-9518-4
- Brewer, K. R. (1963). Decisions under uncertainty: Comment. *The Quarterly Journal of Economics*, 77(1), 159-161.
- Brown, S. L., & Eisenhardt, K. M. (1997). The Art of Continuous Change: Linking Complexity Theory and Time-Paced Evolution in Relentlessly Shifting Organizations. *Administrative Science Quarterly*, 1-34.
- Burt, G., & Heijden, K. v. (2003). First steps: toward purposeful activities in scenario thinking and future studies. *Futures*, 1011-1026.
- Busch, P., Heinonen, T., & Lahti, P. (2007). Heisenberg's uncertainty principle. *Physics Reports*, 452(6), 155-176.

Cambridge, U. P. (2020, 8 24). *Cambridge Dictionary*. dictionary.cambridge.org:

[https://dictionary.cambridge.org/dictionary/english/adresinden alındı](https://dictionary.cambridge.org/dictionary/english/adresinden%20alındı)

Cambridge, U. P. (2020, 8 24). *Cambridge English Corpus*. cambridge.org:

<https://www.cambridge.org/gb/cambridgeenglish/better-learning-insights/corpus> adresinden alındı

Candy, S., & Kornet, K. (2019). Turning Foresight Inside Out: An introduction to ethnographic experiential futures. *Journal of Futures*, 23(3), 3-22.

Cantin, R., & Michel, P. (2003). Towards a new technology future approach. *Futures*(35), 189-201.

Cassell, C., & Symon, G. (2004). *Essential guide to qualitative methods in organizational research*. London: Sage.

Clarke, I. F. (1996). Twentieth century futures thinking: From amateurs to experts. *The Knowledge Base of Future Studies*. <http://www.master-foresight-innovation.fr> adresinden alındı

Corotis, R. B. (2009). Risk communication with generalised uncertainty and linguistic. *Structural Safety*, 31, 113-117.

Davis, F. (1960). Uncertainty in medical prognosis clinical and functional. *American Journal of Sociology*, 66(1), 41-47.

Derbyshire, J. (2016). The implications, challenges, and benefits of a complexity-oriented future studies. *Futures*(77), 45-55.

Derbyshire, J. (2017). The siren call of probability: Dangers associated with using probability for consideration of the future. *Futures*(88), 43-54.

DerKiureghian, A., & Ditlevsen, O. (2009). Aleatory or epistemic? Does it matter?

Structural Safety, 31, 105-112.

Dess, G. G., & Beard, D. W. (1984). Dimensions of organizational task environment.

Administrative Science Quarterly, 29(1), 52-73.

Dong, X., & Hayes, C. (2012). Uncertainty visualizations: Helping decision makers

become more aware of uncertainty and its implications. *Journal of Cognitive*

Engineering and Decision Making, 6(1), 30-56.

Dorsser, C. v., Walker, W. E., Taneja, P., & Marchau, V. A. (2018). Improving the

link between the futures field and policymaking. *Futures*(104), 75-84.

Duncan, R. B. (1972). Characteristics of organizational environment and perceived

environmental uncertainty. *Aministrative Science Quarterly*, 17(3), 313-327.

Edwards, F. R., & Heggstad, A. A. (1973). Uncertainty, market structure and

performance: The galbraith-caves hypothesis and managerial motives in

banking. *The Quarterly Journal of Economics*, 87(3), 455-473.

Elahi, S. (2011). Here be dragons ... exploring the unknown unknowns. *Futures*(43),

196-201.

Ellison, A. M. (1996). An introduction to bayesian inference for ecological research

and environmental decision-making . *Ecological Applications*, 6(4), 1036-

1046.

Elo, S., Kaarlainen, M., Kanste, O., Polkki, T., Utriainen, K., & Kyngas, H. (2014).

Qualitative content analysis: A focus on trustworthiness. *SAGE Open*(January

- March), 1-10.

- Engen, S., Bakke, O., & Islam, A. (1998). Demographic and environmental stochasticity - concepts and definitions. *Biometrics*, 54(3), 840-846.
- Fellner, W. (1961). Distortion of subjective probabilities as a reaction to uncertainty. *The Quarterly Journal of Economics*, 75(4), 670-689.
- FOCUS. (2005, 12 01). 1905-2005 100 Yılın Dahileri, Deneyleri, Buluşları, Çığır Açan Olayları. *FOCUS*, s. 33-52.
- FOCUS. (2005, 12 01). Bu yüzyıl BİT'lendik. *FOCUS*, s. 20-23.
- FOCUS. (2005, 12 01). Dünyayı değiştiren yüzyılın dehaları. *FOCUS*, s. 28-33.
- FOCUS. (2005, 12 01). Telefondan internete. *FOCUS*, s. 44-45.
- Folta, T. B. (1998). Governance and uncertainty: The trade-off between administrative control and commitment. *Strategic Management Journal*, 99(11), 1007-1028.
- Fox, S. (2011). Factors in ontological uncertainty related to ICT innovations. *International Journal of Managing Projects in Business*, 4(1), 137-149.
- Fromm, E. (1947). *Man for himself: An inquiry into psychology of ethica* . Oxon: Routledge.
- Future Learning, U. G. (2020, June 14). Decision making in a complex and uncertain world. University of Groningen, Groningen, Netherlands.
- Galbraith, J. (1977). *Organization Design*. Reading: Addison Wesley.
- Gerrity, M. S., Earp, J. A., DeVellis, R. F., & Light, D. W. (1992). Uncertainty and professional work: Perceptions of physicians in clinical practice. *American Journal of Sociology*, 97(4), 1022-1051.

- Gidley, J. M. (2017). *The Future: A very short introduction*. Oxford: Oxford University Press.
- Gioia, D., Corley, K., & Hamilton, A. (2013). Seeking qualitative rigor in inductive research: Notes on the Gioia methodology. *Organizational research methods*, 16(1), 15-31. doi:10.1177/1094428112452151
- Göl, S. (2008). *An exploratory study on the effects of femininity/masculinity, happiness, space/time perspectives of individuals on assessment of megatrends and corporate foresight projects results*. Istanbul: Yeditepe University Graduate Institute of Social Science.
- Graneheim, U. H., Lindgren, B.-M., & Ludman, B. (2017). Methodological challenges in qualitative content analysis: A discussion paper. *Nurse Education Today*(56), 29-34.
- Grubic, T., Varga, L., & Varga, S. (2013). Future utility services'(un)knowns framework: Knowledge existence and knowledge reach. *Futures*, 54, 68-86.
- Gyawali, D., & Dixit, A. (2001). Water and science: hydrological uncertainties, development aspirations and uningrained scientific culture. *Futures*(33), 689-708.
- Hacking, I. (1975). *The Emergence of Probability*. Cambridge: Cambridge University Press.
- Haegeman, K., Marinelli, E., Scapolo, F., Ricci, A., & Sokolov, A. (2013). Quantitative and qualitative approaches in future-oriented technology analysis (FTA): from combination to integration. *Technological Forecasting & Social Change*(80), 386-397.

- Hall, J., Matas, S., Silvestre, B., & Martin, M. (2011). Managing technological and social uncertainties of innovation: The evolution of Brazilian energy and agriculture. *Technological Forecasting & Social Change*(78), 1147-1157.
- Hall, P. (1980, February). Great planning disaster. *Futures*, 45-50.
- Hauge, K. H., & Barwell, R. (2017). Post-normal science and mathematics education in uncertain times: educating future citizens for extended peer communities. *Futures*(91), 25-34. doi:10.1016/j.futures.2016.11.013
- Haveman, R. H. (1977). The economic evaluation of long-run uncertainties. *Futures*, 365-374.
- Hawking. (1990). A brief story of time from the big bang to black holes. *Alfa*.
- Healy. (1997). Changing science and ensuring our future. *Futures*, 29(6), 505-517.
- Heizer, J., & Render, B. (2008). Decision-making Tools. In J. Heizer, & B. Render, *Operation Management* (pp. 657-666). India: Pearson.
- Hirshleifer, J. (1965). Decision under uncertainty: Choice-theoretic approaches. *The Quarterly Journal of Economics*, 79(4), 509-536.
- Hirshleifer, J. (1966). Investment decision under uncertainty: Applications of the state-preference. *The Quarterly Journal of Economics*, 80(2), 252-277.
- Hodges, J. (1987). Uncertainty, policy, analysis and statistics. *Statistical Science*, 2(3), 259-275.
- Hoffman, W. H. (2007). Strategies for managing a portfolio of alliances. *Strategic Management Journal* , 28(8), 827-856.

Hospers, J. (1956). What is explanation in essays in conceptual analysis. London: Macmillan.

Howell, G., Laufer, A., & Ballard, G. (1993). Uncertainty and project objectives. *Project Appraisal*, 8(1), 37-43.

Hsieh, H.-F., & Shannon, S. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research*, 15(9), 1277-1288.

Hughes, B. B. (2001). Choices in the face of uncertainty: The international futures (IFs) model. *Futures*(33), 55-62.

Ireland, R. D., Hitt, M. A., Bettis, R. A., & Porras, D. A. (1987). Strategy formulation processes: Differences in perceptions of strength and weaknesses indicators and environmental uncertainty by managerial level. *Strategic Management Journal*, 8(5), 469-485.

Irwin, S. (2013). Qualitative secondary data analysis: Ethics, epistemology, and context. *Progress in Development Studies*, 13(4), 295-306.

Kahneman, & Tversky. (1979). An analysis of decisions under risk. *Econometrica*, 47(2), 263-292.

Kahneman, D., & Tversky, A. (1982a). On the study of statistical intuitions. *Cognition*(11), 123-141.

Kamien, M. I., & Schwartzs, N. L. (1972). A direct approach to choice under uncertainty. *Management Science*, 18(8), B470-B477.

Kavrakoğlu, İ. (1990). *Dengeli gelişme için ekonomi politikaları*. İstanbul: Boğaziçi Üniversitesi.

- Kovacik, Z. (2017). Investigating science for governance through the lenses of complexity. *Futures*(91), 80-83.
- Kramer, M. W., Meisenbach, R. J., & Hansen, G. J. (2013). Communication, uncertainty, and volunteer membership. *Journal of Applied Communication Research*, 41(1), 18-39.
- Krippendorff, K. (2019). *Content analysis: An introduction to its methodology*. Los Angeles: SAGE.
- Lawson, T. (1994). The nature of post keynesianism and its links to other traditions: a realist perspective. *Journal of Post Keynesian Economics*(16), 503-538.
- Lazarsfeld, P. F. (1958). Evidence and inference in social research. *Daedalus*, 87(4), 99-130.
- Leland, H. E. (1968). Saving and uncertainty: The precautionary demand for saving. *The Quarterly Journal of Economics*, 82(3), 465-473.
- Lincoln, Y. (1995). Emerging criteria for quality in qualitative and interpretive research. *Qualitative Inquiry*, 1(3), 275-289.
- Löwe, B., & Müller, T. (2011). Data and phenomena in conceptual modelling. *Synthese*, 182(1), 131-148. <https://www.jstor.org/stable/41477622> adresinden alındı
- Ludwig, D. (1996). Uncertainty and the assessment of extinction probabilities. *Ecological Applications*, 6(4), 1067-1076.
- Macgill, S. M., & Siu, Y. L. (2005). A new paradigm for risk analysis. *Futures*(37), 1105-1131.

- Machina, M. J., & Schmeidler, D. (1992). A more robust definition of subjective probability . *Econometrica*, 60(4), 745-780.
- Magnus. (2012). The adventure future: <https://adventure.wordpress.com> adresinden alındı
- Magruk, A. (2017). Concept of uncertainty in relation to the foresight research. *Engineering Management in Production and Services*, 46-55.
- Marris, R. (1963). A model of the "managerial" enterprise. *The Quarterly Journal of Economics*, 77(2), 185-209.
- Mayring, P. (2000, 06 30). *Qualitative content analysis*. qualitative-research-.net: <http://www.qualitative-research.net/index.php/fgs/article/view/1089-2386> adresinden alındı
- Mayring, P. (2000). *Qualitative Content Analysis*,. july 20, 2014 tarihinde Forum: qualitative social research: <http://www.qualitative-research.net/index.php/fgs/article/view/1089-2386> adresinden alındı
- Mendonça, S., & Sapio, B. (2009). Managing foresight in changing organizational settings introducing new perspectives and practices. *Technology Analysis and Strategic Management*, 285-289.
- Mercer, D., & Wilter, A. (2002). Removing the fear of uncertainty from the future: theory and practice. *Foresight*, 4(5), 38-45.
- Meredith, J. R., Raturi, A., Amoako-Gyampah, K., & Kaplan, B. (1989). Alternative Research Paradigms in Operations. *Journal of Operations Management*, 297-326.

- Meyer, U. (2019, March). The emergence of an envisioned future. Sensemaking in the case of industries 4.0 in Germany. *Futures*, 109, 130-141.
doi:10.1016/j.futures.2019.03.001
- Micelotta, E., Lounsbury, M., & Greenwood, R. (2017). Pathways of institutional change: An integrative review and research agenda. *Journal of Management*, 43(6), 1885-1910.
- Milburn, M. (1978). Source of bias in the prediction of future events. *Organizational Behaviour and Human Performance*, 21(1), 17-26.
- Milliken, F. J. (1987). Three types of perceived uncertainty about the environment: State, effect, and response uncertainty. *Academy of Management Review*, 12(1), 133-143.
- Minkov, M., & Hofstede, G. (2014). Clustering of 316 European regions on measures of values: do Europe's countries have national cultures? *Cross- Cultural Research*, 48(2), 144-176.
- Moore, P. G. (1977). The manager's struggles with uncertainty. *Journal of the Royal Statistical Society*, 140(2), 129-165.
- Moore, W., & Tumin, M. (1949). Some social functions of ignorance. *American Sociological Review*, 14(6), 787-795.
- Morgan, D. P. (2002). Rating banks: Risk and uncertainty in an opaque industry. *The American Economic Review*, 92(4), 874-888.
- Morrow, S. (2005). Quality and trustworthiness in qualitative research in counseling psychology. *Journal of Counseling Psychology*(50), 205-260.

- Musgrave, R. A. (1974). Maximum, uncertainty, and the leisure trade-off . *The Quarterly Journal of Economics*, 88(4), 625-632.
- Nash, S. J. (2003). On Pragmatic Philosophy and Knightian Uncertain. *Review of Social Economy*, LXI(2), 251-272.
- Neuman, W. (2014). *Social research methods: Qualitative and quantitative approaches*. Essex: Pearson.
- Newman, L. (2006). Change, uncertainty, and futures of sustainable development. *Futures*, 633-637.
- Osigweh, C. A. (1989). Concept fallibility in organizational science. *Academy of Management Review*, 579-594.
- Oxford, U. P. (2020, 08 26). *Oxford Learner's Dictionaries*.
www.oxfordlearnersdictionaries.com:
<https://www.oxfordlearnersdictionaries.com/definition/english adresinden>
 alındı
- Öner. (2010). On theory building in foresight and futures studies: a discussion note. *Futures*, 1019-1030.
- Öner, A. M., Beşer, H. S., & Şenoğlu, P. (2019). Uncertainty and anticipation. *Anticipation conceptual, theoretical, and emprical issues*. içinde İstanbul: Yeditepe University Press.
- Öner, M. A., Benson, C., & Beşer, S. G. (2014). *Strategic Change*, 185-203.
- Öztemel, E. (2018, 06 01). Endüstri 4.0 ve yapay zeka. *Bilim ve Teknik (TÜBİTAK)*, s. 78-85.

- Parker, W. S., & Risbey, J. S. (2015). False precision, surprise, and improved uncertainty assessment. *Philosophical Transactions: Mathematical, Physical, and Engineering Sciences*, 373(2055), 1-13.
- Peat, F. D. (2007). From certainty to uncertainty: Thought, theory, and action in a postmodern world. *Futures*(39), 920-929.
- Phillips, M., & Lu, J. (2018). A Quick Look at NVivo. *Journal of Electronic Resources Librarianship*, 30(2), 104-106.
- Prior, M. (1980). The cost of electricity under uncertainty. *Futures*(8), 275-288.
- QSR International. (2019). qsrinternational.com. adresinden alındı
- Ramage, C. S. (1980). Sudden Events. *Futures*(8), 268-274.
- Rappert, B. (1999). Rationalising the future? Foresight in science and technology policy co-ordination. *Futures*(31), 527-545.
- Rast, D. E., Hogg, M. A., & Giessner, S. R. (2012). Self-uncertainty and support for autocratic leadership. *Self and Identity*(1), 1-15.
- Regan, Colyvan, & Burgman. (2002). A taxonomy and treatment of uncertainty for ecology and conservation biology. *Ecological Applications*, 618-628.
- Ritchie, J., J. Lewis, Nicholls, C., & Ormston, R. (2013). *Qualitative research practice: A guide for social science students and researchers*. SAGE.
- Roegen, N. G. (1954). Choice, expectations and measurability. *The Quarterly Journal of Economics*, 68(4), 503-534.

- Ross, T. J., Booker, J. M., & Montoya, A. C. (2013). New developments in uncertainty assessment and uncertainty management. *Expert Systems with Application*(40), 964-974.
- Sardar, Z. (2010). The namesake: futures; futures studies; futuroloji; futuristic; foresight - what is a name? *Futures*, 42(3), 177-184.
- Sardar, Z., & Sweeney, J. A. (2016). The three tomorrows of postnormal times. *Futures*(75), 1-13. doi:10.1016/j.futures.2015.10.004
- Schoemaker, P. J. (1993). Multiple scenario development: Its conceptual and behavioral foundation. *Strategic Management Journal*, 14(3), 193-213.
- Schreler, M. (2014). Qualitative content analysis. U. Flick içinde, *The SAGE handbook of qualitative data analysis* (s. 170). London: SAGE.
- Scotland, J. (2012). Exploring the philosophical underpinnings of research: relating ontology and epistemology to the methodology and methods of the scientific, interpretive, and critical research paradigms. *English Language Teaching*, 5(9), 9-16.
- Sharp, M. (1980). Technology and growth. *Futures*(10), 370-385.
- Silverman, D. (2020). *Interpreting qualitative data*. London: SAGE.
- Simpson, P. B. (1949). Neoclassical Economies and Monetary Problems. *The American Economic Review*, 39(5), 861-882.
- Slaughter, R. A. (2018). Two fine additions to the futures literature. *Foresight*, 443-444. doi:10.1108/FS-08-2018-098
- Smithson, M. (1988). New York: Springer-Verlag.

- Snowden, D. J., & Boone, M. E. (2007, November). A leader's framework for decision making. *Harvard Business Review*, 1-9.
- Sollie. (2007). Ethics, technology development, and uncertainty: An outline for any future ethics of technology. *Journal of Information Communication and Ethics in Society*, 5(4), 293-306.
- Sollie, P. (2007). Ethics, technology development, and uncertainty: An outline for any future ethics of technology. *Journal of Information Communication and Ethics in Society*, 5(4), 293-306.
- Star, S. L. (1985). Scientific work and uncertainty. *Social Studies of Science*, 15(3), 391-427.
- Stemler, S. (2001). An overview of content analysis. *Practical Assessment, Research, and Evaluation*, 7(17). doi:10.7275/z6fm-2e34
- Stirling. (2001). Science and precaution in the appraisal of electricity supply options. *Journal of Hazardous Materials*(86), 55-75.
- Stirling, A. (2001). Science and precaution in the appraisal of electricity supply options. *Journal of Hazardous Materials*(86), 55-75.
- Stirling, A. (2010). Keep it complex. *Nature*, 468, 1029-1031.
- Strand, S. (1999). Forecasting the future: pitfalls in controlling for uncertainty. *Futures*, 333-350.
- Strijbos, J., Martens, R., Prins, F., & Jochems, W. (2006). Content analysis: What are they talking about? *Computer & Education*(46), 29-48.

- Sutcliffe, K. M., & Zaheer, A. (1998). Uncertainty in the transaction environment: An empirical test. *Strategic Management Journal*, 19(1), 1-23.
- Swanson, D., Barg, S., Tyler, S., Venema, H., Tomar, S., Bhadwal, S., . . . Drexhage, J. (2010). Seven tools for creating adaptive policies . *Technological Forecasting & Social Change*(77), 924-934.
- Sykes, P., Bell, M., & Dissanayake, D. (2019, May 18). Identifying the factors driving the uncertainty in transport infrastructure project by application of structural dynamic analysis to a backcast scenario. *Futures*, 111, 26-41.
doi:10.1016/j.futures.2019.05.003
- Sykes, P., Bell, M., & Dissanayake, D. (2019). Identifying the factors driving the uncertainty in transport infrastructure project by application of structural dynamic analysis to a backcast scenario. *Futures*(111), 26-41.
- Tapinos, E. (2012). Perceived environmental uncertainty in scenario planning. *Futures*, 338-345.
- The Antidote CSBS. (1999). Living with uncertainty. *CSBS*(20), 55-57.
- The Economist. (2020, 01 01). AI can do that. *The World 2020, Special section on 2020 visions*, s. 133.
- Timmermans, S., & Angell, A. (2001). Evidence-based medicine, clinical uncertainty, and learning to doctor. *Journal of Health and Social Behavior*, 42(4), 342-359.
- Tintner, G. (1941). The theory of choice under subjective risk and uncertainty. *Econometrica*, 9(3/4), 298-304.
- Tintner, G. (1942). A contribution to the non-static theory of choice . *The quarterly journal of economics*, 56(2), 274-306.

- Tirole, J. (2001). Corporate Governance. *Econometrica*, 69(1), 1-35.
- Tonn, B., & Stiefel, D. (2014). Human extinction risk and uncertainty: Assessing conditions for action. *Futures*(63), 134-144.
- Tuomi, I. (2013). *Next-generation foresight in anticipatory organizations*. the European Forum on Forward-Looking Activities: European Commision.
- Tversky, A., & Kahneman, D. (1977). *Causal schemata in judgements under uncertainty*. Defence Advanced Research Project Agency.
- Tversky, A., & Kahneman, D. (1986). Rational choice and the framing of decision. *The Journal of Business*, 59(4), S251-S278.
- Tversky, A., & Kahneman, D. (1991). Loss aversion in risksless choice. *The Quarterly Journal of Economics*, 106(4), 1039-1061.
- University of Calgary Libraries and Cultural Resouces. (2021).
<https://library.ucalgary.ca/SRinBusiness>. adresinden alındı
- Vaitheeswaran, V. (2020, 01 01). Splinternet of Things. *The Economist, The World in 2020*, s. 109.
- Van Der Merwe, A. P. (2002). Project management and business development: integrating strategy, structure, processes, and project. *International Journal of Project*, 20, 401-411.
- VanAsselt, M. B., & Rotman, J. (2002). Uncertainty in integrated assessment modelling: from positivism to pluralism. *Climatic Change*(54), 75-105.

- Vandell, K. D. (1984). Imperfect information, uncertainty, and credit rationing: Comment and extension. *The Quarterly Journal of Economics*, 99(4), 841-863.
- Varum, C. A., & Melo, C. (2010). Directions in scenario planning literatures - A review of the past decades. *Futures*(42), 355-369.
- Veenman, S., & Leroy, P. (2016). Environmental outlooks: how they frame futures and long term uncertainty. *Futures*(82), 63-75.
doi:10.1016/j.futures.2016.06.004
- Vioglio, S. C., Maccheroni, F., Marinacci, M., & Montrucchio, L. (2011). Uncertainty averse preferences. *Journal of Economic Theory*(146), 1275-1330.
- Voros, J. (2017). Big history and anticipation: using big history as a framework for global foresight. R. Poli içinde, *Handbook of anticipation* (s. 40). Springer International.
- Wacker, J. G. (2004). A theory of formal conceptual definitions: developing theory-building measurement instruments. *Journal of Operations Management*, 629-650.
- Walker, W. E., Marchau, V. A., & Swanson, D. (2010). Addressing deep uncertainty using adaptive policies: Introduction to section 2. *Technological Forecasting & Social Change* (77), 917-923.
- Walker, W. E., Marchau, V. A., Bloeman, P. J., & Popper, S. W. (2019). *Decision making under deep uncertainty*. Cham: Springer.
- Walker, W., Harremoes, P., Rotmans, J., Sluijs, J. V., Asselt, M. V., Janssen, P., & Krauss, M. K. (2003). Defining uncertainty: A conceptual basis for uncertainty

management in model-based decision support. *Integrated Assessment*, 4(1), 1-13.

Wallentin, G., & Car, A. (2013). A framework for uncertainty assessment in simulation models. *International Journal of Geographical Information Science*, 27(2), 408-422.

Walley, P. (1991). *Statistical reasoning with imprecise probabilities*. London: Chapman & Hall.

Weber, C. A., Current, J. R., & Benton, W. C. (1991). Vendor selection criteria and methods. *European Journal of Operational Research*, 50, 2-18.

Weinstein, N. D. (1980). Unrealistic optimism about future life events. *Journal of Personality and Social Psychology*, 39(5), 806-820.

Weitzman, M. L. (1971). Material balances under uncertainty. *The Quarterly Journal of Economics*, 85(2), 262-282.

Westbrook, J. H., & Conrad, H. (1973). The science of hardness testing and its research applications. *American Society for metals*.

WIKİPEDI. (2021, 06 01). 2021 tarihinde tr.wikipedia.org:
<https://tr.wikipedia.org/wiki/Hippi> adresinden alındı

Wilson, C. B., & Clisset, P. (2011). Involving older people in research: Practical considerations when using the authenticity criteria in constructive inquiry. *Journal of Advanced Nursing*, 67(3), 677-686.

Wilson, M. C. (2009). Creativity, probability, and unertainty. *Journal of Economic Methodology*, 16(1), 45-56.

Wolfson, L. J., Kadane, J. B., & Small, M. J. (1996). Bayesian environmental policy decisions: Two case studies. *Ecological Applications*, 6(4), 1056-1066.

Yarrow, G. K. (1973). Managerial utility maximization under uncertainty. *Economica*, 40(158), 155-173.

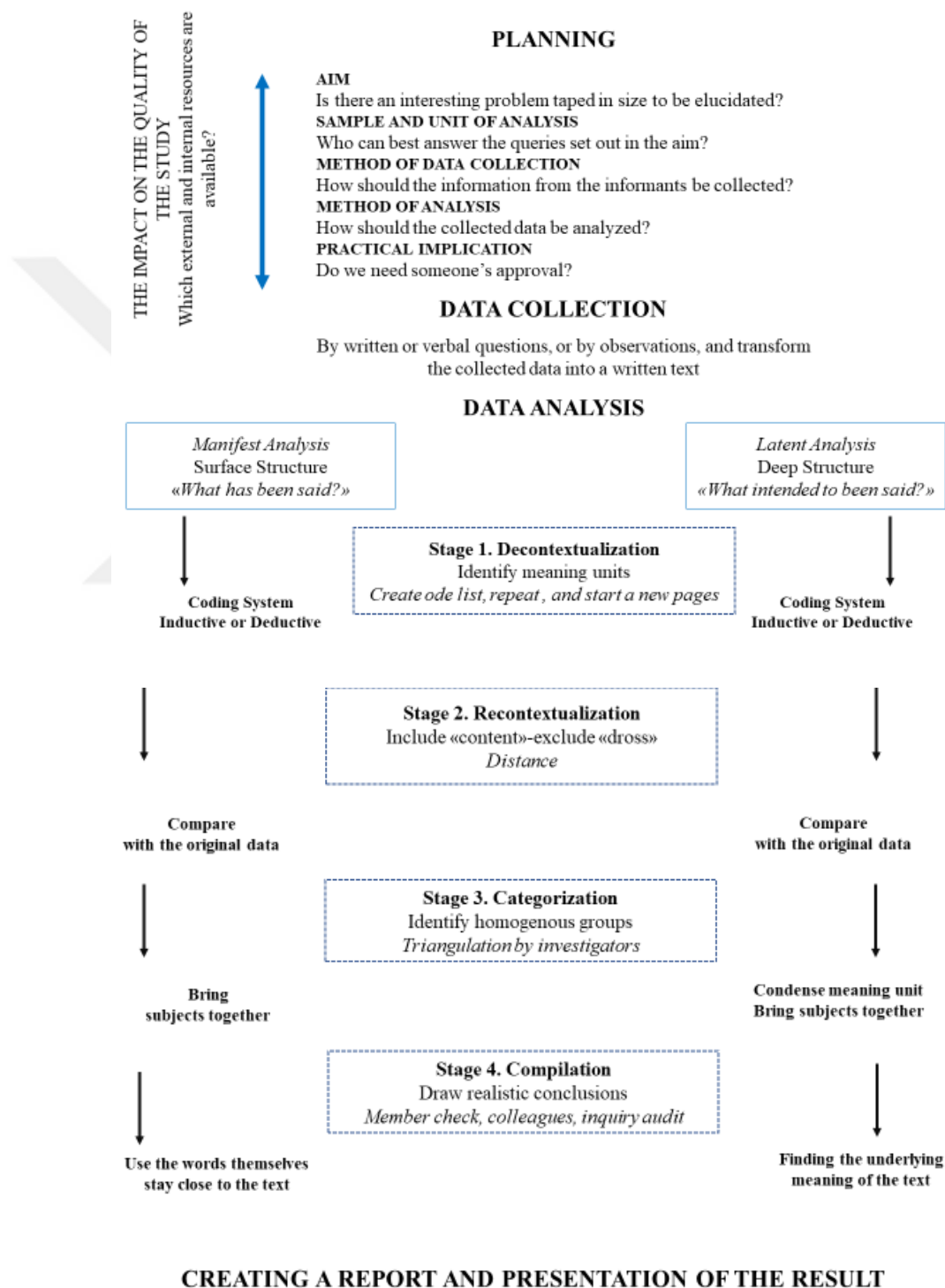
Zadeh, L. A. (1973). Outline of a new approach to the analysis of complex systems and decision process. *IEEE Transaction on systems, Man, and Cybernetics*(1), 28-44.

Zhang, Cao, & Doll. (2019). Fuzzy front end of innovation: A dual theoretical rationale. *Journal of Business & Industrial Marketing*, 34(1), 176-191.

APPENDIX A

Figure 20

An Overview of the Process of a Qualitative Content Analysis from Planning to Presentation



APPENDIX B

Figure 21

Checklist for Researchers Attempting to Improve the Trustworthiness of a Content Analysis Study

Phase of the content analysis study	Questions to check
• Preparation phase	• Data collection method • How do I collect the most suitable data for my content analysis? • Is this method the best available to answer the target research questions? • Should I use either descriptive or semi-structured questions? • Self-awareness • What are my skills as a researcher? • How do I pre-test my data collections method? • Sampling strategy • What is the best sampling method for my study? • Who are the best informants for my study? • What criteria should be used to select the participants? • Is my sample appropriate? • Is my data well saturated? • Selecting the unit of analysis • What is the unit of analysis? • Is the unit of analysis too narrow or too broad?
• Organization phase	• Categorization and abstraction • How should the concepts or categories be created? • Is there still too many concepts? • Is there any overlap between categories? • Interpretation • What is the degree of interpretation in the analysis? • How do I ensure that the data accurately represent the information that the participants provided? • Representativeness • How do I check the trustworthiness of the analysis process? • How do I check the representativeness of the data as a whole?
• Reporting phase	• Reporting results • Are the results reported systematically and logically? • How are connections between the data and results reported? • Is the content and structure of concept presented in a clear and understandable way? • Can the reader evaluate the transferability of the results (are the data, sampling, method, and participants described in a detailed manner)? • How well do the categories cover the data? • Are there similarities within and difference between categories? • Reporting analysis process • Is there a full description of the analysis process? • Is the trustworthiness of the content analysis discussed based on some criteria?

Note. (Elo et al., 2014)

APPENDIX C

Table 40

Articles List

	Year	Author	Article	Source	Vol.	No	Page
1	1941	Tintner	The theory of choice under subjective risk and uncertainty	Econometrica	9	3	298-304
2	1942	Tintner	A contribution to the non-static theory of choice	The Quarterly Journal of Economics	56	2	274-306
3	1949	Simpson	Neoclassical economics and monetary problems	The American Economic Review	39	5	861-882
4	1949	Moore & Tumin	Some social functions of ignorance	American Sociological Review	14	6	787-795
5	1950	Alchian	Uncertainty, evolution, and economic theory	Journal of Political Economy	58	3	211-221
6	1951	Arrow	Alternative approaches to the theory of choice in risk-taking situations	Econometrica	19	4	404-437
7	1954	Roegen	Choice, expectations and measurability	The Quarterly Journal of Economics	68	4	503-534
8	1960	Davis	Uncertainty in medical prognosis clinical and functional	American Journal of Sociology	66	1	41-47
9	1961	Fellner	Distortion of subjective probabilities as a reaction to uncertainty	The Quarterly Journal of Economics	75	4	670-689
10	1963	Brewer	Decisions under uncertainty: comments	The Quarterly Journal of Economics	77	1	159-161
11	1963	Marris	A model of the "managerial" enterprise	The Quarterly Journal of Economics	77	2	185-209
12	1965	Hirshleifer	Investment decision under uncertainty: choice-theoretic approaches	The Quarterly Journal of Economics	79	4	509-536
13	1966	Hirshleifer	Investment decision under uncertainty: applications of the state - preference approach	The Quarterly Journal of Economics	80	2	252-277
14	1968	Leland	Saving and uncertainty: the precautionary demand for saving	The Quarterly Journal of Economics	82	3	465-473
15	1971	Weitzman	Material balances under uncertainty	The Quarterly Journal of Economics	85	2	262-282

16	1972	Duncan	Characteristics of organizational environments and perceived environmental uncertainty	Administrative Science Quarterly	17	3	313-327
17	1972	Kamien&Schwartz	A direct approach to choice under uncertainty	Management Science	18	8	B470-B477
18	1973	Yarrow	Managerial utility maximization under uncertainty	Economica	40	158	155-173
19	1973	Edwards&Heggsted	Uncertainty, market structure, and performance	The Quarterly Journal of Economics	87	3	455-473
20	1974	Musgrave	Maximin, uncertainty, and the leisure trade-off	The Quarterly Journal of Economics	88	4	625-632
21	1977	Moore	The manager's struggles with uncertainty	Journal of the Roayal Statistical Society	140	2	129-165
22	1979	Kahneman&Tversky	An analysis of decisions under risk	Econometrica	47	2	263-292
23	1980	Prior	The cost of electricity under uncertainty	Futures		8	275-288
24	1980	Hall	Great Planning Disaster	Futures		2	45-50
25	1980	Ramage	Sudden Events	Futures		8	268-274
26	1980	Sharp	Technology and Growth	Futures		10	370-385
27	1980	Weinstein	Unrealistic Optimism About Future Life Events	Journal of Personality and Social Psychology	39	5	806-820
28	1984	Dess & Beard	Dimensions of Organizational Task Environment	Administrative Science Quarterly	29	1	52-73
29	1984	Vandell	Imperfect Information, Uncertainty, and Credit Rationing: Comment and Extension	The Quarterly Journal of Economics	99	4	841-863
30	1985	Star	Scientific Work and Uncertainty	Social Studies of Science	15	3	391-427
31	1985	Bourgeois	Strategic Goals, Perceived Uncertainty, and Economic Performance in Volatile Environments	Academy of Management Journal	28	3	548-573
32	1986	Tversky&Kahneman	Rational Choice and the Framing of Decisions	The Journal of Business	59	4	S251-S278
33	1987	Hodges	Uncertainty, Policy Analysis and Statistics	Statistical Science	2	3	259-275
34	1987	Ireland et al.	Strategy Formulation Process	Strategic Management Journal	8	5	469-485
35	1987	Milliken	Three Types of Perceived Uncertainty about The Environment	Academy of Management Review	12	1	133-143

36	1991	Tversky&Kahneman	Loss Aversion in Riskless Choice	The Quarterly Journal of Economics	106	4	1039-1061
37	1992	Gerrity et al.	Uncertainty and Professional Work	American Journal of Sociology	97	4	1022-1051
38	1992	Machina&Schmeidler	A More Robust Definition of Subjective Probability	Econometrica	60	1	745-780
39	1993	Schoemaker	Multiple Scenario Development: Its Conceptual and Behavioral Foundation	Strategic Management Journal	14	3	193-213
40	1993	Howell et al.	Uncertainty and Project Objectives	Project Appraisal	8	1	37-43
41	1996	Ellison	An Introduction to Bayesian Inference for Ecological Research and Environmental Decision-Making	Ecological Applications	6	4	1036-1046
42	1996	Wolfsan et al.	Bayesian Environmental Policy Decisions	Ecological Applications	6	4	1056-1066
43	1996	Ludwig	Uncertainty and The Assessment of Extinction Probabilities	Ecological Applications	6	4	1067-1076
44	1997	Healy	Changing Sciences and Ensuring our Future	Futures	29	6	509-517
45	1998	Engen et al.	Demographic and Environmental Stochasticity - Concept and Definitions	Biometrics	54	3	840-846
46	1998	Folta	Governance and Uncertainty	Strategic Management Journal	19	11	1007-1028
47	1998	Sutcliffe&Zaheer	Uncertainty in The Transaction Environment	Strategic Management Journal	19	1	.10-23.
48	1999	Strand	Forecasting Future	Futures	31		333-350
49	1999		Living with Uncertainty	The Antidote - CSBS	20		55-57
50	1999	Rappert	Rationalising the Future	Futures	31		527-545
51	2001	Tirole	Corporate Governance	Econometrica	69	1	.1-35
52	2001	Hughes	Choices in The Face of Uncertainty	Futures	33		55-62
53	2001	Timmermans&Angell	Evidence-Based Medicine, Clinical Uncertainty, and Learning to Doctor	Journal of Health and Social Behavior	42	4	342-359
54	2001	Gyawali&Dixit	Water and Science	Futures	33		689-708
55	2002	Morgan	Rating Banks: Risk and Uncertainty in an Opaque Industry	The American Economic Review	92	4	874-888

56	2002	Mercer&Wilter	Removing the Fear of Uncertainty from The Future: Theory and Practice	Foresight	4	5	38-45
57	2002	Regan et al.	A Taxonomy and Treatment of Uncertainty for Ecology and Conservation Biology	Ecological Applications	12	2	618-628
58	2003	Cantin&Michel	Towards a New Technology Future Approach	Futures		35	189-201
59	2004	Bedsworth et al.	Uncertainty and Regulation	Science, Technology & Human Values	29	3	406-427
60	2005	Artigiani	Leadership and Uncertainty: Complexity and The Lessons of History	Futures		37	585-603
61	2005	Macgill&Sui	A new paradigm for risk analysis	Futures		37	1105-1131
62	2005	Bradfield et al.	The origins and evolution of scenario techniques in long range business planning	Futures		37	795-812
63	2006	Newman	Change, uncertainty, and futures of sustainable development	Futures		38	633-637
64	2006	Börjeson et al.	Scenario types and techniques: Towards a user's guide	Futures		38	723-739
65	2007	Sollie	Ethics, technology development and uncertainty: an outline for any future ethics of technology	Journal of Information, Communication & Ethics in Society	5	4	293-306
66	2007	Peat	From certainty to uncertainty: thought, theory, and action in a postmodern world	Futures		39	920-929
67	2007	Hoffman	Strategies for managing a portfolio of alliances	Strategic Management Journal	28	8	827-856
68	2009	Wilson	Creativity, probability, and uncertainty	Journal of Economic Methodology	16	1	45-56
69	2009	Bloom	The impact of uncertainty shocks	Econometrica	77	3	623-685
70	2010	Walker et al.	Addressing deep uncertainty using adaptive policies: introduction to section 2	Technological Forecasting & Social Change		77	917-923
71	2010	Swanson et al.	Seven tools for creating adaptive policies	Technological Forecasting & Social Change		70	924-939
72	2010	Varum&Melo	Directions in scenario planning literature- a review of the past decades	Futures		42	355-369
73	2010	Sardar	The namesake: futures, futures studies, futurology, futuristic, foresight-What's in a name?	Futures		42	177-184
74	2011	Fox	Factors in ontological uncertainty related to ICT innovations	International Journal of Managing Projects in Business	4	1	137-149
75	2011	Elahi	Here be dragons ... exploring the 'unknown unknown'	Futures		43	196-201

76	2011	Blau	Uncertainty and the history of ideas	History and Theory	50	3	358-372
77	2011	Hall et al.	Managing technological and social uncertainties of innovation	Technological Forecasting & Social Change	78		1147-1157
78	2011	Tapinos	Perceived environmental uncertainty in scenario planning	Futures	44		338-345
79	2011	Vioglio et al.	Uncertainty averse preferences	Journal of Economic Theory	146		1275-1330
80	2012	Rast et al.,	Self-uncertainty and support for autocratic leadership	Psychology Press	1		.1-15.
81	2012	Dong & Hayes	Uncertainty Visualization	Journal of Cognitive Engineering and Decision Making	6	1	30-56
82	2013	Blockley	Analysing Uncertainties	Mechanical Systems and Signal Processing	37		30-42
83	2013	Kramer et al.,	Communication, uncertainty, and volunteer membership	Journal of Applied Communication Research	41	1	18-39
84	2013	Wallentin & Car	A framework for uncertainty assessment in simulation models	International Journal of Geographical Information Science	27	2	408-422
85	2013	Grubic et al.,	Future utility services'(un)knowns framework	Futures	54		68-86
86	2013	Ross et al.,	New developments in uncertainty assessment and uncertainty management	Experts Systems with Applications	40		964-974
87	2013	Haegeman et al.,	Quantitative and qualitative approaches in FTA	Technological Forecasting & Social Change	80		386-397
88	2014	Tonn & Stiefel	Human extinction risk and uncertainty	Futures	63		134-144
89	2014	Bradly & Drechsler	Types of Uncertainty	Erkenntnis / Springer	79	6	1225-1248
90	2015	Parker & Risbey	False precision, surprise, and improved uncertainty assessment	Philosophical Transactions: Mathematical, Physical, and Engineering Sciences	373	2055	.1.-.13.
91	2016	Derbyshire	The implications, challenges, and benefits of a complexity-oriented future studies	Futures	77		45-55
92	2016	Veenman & Leroy	Environmental outlooks: how they frame futures and long tem uncertainty	Futures	82		63-75
93	2016	Hauge&Barwell	Post-normal science and mathematics education in uncertain times	Futures	91		25-34
94	2016	Sardar&Sweeny	The three tomorrows of postnormal times	Futures	75		.1.-.13
95	2017	Kovacic	Investigating science	Futures	91		81-83

96	2017	Magruk	Concept of uncertainty in relation to the foresight research	ISMSME	9	1	46-55
97	2017	Derbyshire	The siren call of probability	Futures		88	43-54
98	2018	Dorsser et al.,	Improving the link between the futures field and policy making	Futures		104	75-84
99	2018	Andersson&Törnbeg	Wickedness and the anatomy of complexity	Futures		96	118-138
100	2019	Skyes et al.,	Identifying the factors driving the uncertainty in transport infrastructure project	Futures		111	26-41
101	2019	Meyer	The emergence of an envisioned future	Futures		109	130-141

APPENDIX D

Table 41

Verb Frequency List (1941-2019) 1

VERB	FREQUENCY	VERB	FREQUENCY
reduce uncertainty	30	highlight uncertainty	4
deal with uncertainty	24	indicate uncertainty	4
cope with uncertainty	18	investigate uncertainty	4
face uncertainty	16	present uncertainty	4
understand uncertainty	15	take uncertainty into account	4
consider uncertainty	14	underly uncertainty	4
recognize uncertainty	14	use uncertainty	4
describe uncertainty	13	view uncertainty	4
manage uncertainty	13	accept uncertainty	3
handle uncertainty	11	account for uncertainty	3
increase uncertainty	11	call uncertainty	3
define uncertainty	10	capture uncertainty	3
address uncertainty	9	control uncertainty	3
assess uncertainty	9	convert uncertainty	3
create uncertainty	9	decompose uncertainty	3
discuss uncertainty	9	decrease uncertainty	3
express uncertainty	9	emphasize uncertainty	3
ignore uncertainty	9	engage with uncertainty	3
measure uncertainty	9	evaluate uncertainty	3
resolve uncertainty	9	explore uncertainty	3
characterize uncertainty	8	focus on uncertainty	3
eliminate uncertainty	8	generate uncertainty	3
experience uncertainty	8	make uncertainty	3
introduce uncertainty	8	manifest uncertainty	3
quantify uncertainty	8	model uncertainty	3
represent uncertainty	8	overcome uncertainty	3
distinguish uncertainty	7	prevent uncertainty	3
identify uncertainty	7	produce uncertainty	3
minimize uncertainty	7	provide uncertainty	3
perceive uncertainty	7	regard uncertainty	3
show uncertainty	7	relate uncertainty	3
treat uncertainty	7	specify uncertainty	3
arise uncertainty	6	struggle with uncertainty	3
classify uncertainty	6	take account of uncertainty	3
conceptualize uncertainty	6	acknowledge uncertainty	2
focus uncertainty	6	add uncertainty	2
incorporate uncertainty	6	admit uncertainty	2
interpret uncertainty	6	affect uncertainty	2
involve uncertainty	6	appear uncertainty	2
reflect uncertainty	6	categorize uncertainty	2
associate with uncertainty	5	clarify uncertainty	2
concern uncertainty	5	compose uncertainty	2
contribute to uncertainty	5	concern with uncertainty	2
examine uncertainty	5	construct uncertainty	2
include uncertainty	5	contain uncertainty	2
respond uncertainty	5	contribute uncertainty	2
take uncertainty	5	convey uncertainty	2
analyze uncertainty	4	decide uncertainty	2
argue uncertainty	4	demonstrate uncertainty	2
avoid uncertainty	4	denote uncertainty	2
capture uncertainty	4	differentiate uncertainty	2
determine uncertainty	4	diminish uncertainty	2
entail uncertainty	4	display uncertainty	2
estimate uncertainty	4	disregard uncertainty	2

Table 42*Verb Frequency List (1941-2019) 2*

VERB	FREQUENCY	VERB	FREQUENCY
embody uncertainty	2	come with uncertainty	1
embrace uncertainty	2	communicate uncertainty	1
exist uncertainty	2	compound uncertainty	1
explain uncertainty	2	concede uncertainty	1
find uncertainty	2	confuse uncertainty	1
heighten uncertainty	2	constrain uncertainty	1
improve uncertainty	2	correspond uncertainty	1
influence uncertainty	2	counter uncertainty	1
lead uncertainty	2	cover uncertainty	1
mention uncertainty	2	criticize uncertainty	1
mitigate uncertainty	2	delineate uncertainty	1
place uncertainty	2	detail uncertainty	1
predict uncertainty	2	develop uncertainty	1
propose uncertainty	2	direct uncertainty	1
react to uncertainty	2	disclose uncertainty	1
report uncertainty	2	dissipate uncertainty	1
rise uncertainty	2	do with uncertainty	1
see uncertainty	2	dominate uncertainty	1
suggest uncertainty	2	draw attention to uncertainty	1
summarize uncertainty	2	draw uncertainty	1
suppose uncertainty	2	drive uncertainty	1
suppress uncertainty	2	eclipse uncertainty	1
take into account uncertainty	2	elaborate uncertainty	1
transform uncertainty	2	embed uncertainty	1
weigh uncertainty	2	encounter uncertainty	1
absorb uncertainty	1	encourage uncertainty	1
accentuate uncertainty	1	enhance uncertainty	1
account uncertainty	1	entrench uncertainty	1
achieve uncertainty	1	enumerate uncertainty	1
act in uncertainty	1	escalate uncertainty	1
adapt to uncertainty	1	eschew uncertainty	1
adopt uncertainty	1	exacerbate uncertainty	1
alleviate uncertainty	1	exclude uncertainty	1
allocate uncertainty	1	exhibit uncertainty	1
ameliorate uncertainty	1	expect uncertainty	1
anticipate uncertainty	1	explicate uncertainty	1
apply to uncertainty	1	face with uncertainty	1
apply uncertainty	1	facilitate uncertainty	1
appreciate uncertainty	1	fear uncertainty	1
assume uncertainty	1	feel uncertainty	1
augment uncertainty	1	fill with uncertainty	1
be acquainted with uncertainty	1	formulate uncertainty	1
be aware of uncertainty	1	frame uncertainty	1
be disappointed with uncertainty	1	gauge uncertainty	1
bear uncertainty	1	get used to uncertainty	1
bring about uncertainty	1	grasp uncertainty	1
build uncertainty	1	grow uncertainty	1
bury uncertainty	1	illustrate uncertainty	1
change uncertainty	1	imply uncertainty	1
choose uncertainty	1	impose uncertainty	1
claim uncertainty	1	impute uncertainty	1
cluster uncertainty	1	inject uncertainty	1
collapse uncertainty	1	judge uncertainty	1
combine uncertainty	1	lay out uncertainty	1

Table 43*Verb Frequency List (1941-2019) 3*

VERB	FREQUENCY	VERB	FREQUENCY
limit uncertainty	1	stem from uncertainty	1
live with uncertainty	1	stress uncertainty	1
maintain uncertainty	1	striae uncertainty	1
map onto uncertainty	1	strip uncertainty	1
map uncertainty	1	study uncertainty	1
master uncertainty	1	subsume uncertainty	1
maximize uncertainty	1	tackle uncertainty	1
mean uncertainty	1	take on uncertainty	1
mediate uncertainty	1	take up uncertainty	1
motivate uncertainty	1	tame uncertainty	1
move from uncertainty	1	term uncertainty	1
name uncertainty	1	test uncertainty	1
navigate uncertainty	1	theorize uncertainty	1
neglect uncertainty	1	think about uncertainty	1
obtain uncertainty	1	think uncertainty	1
omit uncertainty	1	tolerate uncertainty	1
open to uncertainty	1	transform into uncertainty	1
open up for uncertainty	1	trig uncertainty	1
operationalize uncertainty	1	uncover uncertainty	1
order uncertainty	1	underplay uncertainty	1
pay attention uncertainty	1	understate uncertainty	1
perform uncertainty	1	vary uncertainty	1
perpetuate uncertainty	1	visualize uncertainty	1
plan uncertainty	1	voice uncertainty	1
point at uncertainty	1	work with uncertainty	1
possess uncertainty	1	write about uncertainty	1
propagate uncertainty	1	yield to uncertainty	1
put uncertainty into perspective	1		
range uncertainty	1		
rate uncertainty	1		
reconfirm uncertainty	1		
refer uncertainty	1		
reflect upon uncertainty	1		
relegate uncertainty	1		
remark uncertainty	1		
reshape uncertainty	1		
respect to uncertainty	1		
respect uncertainty	1		
respond to uncertainty	1		
reveal uncertainty	1		
review uncertainty	1		
robust uncertainty	1		
role uncertainty	1		
seek uncertainty	1		
separate uncertainty	1		
shape uncertainty	1		
share uncertainty	1		
shift uncertainty	1		
shroud uncertainty	1		
sift uncertainty	1		
situate uncertainty	1		
solve uncertainty	1		
start with uncertainty	1		
state uncertainty	1		

Table 44*Adjective Frequency List (1941-2019) 1*

ADJECTIVE	FREQUENCY	ADJECTIVE	FREQUENCY
high uncertainty	20	diagnostic uncertainty	3
low uncertainty	14	double uncertainty	3
perceived uncertainty	11	exogenous uncertainty	3
environmental uncertainty	10	external uncertainty	3
inherent uncertainty	10	high-level uncertainty	3
technological uncertainty	10	increasing uncertainty	3
subjective uncertainty	9	inevitable uncertainty	3
greater uncertainty	8	little uncertainty	3
less uncertainty	8	much uncertainty	3
technical uncertainty	8	present uncertainty	3
considerable uncertainty	7	primary uncertainty	3
deep uncertainty	7	recognized uncertainty	3
epistemic uncertainty	7	relative uncertainty	3
fundamental uncertainty	7	severe uncertainty	3
more uncertainty	7	social uncertainty	3
total uncertainty	7	statistical uncertainty	3
increased uncertainty	6	stochastic uncertainty	3
major uncertainty	6	strategic uncertainty	3
epistemological uncertainty	5	accompanying uncertainty	2
great uncertainty	5	accumulated uncertainty	2
objective uncertainty	5	acknowledged uncertainty	2
political uncertainty	5	cognitive uncertainty	2
basic uncertainty	4	compounded uncertainty	2
clinical uncertainty	4	conceptual uncertainty	2
economic uncertainty	4	constant uncertainty	2
future uncertainty	4	current uncertainty	2
intrinsic uncertainty	4	distinct uncertainty	2
irreducible uncertainty	4	endogenous uncertainty	2
large uncertainty	4	estimated uncertainty	2
ontological uncertainty	4	functional uncertainty	2
parameter uncertainty	4	genuine uncertainty	2
real uncertainty	4	heightened uncertainty	2
residual uncertainty	4	high-degree uncertainty	2
significant uncertainty	4	initial uncertainty	2
strong uncertainty	4	internal uncertainty	2
structural uncertainty	4	intractable uncertainty	2
associated uncertainty	3	macro uncertainty	2
competitive uncertainty	3	maximum uncertainty	2
complete uncertainty	3	methodological uncertainty	2
conventional uncertainty	3	minimal uncertainty	2
critical uncertainty	3	multi-faceted uncertainty	2

Table 45*Adjective Frequency List (1941-2019) 2*

ADJECTIVE	FREQUENCY	ADJECTIVE	FREQUENCY
normative uncertainty	2	counterfactual uncertainty	1
organizational uncertainty	2	daily uncertainty	1
pervasive uncertainty	2	deeper uncertainty	1
potential uncertainty	2	dimensional uncertainty	1
probabilistic uncertainty	2	diminishing uncertainty	1
procedural uncertainty	2	distinguished uncertainty	1
pure uncertainty	2	dual uncertainty	1
quantified uncertainty	2	ecological uncertainty	1
radical uncertainty	2	empirical uncertainty	1
random uncertainty	2	erratic uncertainty	1
reduced uncertainty	2	ethical uncertainty	1
reducible uncertainty	2	experienced uncertainty	1
remaining uncertainty	2	factual uncertainty	1
scientific uncertainty	2	falling uncertainty	1
secondary uncertainty	2	full uncertainty	1
shallow uncertainty	2	generic uncertainty	1
small uncertainty	2	geological uncertainty	1
specific uncertainty	2	given uncertainty	1
substantive uncertainty	2	good uncertainty	1
surface uncertainty	2	great deal of uncertainty	1
weak uncertainty	2	grounded uncertainty	1
absolute uncertainty	1	growing uncertainty	1
additional uncertainty	1	higher uncertainty	1
aleatoric uncertainty	1	historical uncertainty	1
aleatory uncertainty	1	hydrological uncertainty	1
all uncertainty	1	identical uncertainty	1
analogical uncertainty	1	immediate uncertainty	1
anticipated uncertainty	1	important uncertainty	1
attaching uncertainty	1	inadequate uncertainty	1
attendant uncertainty	1	incredible uncertainty	1
bad uncertainty	1	independent uncertainty	1
behavioral uncertainty	1	indeterminable uncertainty	1
categorized uncertainty	1	indeterminate uncertainty	1
certain uncertainty	1	indifferent uncertainty	1
commercial uncertainty	1	indistinguishable uncertainty	1
compared uncertainty	1	inescapable uncertainty	1
compounding uncertainty	1	inference uncertainty	1
confronted uncertainty	1	innovative uncertainty	1
constructive uncertainty	1	institutional uncertainty	1
contextual uncertainty	1	interactive uncertainty	1
continued uncertainty	1	interpreted uncertainty	1

Table 46*Adjective Frequency List (1941-2019) 3*

ADJECTIVE	FREQUENCY	ADJECTIVE	FREQUENCY
introduced uncertainty	1	plausible uncertainty	1
irremediable uncertainty	1	possible uncertainty	1
key uncertainty	1	predictable uncertainty	1
larger uncertainty	1	predictive uncertainty	1
largest uncertainty	1	presented uncertainty	1
little uncertainty	1	pretended uncertainty	1
lingering uncertainty	1	prior uncertainty	1
linguistic uncertainty	1	produced uncertainty	1
local uncertainty	1	prognostic uncertainty	1
long term uncertainty	1	prominent uncertainty	1
long-run uncertainty	1	proxy uncertainty	1
lower uncertainty	1	purest uncertainty	1
manageable uncertainty	1	quantifiable uncertainty	1
many uncertainties	1	regulative uncertainty	1
mathematical uncertainty	1	relevant uncertainty	1
maximal uncertainty	1	represented uncertainty	1
measurable uncertainty	1	resultant uncertainty	1
medical uncertainty	1	scaling uncertainty	1
micro uncertainty	1	second-order uncertainty	1
mild uncertainty	1	separable uncertainty	1
minimum uncertainty	1	simple uncertainty	1
mixed uncertainty	1	spatial uncertainty	1
modal uncertainty	1	state uncertainty	1
model uncertainty	1	substantial uncertainty	1
monolithic uncertainty	1	subsumed uncertainty	1
most uncertainty	1	superimposing uncertainty	1
natural uncertainty	1	tamable uncertainty	1
negligible uncertainty	1	taxonomic uncertainty	1
neutral uncertainty	1	temporary uncertainty	1
no uncertainty	1	terminological uncertainty	1
non-negligible uncertainty	1	time-changing uncertainty	1
non-numeric uncertainty	1	time-varying uncertainty	1
non-probabilistic uncertainty	1	treacherous uncertainty	1
novel uncertainty	1	true uncertainty	1
numerical uncertainty	1	two-state uncertainty	1
painful uncertainty	1	unavoidable uncertainty	1
parametric uncertainty	1	uncounted uncertainty	1
paramount uncertainty	1	underappreciated uncertainty	1
permissible uncertainty	1	unique uncertainty	1
personal uncertainty	1	unknowable uncertainty	1
pertinent uncertainty	1	unknown uncertainty	1
		unmeasurable uncertainty	1
		unproblematic uncertainty	1
		unwarranted uncertainty	1
		variability uncertainty	1
		various uncertainties	1

Table 47*Concept Frequency List (1941-2019) 1*

CONCEPT	FREQUENCY	CONCEPT	FREQUENCY
degree of uncertainty	26	management of uncertainty	5
level of uncertainty	25	perception of uncertainty	5
source of uncertainty	21	scope of uncertainty	5
decision-making under uncertainty	20	significance of uncertainty	5
measure of uncertainty	18	situation of uncertainty	5
type of uncertainty	17	study of uncertainty	5
under uncertainty	14	about uncertainty	4
condition of uncertainty	13	analysis of uncertainty	4
effect of uncertainty	13	characterization of uncertainty	4
concept of uncertainty	12	choice under uncertainty	4
nature of uncertainty	11	context of uncertainty	4
aspect of uncertainty	10	discussion of uncertainty	4
amount of uncertainty	9	factor of uncertainty	4
form of uncertainty	9	increase in uncertainty	4
kind of uncertainty	9	influence of uncertainty	4
case of uncertainty	8	location of uncertainty	4
definition of uncertainty	8	parameter of uncertainty	4
dimension of uncertainty	8	quantification of uncertainty	4
impact of uncertainty	8	reduction of uncertainty	4
problem of uncertainty	8	research on uncertainty	4
response to uncertainty	8	resolution of uncertainty	4
treatment of uncertainty	8	scale uncertainty	4
face of uncertainty	7	sense of uncertainty	4
managing uncertainty	7	state uncertainty	4
presence of uncertainty	7	uncertainty analysis	4
range of uncertainty	7	uncertainty assessment	4
representation of uncertainty	7	uncertainty management	4
uncertainty about	7	value of uncertainty	4
uncertainty regarding	7	variety of uncertainty	4
uncertainty surrounding	7	attitude toward uncertainty	3
assessment of uncertainty	6	aware of uncertainty	3
awareness of uncertainty	6	category of uncertainty	3
identification of uncertainty	6	characteristic of uncertainty	3
importance of uncertainty	6	class of uncertainty	3
role of uncertainty	6	classification of uncertainty	3
typology of uncertainty	6	component of uncertainty	3
area of uncertainty	5	consequence of uncertainty	3
conceptualization of uncertainty	5	construct of uncertainty	3
decision under uncertainty	5	denial of uncertainty	3
emphasis on uncertainty	5	element of uncertainty	3
issue of uncertainty	5	example of uncertainty	3

Table 48*Concept Frequency List (1941-2019) 2*

CONCEPT	FREQUENCY	CONCEPT	FREQUENCY
expression of uncertainty	3	indication of uncertainty	2
focus of uncertainty	3	interpretation of uncertainty	2
implication of uncertainty	3	key uncertainty	2
magnitude of uncertainty	3	management under uncertainty	2
market uncertainty	3	maximization under uncertainty	2
measuring uncertainty	3	measurement of uncertainty	2
model uncertainty	3	modelling uncertainty	2
pervasiveness of uncertainty	3	negotiation of uncertainty	2
question of uncertainty	3	notion of uncertainty	2
regarding uncertainty	3	operationalization of uncertainty	2
taxonomy of uncertainty	3	outcome of uncertainty	2
uncertainty in system	3	pattern of uncertainty	2
uncertainty of future	3	period of uncertainty	2
understanding of uncertainty	3	proxy for uncertainty	2
view of uncertainty	3	quality of uncertainty	2
acceptance of uncertainty	2	reaction to uncertainty	2
account of uncertainty	2	recognition of uncertainty	2
acknowledgement of uncertainty	2	result uncertainty	2
approach to uncertainty	2	room for uncertainty	2
cause of uncertainty	2	scenario uncertainty	2
change in uncertainty	2	set of uncertainty	2
characterizing uncertainty	2	sociology of uncertainty	2
choice and uncertainty	2	specification uncertainty	2
communication of uncertainty	2	state of uncertainty	2
consideration of uncertainty	2	structure uncertainty	2
controlling for uncertainty	2	supplier uncertainty	2
demand uncertainty	2	system uncertainty	2
domain of uncertainty	2	training for uncertainty	2
effect uncertainty	2	uncertainty aversion	2
estimate of uncertainty	2	uncertainty avoidance	2
evaluation of uncertainty	2	uncertainty concept	2
existence of uncertainty	2	uncertainty information	2
experience of uncertainty	2	uncertainty measure	2
extent of uncertainty	2	uncertainty of outcome	2
fact of uncertainty	2	uncertainty overlaps	2
framework of uncertainty	2	uncertainty preference	2
fraught with uncertainty	2	uncertainty reduction	2
function of uncertainty	2	uncertainty representation	2
future of uncertainty	2	uncertainty visualization	2
in terms of uncertainty	2	uncomfortable with uncertainty	2
incorporation of uncertainty	2	use of uncertainty	2

Table 49*Concept Frequency List (1941-2019) 3*

CONCEPT	FREQUENCY	CONCEPT	FREQUENCY
absence of uncertainty	1	cone of uncertainty	1
accepting uncertainty	1	confusion about uncertainty	1
accounting for uncertainty	1	consisting of uncertainty	1
accumulation of uncertainty	1	construction of uncertainty	1
accurrence of uncertainty	1	consumer uncertainty	1
actions under uncertainty	1	consumption uncertainty	1
admission of uncertainty	1	continuum of uncertainty	1
admitting uncertainty	1	contributor uncertainty	1
adoption to uncertainty	1	converting uncertainty	1
allowance for uncertainty	1	creation of uncertainty	1
analyzing of uncertainty	1	credit uncertainty	1
analysis uncertainty	1	criteria of uncertainty	1
analyzing uncertainty	1	critical thinking about uncertainty	1
appreciation of uncertainty	1	culture of uncertainty	1
approach for uncertainty	1	customer uncertainty	1
assembling uncertainty	1	deal of uncertainty	1
assumption of uncertainty	1	dealing with uncertainty	1
assumptions under uncertainty	1	decision based on uncertainty	1
attention to uncertainty	1	decrease of uncertainty	1
attribute of uncertainty	1	deletion of uncertainty	1
aversion for uncertainty	1	description of uncertainty	1
away with uncertainty	1	developing uncertainty element	1
background of uncertainty	1	development in uncertainty	1
barrier of uncertainty	1	diagnosis of uncertainty	1
baseline uncertainty	1	difficulty of uncertainty	1
basis of uncertainty	1	disregard of uncertainty	1
be comfortable with uncertainty	1	disturbed by uncertainty.	1
because of uncertainty	1	dominance of uncertainty	1
behavior under uncertainty	1	downplaying of uncertainty	1
behind uncertainty	1	driver of uncertainty	1
bothered by uncertainty	1	duration of uncertainty	1
bundle of uncertainty	1	economics of uncertainty	1
burst of uncertainty	1	enhancement of uncertainty	1
catalogue of uncertainty	1	estimation of uncertainty	1
circle of uncertainty	1	existence under uncertainty	1
circumstances of uncertainty	1	experiment for uncertainty	1
combination of uncertainty	1	expert in uncertainty	1
comment on uncertainty	1	extreme of uncertainty	1
completeness uncertainty	1	fear of uncertainty	1
conception of uncertainty	1	feature of uncertainty	1
condition uncertainty	1	feeling of uncertainty	1

Table 50*Concept Frequency List (1941-2019) 4*

CONCEPT	FREQUENCY	CONCEPT	FREQUENCY
finding from uncertainty	1	method of uncertainty	1
force of uncertainty	1	multidimensionality of uncertainty	1
formalization uncertainty	1	multiplication of uncertainty	1
format of uncertainty	1	norm uncertainty	1
framework for uncertainty	1	nuances of uncertainty	1
framing of uncertainty	1	object of uncertainty	1
future uncertainty	1	obverse of uncertainty	1
governance and uncertainty	1	occurrence of uncertainty	1
handling uncertainty	1	onset of uncertainty	1
higher level of uncertainty	1	openness to uncertainty	1
history of uncertainty	1	opt for uncertainty	1
homogeneity of uncertainty	1	ordering of uncertainty	1
idea of uncertainty	1	origin of uncertainty	1
identifying uncertainty	1	outcome uncertainty	1
ignoring uncertainty	1	parameterization uncertainty	1
image of uncertainty	1	perpetuation of uncertainty	1
implicit in uncertainty	1	perturbed by uncertainty	1
improvement in uncertainty	1	phenomenon of uncertainty	1
in relation to uncertainty	1	picture of uncertainty	1
including uncertainty	1	pitfall of uncertainty	1
inclusion of uncertainty	1	place of uncertainty	1
indicator of uncertainty	1	placement of uncertainty	1
industry uncertainty	1	planning uncertainty	1
innovation uncertainty	1	policy uncertainty	1
intolerance of uncertainty	1	politics of uncertainty	1
introducing uncertainty	1	portraying of uncertainty	1
inverse of uncertainty	1	precision of uncertainty	1
involving uncertainty	1	preoccupation with uncertainty	1
knowledge uncertainty	1	pretense of uncertainty	1
lack of uncertainty	1	primacy of uncertainty	1
leadership and uncertainty	1	process pf uncertainty	1
legitimacy uncertainty	1	productivity uncertainty	1
literature on uncertainty	1	prominence of uncertainty	1
living with uncertainty	1	prompting for uncertainty	1
locus of uncertainty	1	property of uncertainty	1
making decision under uncertainty	1	rationality-in-uncertainty	1
management level in uncertainty	1	realm of uncertainty	1
managing under uncertainty	1	real-world uncertainty	1
manifestation of uncertainty	1	reducing uncertainty	1
meaning of uncertainty	1	reduction in uncertainty	1
measurement uncertainty	1	re-examining uncertainty	1

Table 51*Concept Frequency List (1941-2019) 5*

CONCEPT	FREQUENCY	CONCEPT	FREQUENCY
region of uncertainty	1	time of uncertainty	1
regulatory uncertainty	1	tolerance for uncertainty	1
related to uncertainty	1	tolerance of uncertainty	1
relative to uncertainty	1	topic of uncertainty	1
relevance of uncertainty	1	toward uncertainty	1
replete with uncertainty	1	transformation of uncertainty	1
representation for uncertainty	1	unavoidability of uncertainty	1
requirement for uncertainty	1	uncertainty in assumption	1
research-based uncertainty	1	uncertainty about future	1
research of uncertainty	1	uncertainty and probability	1
resolving uncertainty	1	uncertainty approach	1
resource uncertainty	1	uncertainty around	1
response uncertainty	1	uncertainty attitude	1
retooling of uncertainty	1	uncertainty awareness	1
review of uncertainty	1	uncertainty bounding	1
risk and uncertainty	1	uncertainty combination	1
sand of uncertainty	1	uncertainty component	1
saving and uncertainty	1	uncertainty concerning	1
scheme of uncertainty	1	uncertainty conditions	1
self-uncertainty	1	uncertainty created by	1
separation of uncertainty	1	uncertainty data	1
setting of uncertainty	1	uncertainty debate	1
severity of uncertainty	1	uncertainty expression	1
sharing of uncertainty	1	uncertainty in data	1
some of uncertainty	1	uncertainty in demand	1
sort of uncertainty	1	uncertainty in environment	1
spectrum of uncertainty	1	uncertainty in loss function	1
stage of uncertainty	1	uncertainty in process	1
standardization of uncertainty	1	uncertainty in regulation	1
stress from uncertainty	1	uncertainty in theory	1
subset of uncertainty	1	uncertainty interaction	1
surrounded by uncertainty	1	uncertainty inventory	1
surrounding uncertainty	1	uncertainty level	1
target of uncertainty	1	uncertainty literature	1
task uncertainty	1	uncertainty matrix	1
term of uncertainty	1	uncertainty measurement	1
theme of uncertainty	1	uncertainty model	1
theoretical uncertainty system	1	uncertainty of conclusion	1
theory of uncertainty	1	uncertainty of data	1
theory under uncertainty	1	uncertainty of development	1
thought of uncertainty	1	uncertainty of ethics	1

Table 52*Concept Frequency List (1941-2019) 6*

CONCEPT	FREQUENCY
uncertainty of event	1
uncertainty of knowledge	1
uncertainty of life	1
uncertainty of management	1
uncertainty of medicine	1
uncertainty of project	1
uncertainty of response	1
uncertainty of something	1
uncertainty of struggle	1
uncertainty of subordination	1
uncertainty of treatment	1
uncertainty outcome	1
uncertainty principle	1
uncertainty process	1
uncertainty quantification	1
uncertainty range	1
uncertainty resolution	1
uncertainty scale	1
uncertainty shock	1
uncertainty situation	1
uncertainty theory	1
uncertainty typology	1
under estimation of uncertainty	1
understanding uncertainty	1
update of uncertainty	1
updating of uncertainty	1
validation uncertainty	1
variability uncertainty	1
variance in uncertainty	1
variance in uncertainty	1
various uncertainty	1
version of uncertainty	1
volume uncertainty	1
wealth of uncertainty	1
well-defined uncertainty	1
with uncertainty	1
writing on uncertainty	1

APPENDIX E

Table 53

First Decade VAC (Verb, Adjective, Concept) List

	Verb	Adjective	Concept
1	to appear uncertainty	attaching uncertainty	absence of uncertainty
2	to concern uncertainty	basic uncertainty	actions under uncertainty
3	to consider uncertainty	complete uncertainty	assets under uncertainty
4	to construct uncertainty	double uncertainty	assumption of uncertainty
5	to define uncertainty	given uncertainty.	assumptions under uncertainty
6	to describe uncertainty	objective uncertainty	because of uncertainty
7	to direct uncertainty	possible uncertainty	behavior under uncertainty
8	to exclude uncertainty	prominent uncertainty	behavior under uncertainty
9	to express uncertainty	recognized uncertainty.	case of uncertainty
10	to interpret uncertainty	relative uncertainty	case of uncertainty
11	to introduce uncertainty	subjective uncertainty	choice under uncertainty
12	to maximize uncertainty	subjective uncertainty	choice under uncertainty
13	to produce uncertainty	subjective uncertainty	choice under uncertainty
14	to reduce uncertainty	technological uncertainty	concept of uncertainty
15	to regard uncertainty	technological uncertainty	conditions of uncertainty
16	to regard uncertainty	treacherous uncertainty	conditions of uncertainty
17	to relate uncertainty	true uncertainty	consequences about uncertainty
18	to represent uncertainty	unmeasurable uncertainty	creation of uncertainty systems
19	to start with uncertainty		decision-making under uncertainty
20	to suppress uncertainty		degree of uncertainty
21			describing uncertainty.
22			description of uncertainty
23			developing uncertainty elements
24			difficulties of uncertainty
25			discussion of uncertainty
26			disturbed by uncertainty.
27			economics of uncertainty
28			evaluation of uncertainty
29			existence of uncertainty
30			existence of uncertainty
31			formulation of uncertainty
32			functional view of uncertainty
33			history of uncertainty
34			implicit in uncertainty
35			inclusion of uncertainty
36			knowledge of uncertainty
37			pervasiveness of uncertainty
38			phenomenon of uncertainty

39			position relative to uncertainty
40			preference for uncertainty
41			presence of uncertainty
42			problems of uncertainty
43			question of uncertainty
44			reaction to uncertainty
45			system of uncertainty
46			theoretical uncertainty systems
47			theory of uncertainty
48			types of uncertainty
49			uncertainty of a situation
50			uncertainty of consequences
51			uncertainty of outcome
52			uncertainty preference
53			uncertainty preference
54			uncertainty situation.
55			uncertainty situations

Table 54*Second Decade VAC (Verb, Adjective, Concept) List*

	Verb	Adjective	Concept
1	to involve uncertainty	clinical uncertainty	acceptance of uncertainty
2	to argue uncertainty	complete uncertainty	admission of uncertainty
3	to associate with uncertainty	diagnostic uncertainty	choice among uncertainties
4	to associate with uncertainty	distinct uncertainty	choice and uncertainty
5	to compose uncertainty	functional uncertainty	communication of uncertainty
6	to concede uncertainty	great uncertainty	concept of uncertainty
7	to consider uncertainty	identical uncertainty	decision making under uncertainty.
8	to cope with uncertainty	indifferent uncertainties	decision under uncertainty
9	to do with uncertainty	introduced uncertainty	decision under uncertainty
10	to eliminate uncertainty	measurable uncertainty	decision under uncertainty
11	to entail uncertainty	neutral uncertainty	degree of uncertainty
12	to examine uncertainty	present uncertainty	degree of uncertainty
13	to get used to uncertainty.	pretended uncertainty.	degree of uncertainty
14	to increase uncertainty	prognostic uncertainty	domain of uncertainty
15	to interpret uncertainty	purest uncertainty	domain of uncertainty
16	to introduce uncertainty	real uncertainty	duration of uncertainty
17	to make uncertainty	superimposing uncertainty	effect of uncertainty
18	to order uncertainty	two-state uncertainty	example of uncertainty
19	to reduce uncertainty	unwarranted uncertainty	existence under uncertainty
20	to relate uncertainty		form of uncertainty
21	to represent uncertainty		form of uncertainty
22	to state uncertainty		fraught with uncertainty
23	to treat uncertainty		function of uncertainty
24			influence of uncertainty
25			intolerance of uncertainty
26			issue of uncertainty
27			measure of uncertainty
28			ordering of uncertainty
29			perpetuation of uncertainty
30			portraying of uncertainty
31			pretense of uncertainty
32			problem of uncertainty
33			range of uncertainty
34			reaction to uncertainty
35			saving and uncertainty
36			scope of uncertainty
37			significance of uncertainty
38			theory of uncertainty
39			treatment of uncertainty
40			uncertainty and probability

Table 55*Third Decade VAC (Verb, Adjective, Concept) List*

	Verb	Adjective	Concept
1	to avoid uncertainty	basic uncertainty	amount of uncertainty
2	to build uncertainty	clinical uncertainty	area of uncertainty
3	to change uncertainty	confronted uncertainty	aspect of uncertainty
4	to concern uncertainty	considerable uncertainty	aspect of uncertainty
5	to contain uncertainty	considerable uncertainty	assessment of uncertainty
6	to cope with uncertainty	considerable uncertainty	attitude toward uncertainty
7	to describe uncertainty	constant uncertainty	aversion for uncertainty
8	to eliminate uncertainty	conventional uncertainty	choice under uncertainty
9	to encourage uncertainty	conventional uncertainty	component of uncertainty
10	to experience uncertainty	daily uncertainty	concept of uncertainty
11	to explain uncertainty	diagnostic uncertainty	contributor to uncertainty
12	to face uncertainty	double uncertainty	decision making under uncertainty
13	to introduce uncertainty	dual uncertainty	decision under uncertainty
14	to involve uncertainty	economic uncertainty	decision-making under uncertainty
15	to lead uncertainty	environmental uncertainty	decision-making under uncertainty
16	to model uncertainty	environmental uncertainty	decision-making under uncertainty
17	to place uncertainty	environmental uncertainty	decision-making under uncertainty
18	to predict uncertainty	environmental uncertainty	definition of uncertainty
19	to quantify uncertainty	epistemological uncertainty	degree of uncertainty
20	to reflect uncertainty	functional uncertainty	degree of uncertainty
21	to reflect uncertainty	geological uncertainty	effect of uncertainty
22	to struggle with uncertainty	great uncertainty	effect of uncertainty
23	to treat uncertainty	great uncertainty	effect of uncertainty
24		greater uncertainty	enhancement of uncertainty
25		high uncertainty	experts in uncertainty
26		high-degree uncertainty	face of uncertainty
27		high-level uncertainty	impact of uncertainty
28		immediate uncertainty	introduction of uncertainty
29		increased uncertainty	level of uncertainty
30		increasing uncertainty	maximization under uncertainty
31		inescapable uncertainty	maximization under uncertainty
32		interactive uncertainty	measure of uncertainty
33		little uncertainty	measurement of uncertainty
34		local uncertainty	measures of uncertainty
35		low uncertainty	measuring uncertainty
36		major uncertainty	norm uncertainty
37		monolithic uncertainty	perception of uncertainty
38		perceived uncertainty	presence of uncertainty
39		perceived uncertainty	quantification of uncertainty
40		perceived uncertainty	recognition of uncertainty

41		pertinent uncertainty	representation of uncertainty
42		political uncertainty	role of uncertainty
43		severe uncertainty	separation of uncertainty
44		subsumed uncertainty	situation of uncertainty
45		taxonomic uncertainty	theory under uncertainty
46		technical uncertainty	tolerance for uncertainty
47		technical uncertainty	treatment of uncertainty
48		technological uncertainty	type of uncertainty
49		total uncertainty	uncertainty about
50			uncertainty avoidance
51			uncertainty component
52			uncertainty expression
53			uncertainty information
54			uncertainty literature
55			uncertainty model
56			uncertainty of event
57			uncertainty regarding
58			uncertainty regarding
59			uncertainty theory
60			under uncertainty
61			under uncertainty
62			under uncertainty
63			under uncertainty
64			variance in uncertainty
65			view of uncertainty.

Table 56*Fourth Decade VAC (Verb, Adjective, Concept) List*

	Verb	Adjective	Concept
1	to absorb uncertainty	basic uncertainty	account of uncertainty
2	to account for uncertainty	clinical uncertainty	accounting for uncertainty
3	to account uncertainty	confronted uncertainty	accumulation of uncertainty
4	to add uncertainty	considerable uncertainty	amount of uncertainty
5	to address uncertainty	considerable uncertainty	amount of uncertainty
6	to arise uncertainty	constant uncertainty	analyzing uncertainty
7	to assess uncertainty	conventional uncertainty	analysis of uncertainty
8	to avoid uncertainty	daily uncertainty	area of uncertainty
9	to bury uncertainty	diagnostic uncertainty	area of uncertainty
10	to capture uncertainty	double uncertainty	area of uncertainty
11	to characterize uncertainty	dual uncertainty	assembling uncertainty
12	to concern uncertainty	economic uncertainty	assessment of uncertainty
13	to consider uncertainty	environmental uncertainty	attribute of uncertainty
14	to contribute uncertainty	environmental uncertainty	awareness of uncertainty
15	to convert uncertainty	environmental uncertainty	case of uncertainty
16	to cope with uncertainty	environmental uncertainty	catalogue of uncertainty
17	to cope with uncertainty	environmental uncertainty	characterizing uncertainty
18	to cope with uncertainty	epistemological uncertainty	completeness uncertainty
19	to cope with uncertainty	functional uncertainty	concept of uncertainty
20	to cope with uncertainty	geological uncertainty	concept of uncertainty
21	to counter uncertainty	great deal of uncertainty	conceptualization of uncertainty
22	to create uncertainty	great uncertainty	condition of uncertainty
23	to deal with uncertainty	great uncertainty	condition of uncertainty
24	to deal with uncertainty	greater uncertainty	confusion about uncertainty
25	to deal with uncertainty	greater uncertainty	consequence of uncertainty
26	to deal with uncertainty	high level of uncertainty	construct of uncertainty.
27	to decrease uncertainty	high-degree uncertainty	context of uncertainty
28	to define uncertainty	high-degree uncertainty	decision making under uncertainty
29	to define uncertainty	high-level uncertainty	decision-making under uncertainty
30	to describe uncertainty	immediate uncertainty	definition of uncertainty
31	to describe uncertainty	increased uncertainty	degree of uncertainty
32	to describe uncertainty	increasing uncertainty	deletion of uncertainty
33	to diminish uncertainty	inescapable uncertainty	discussion about uncertainty
34	to discuss uncertainty	interactive uncertainty	discussion of uncertainty
35	to distinguish uncertainty	less uncertainty	effect of uncertainty
36	to elaborate uncertainty	lingering uncertainty	effect of uncertainty
37	to eliminate uncertainty	local uncertainty	effect uncertainty
38	to embody of uncertainty	lower uncertainty	estimation of uncertainty
39	to emphasize uncertainty	major uncertainty	existence of uncertainty
40	to emphasize uncertainty	model uncertainty	experience of uncertainty

41	to entail uncertainty	monolithic uncertainty	experiment for uncertainty.
42	to exist uncertainty	more uncertainty	fact of uncertainty
43	to experience uncertainty	parameter uncertainty	focus of uncertainty.
44	to experience uncertainty	perceived uncertainty	focus of uncertainty.
45	to face uncertainty	perceived uncertainty	form of uncertainty.
46	to face uncertainty	perceived uncertainty	future of uncertainty
47	to find uncertainty	plausible uncertainty	future uncertainty
48	to focus uncertainty	political uncertainty	homogeneity of uncertainty
49	to focus uncertainty	predictive uncertainty	implication of uncertainty
50	to formulate uncertainty	remaining uncertainty	importance of uncertainty
51	to handle uncertainty	severe uncertainty	in light of uncertainty
52	to handle uncertainty	significant uncertainty	indicator of uncertainty
53	to heighten uncertainty	state uncertainty	involving uncertainty.
54	to ignore uncertainty	structural uncertainty	kind of uncertainty
55	to ignore uncertainty	subjective uncertainty	kind of uncertainty
56	to impose uncertainty	subsumed uncertainty	kind of uncertainty
57	to incorporate uncertainty	taxonomic uncertainty	level of uncertainty
58	to incorporate uncertainty	technical uncertainty	location for uncertainty
59	to increase uncertainty	technical uncertainty	magnitude of uncertainty
60	to increase uncertainty	technical uncertainty	management level in uncertainty
61	to influence uncertainty	technological uncertainty	management of uncertainty
62	to introduce uncertainty	total uncertainty	management of uncertainty
63	to make uncertainty	uncounted uncertainty	management of uncertainty
64	to manage uncertainty		manifestation of uncertainty
65	to manifest uncertainty		measure of uncertainty
66	to measure uncertainty		measure of uncertainty
67	to measure uncertainty		measure of uncertainty
68	to measure uncertainty		measuring of uncertainty
69	to measure uncertainty		method of uncertainty
70	to omit uncertainty		modelling uncertainty
71	to perceive uncertainty		nature of uncertainty
72	to perceive uncertainty		operationalization of uncertainty
73	to possess uncertainty		path of uncertainty
74	to present uncertainty		perception of uncertainty
75	to prevent uncertainty		perception of uncertainty
76	to propagate uncertainty		perception of uncertainty
77	to recognize uncertainty		pervasiveness of uncertainty
78	to recognize uncertainty		problem of uncertainty
79	to reduce uncertainty		range of uncertainty
80	to reduce uncertainty		reducing uncertainty
81	to resolve uncertainty		reduction of uncertainty
82	to respect uncertainty		re-examining uncertainty
83	to respond uncertainty		regarding uncertainty
84	to seek uncertainty		representation of uncertainty

85	to sift uncertainty		research on uncertainty
86	to specify uncertainty		response uncertainty
87	to subsume uncertainty		role of uncertainty
88	to take account of uncertainty		scheme of uncertainty
89	to take uncertainty		segmentation of uncertainty
90	to transform uncertainty		sense of uncertainty
91	to treat uncertainty		sociology of uncertainty
92	to underly uncertainties		source of uncertainty
93	to understand uncertainty		source of uncertainty
94	to understate uncertainty		state uncertainty
95	to weigh uncertainty		system uncertainty
96	to write about uncertainty		taxonomy of uncertainty
97			training for uncertainty
98			training for uncertainty
99			transformation of uncertainty
100			treatment of uncertainty
101			type of uncertainty
102			type of uncertainty
103			type of uncertainty
104			type of uncertainty
105			typology of uncertainty
106			uncertainty avoidance
107			uncertainty created by
108			uncertainty in demand
109			uncertainty in loss function
110			uncertainty in system
111			uncertainty of outcome
112			uncertainty reduction
113			uncertainty resolution
114			uncertainty scale
115			under uncertainty
116			under uncertainty
117			under uncertainty
118			variance in uncertainty
119			variety of uncertainty
120			various uncertainty

Table 57*Fifth Decade VAC (Verb, Adjective, Concept) List*

	Verb	Adjective	Concept
1	to accentuate uncertainty	acknowledged uncertainty.	adoption to uncertainty
2	to accept uncertainty	basic uncertainty	amount of uncertainty
3	to account for uncertainty	behavioral uncertainty	amount of uncertainty
4	to achieve uncertainty	clinical uncertainty	aspect of uncertainty
5	to acknowledge uncertainty	competitive uncertainty	assessment of uncertainty
6	to address uncertainty	considerable uncertainty	assessment of uncertainty
7	to affect uncertainty	considerable uncertainty	awareness of uncertainty
8	to analyze uncertainty	constructive uncertainty	be comfortable with the uncertainty.
9	to apply to uncertainty	contextual uncertainty	bothered by uncertainty
10	to appreciate uncertainty	conventional uncertainty	bundle of uncertainty
11	to arise uncertainty	deep uncertainty	case of uncertainty
12	to be acquainted with uncertainty	diagnostic uncertainty	case of uncertainty
13	to bear uncertainty	ecological uncertainty	category of uncertainty
14	to capture uncertainty	economic uncertainty	characterization of uncertainty
15	to capture uncertainty	endogenous uncertainty	characterizing uncertainty
16	to capture uncertainty	environmental uncertainty	choice under uncertainty
17	to characterize uncertainty	exogenous uncertainty	circle of uncertainty
18	to classify uncertainty	exogenous uncertainty	class of uncertainty
19	to classify uncertainty	experienced uncertainty	combination of uncertainty
20	to collapse uncertainty	external uncertainty	communication of uncertainty
21	to conceptualize uncertainty	fundamental uncertainty	component of uncertainty
22	to concern uncertainty	future uncertainty	concept of uncertainty
23	to consider uncertainty	future uncertainty	conception of uncertainty
24	to consider uncertainty	genuine uncertainty	conceptualization of uncertainty
25	to control uncertainty	great uncertainty	condition of uncertainty
26	to control uncertainty	greater uncertainty	condition of uncertainty
27	to convert uncertainty	greater uncertainty	condition of uncertainty
28	to convey uncertainty	greatest uncertainty	consequence of uncertainty
29	to convey uncertainty	growing uncertainty	consequence of uncertainty
30	to cope with uncertainty	high uncertainty	consideration of uncertainty
31	to cope with uncertainty	high uncertainty	consisting of uncertainty
32	to cope with uncertainty	high uncertainty	construct of uncertainty
33	to cope with uncertainty	high uncertainty	construct of uncertainty
34	to cover uncertainty	increased uncertainty	continuum of uncertainty
35	to create uncertainty	increased uncertainty	controlling for uncertainty
36	to create uncertainty	inherent uncertainty	controlling for uncertainty
37	to deal with uncertainty	initial uncertainty	converting uncertainty
38	to decompose uncertainty	initial uncertainty	customer uncertainty
39	to decrease uncertainty	large uncertainty	decision based on uncertainty.
40	to define uncertainty	less uncertainty	decision-making under uncertainty

41	to define uncertainty	less uncertainty	decision-making under uncertainty
42	to delineate uncertainty	little uncertainty	decision-making under uncertainty
43	to demonstrate uncertainty	little uncertainty	decision-making under uncertainty
44	to describe uncertainty	low uncertainty	definition of uncertainty
45	to describe uncertainty	low uncertainty	degree of uncertainty
46	to describe uncertainty	low uncertainty	degree of uncertainty
47	to develop uncertainty	major uncertainty	degree of uncertainty
48	to differentiate uncertainty	manageable uncertainty	degree of uncertainty
49	to disclose uncertainty	maximum uncertainty	degree of uncertainty
50	to discuss uncertainty	minimal uncertainty	demand uncertainty
51	to disregard uncertainty	minimum uncertainty	denial of uncertainty
52	to distinguish uncertainty	mixed uncertainty	diagnosis of uncertainty
53	to distinguish uncertainty	more uncertainty	dimension of uncertainty
54	to eliminate uncertainty	more uncertainty	disregard of uncertainty
55	to eliminate uncertainty	much uncertainty	effect of uncertainty
56	to eliminate uncertainty	much uncertainty	effect of uncertainty
57	to embrace uncertainty	objective uncertainty	effect of uncertainty
58	to encounter uncertainty	objective uncertainty	effect uncertainty
59	to enhance uncertainty	objective uncertainty	element of uncertainty
60	to escalate uncertainty	painful uncertainty	element of uncertainty
61	to eschew uncertainty	perceived uncertainty	emphasis on uncertainty
62	to examine uncertainty	perceived uncertainty	estimate of uncertainty
63	to examine uncertainty	perceived uncertainty	experience of uncertainty
64	to expect uncertainty	permissible uncertainty	expression of uncertainty
65	to experience uncertainty	pervasive uncertainty	face of uncertainty
66	to experience uncertainty	political uncertainty	face of uncertainty
67	to express uncertainty	predictable uncertainty	form of uncertainty
68	to express uncertainty	present uncertainty	framework of uncertainty
69	to face uncertainty	present uncertainty	framing of uncertainty
70	to face uncertainty	presented uncertainty	governance and uncertainty
71	to face uncertainty	primary uncertainty	impact of uncertainty
72	to face with uncertainty	quantifiable uncertainty	implication of uncertainty
73	to feel uncertainty	remaining uncertainty	importance of uncertainty
74	to fill with uncertainty	scientific uncertainty	importance of uncertainty
75	to find uncertainty	secondary uncertainty	in relation to uncertainty
76	to focus on uncertainty	severe uncertainty	in terms of uncertainty
77	to focus on uncertainty	significant uncertainty	including uncertainty
78	to focus on uncertainty	strategic uncertainty	incorporation of uncertainty
79	to handle uncertainty	subjective uncertainty	increase in uncertainty
80	to handle uncertainty	subjective uncertainty	increase in uncertainty.
81	to handle uncertainty	technical uncertainty	indication of uncertainty
82	to handle uncertainty	technological uncertainty	influence of uncertainty
83	to heighten uncertainty	technological uncertainty	interpretation of uncertainty
84	to identify uncertainty	technological uncertainty	key uncertainty

85	to identify uncertainty	terminological uncertainty	kind of uncertainty
86	to ignore uncertainty	total uncertainty	kind of uncertainty
87	to ignore uncertainty	unavoidable uncertainty	lack of uncertainty
88	to illustrate uncertainty		level of uncertainty
89	to include uncertainty		level of uncertainty
90	to include uncertainty		level of uncertainty
91	to incorporate uncertainty		level of uncertainty
92	to incorporate uncertainty		level of uncertainty
93	to increase uncertainty		level of uncertainty
94	to indicate uncertainty		magnitude of uncertainty
95	to indicate uncertainty		management of uncertainty
96	to inject uncertainty		managing under uncertainty
97	to introduce uncertainty		measure of uncertainty
98	to investigate uncertainty		measure of uncertainty
99	to involve uncertainty		measure of uncertainty
100	to make uncertainty		measure of uncertainty
101	to manage uncertainty		measure of uncertainty
102	to measure uncertainty		measurement uncertainty
103	to mention uncertainty		multidimensionality of uncertainty
104	to minimize uncertainty		nature of uncertainty
105	to minimize uncertainty		nature of uncertainty
106	to minimize uncertainty		negotiation of uncertainty
107	to obtain uncertainty		notion of uncertainty
108	to operationalize uncertainty		obverse of uncertainty
109	to perceive uncertainty		operationalization of uncertainty
110	to perceive uncertainty		outcome of uncertainty
111	to perpetuate uncertainty		parameter of uncertainty
112	to place uncertainty		pattern of uncertainty
113	to prevent uncertainty		perception of uncertainty
114	to propose uncertainty		period of uncertainty
115	to provide uncertainty		perturbed by uncertainty.
116	to put uncertainty into perspective		pervasiveness of uncertainty
117	to quantify uncertainty		preoccupation with uncertainty
118	to rate uncertainty		presence of uncertainty
119	to react to uncertainty		presence of uncertainty
120	to recognize uncertainty		problem of uncertainty
121	to reduce uncertainty		prominence of uncertainty
122	to reduce uncertainty		question of uncertainty
123	to reduce uncertainty		range of uncertainty
124	to reduce uncertainty		range of uncertainty
125	to reflect uncertainty		rationality-in-uncertainty
126	to reflect uncertainty		reaction to uncertainty
127	to relegate uncertainty		real-world uncertainty
128	to represent uncertainty		reduction of uncertainty

129	to reshape uncertainty		regarding uncertainty
130	to resolve uncertainty		regarding uncertainty
131	to resolve uncertainty		related to uncertainty
132	to resolve uncertainty		representation of uncertainty
133	to resolve uncertainty		representation of uncertainty
134	to respond to uncertainty		research on uncertainty
135	to respond uncertainty		research on uncertainty
136	to respond uncertainty		resolution of uncertainty
137	to share uncertainty		resolution of uncertainty
138	to shift uncertainty		resolution of uncertainty
139	to show uncertainty		response to uncertainty
140	to show uncertainty		response to uncertainty
141	to specify uncertainty		response to uncertainty
142	to struggle with uncertainty		response to uncertainty
143	to summarize uncertainty		response uncertainty
144	to take account of uncertainty		role of uncertainty
145	to take uncertainty into account		role of uncertainty
146	to take uncertainty into account		scale uncertainty
147	to take uncertainty into account		scope of uncertainty
148	to theorize uncertainty		sense of uncertainty
149	to think uncertainty		set of uncertainty
150	to tolerate uncertainty		set of uncertainty
151	to treat uncertainty		setting of uncertainty
152	to understand uncertainty		sharing of uncertainty
153	to understand uncertainty		situation of uncertainty
154	to use uncertainty		sociology of uncertainty
155	to view uncertainty		source of uncertainty
156	to view uncertainty		source of uncertainty
157	to work with uncertainty		source of uncertainty
158			source of uncertainty
159			source of uncertainty
160			specification uncertainty
161			state uncertainty
162			stress from uncertainty
163			structure uncertainty
164			study of uncertainty
165			study of uncertainty
166			supplier uncertainty
167			surrounding uncertainty
168			tolerance of uncertainty
169			treatment of uncertainty
170			type of uncertainty
171			type of uncertainty
172			type of uncertainty

173		typology of uncertainty
174		unavoidability of uncertainty
175		uncertainty about
176		uncertainty bounding
177		uncertainty conditions
178		uncertainty data
179		uncertainty in environment
180		uncertainty information
181		uncertainty interaction
182		uncertainty level
183		uncertainty matrix
184		uncertainty measure
185		uncertainty of knowledge
186		uncertainty of life
187		uncertainty of medicine
188		uncertainty of project
189		uncertainty of response
190		uncertainty of subordination
191		uncertainty of treatment
192		uncertainty outcome
193		uncertainty range
194		uncertainty reduction
195		uncertainty regarding
196		uncertainty regarding
197		uncertainty surrounding
198		uncertainty surrounding
199		uncomfortable with uncertainty
200		under uncertainty
201		underestimation of uncertainty
202		understanding of uncertainty
203		use of uncertainty
204		value of uncertainty
205		volume uncertainty
206		well-defined uncertainty
207		with uncertainty

Table 58*Sixth Decade VAC (Verb, Adjective, Concept) List*

	Verb	Adjective	Concept
1	to accept uncertainty	accompanying uncertainty	about uncertainty
2	to account for uncertainty	accumulated uncertainty	about uncertainty
3	to act in uncertainty	acknowledged uncertainty	about uncertainty
4	to address uncertainty	additional uncertainty	acceptance of uncertainty
5	to admit uncertainty	aleatory uncertainty	allowance for uncertainty
6	to adopt uncertainty	anticipated uncertainty	amount of uncertainty
7	to alleviate uncertainty	associated uncertainty	analysis of uncertainty
8	to analyze uncertainty	attendant uncertainty	approach to uncertainty
9	to argue uncertainty	categorized uncertainty	aspect of uncertainty
10	to argue uncertainty	clinical uncertainty	attitude toward uncertainty
11	to assess uncertainty	competitive uncertainty	baseline uncertainty
12	to associate with uncertainty	competitive uncertainty	burst of uncertainty
13	to augment uncertainty	compounded uncertainty	case of uncertainty
14	to avoid uncertainty	compounding uncertainty	case of uncertainty
15	to be disappointed with uncertainty	constant uncertainty	category of uncertainty
16	to capture of uncertainty	critical uncertainty	change in uncertainty
17	to clarify uncertainty	critical uncertainty	circle of uncertainty
18	to classify uncertainty	current uncertainty	class of uncertainty
19	to come with uncertainty	deep uncertainty	concept of uncertainty
20	to compound uncertainty	deep uncertainty	concept of uncertainty
21	to conceptualize uncertainty	diminishing uncertainty	concept of uncertainty
22	to conceptualize uncertainty	distinct uncertainty	conceptualization of uncertainty
23	to concern with uncertainty	distinguished uncertainty	condition of uncertainty
24	to consider uncertainty	endogenous uncertainty	condition of uncertainty
25	to consider uncertainty	environmental uncertainty	condition of uncertainty
26	to contribute to uncertainty	environmental uncertainty	condition of uncertainty
27	to control uncertainty	epistemic uncertainty	condition of uncertainty
28	to cope with uncertainty	epistemic uncertainty	condition of uncertainty
29	to cope with uncertainty	epistemological uncertainty	condition of uncertainty
30	to cope with uncertainty	epistemological uncertainty	consumer uncertainty
31	to cope with uncertainty	estimated uncertainty	consumption uncertainty
32	to cope with uncertainty	exogenous uncertainty	context of uncertainty
33	to cope with uncertainty	external uncertainty	criteria of uncertainty
34	to create uncertainty	falling uncertainty	culture of uncertainty
35	to create uncertainty	fundamental uncertainty	dealing with uncertainty
36	to create uncertainty	fundamental uncertainty	decision under uncertainty
37	to create uncertainty	fundamental uncertainty	decision-making under uncertainty
38	to deal with uncertainty	fundamental uncertainty	decrease of uncertainty
39	to deal with uncertainty	greater uncertainty	definition of uncertainty
40	to deal with uncertainty	greater uncertainty	definition of uncertainty
41	to deal with uncertainty	grounded uncertainty	degree of uncertainty
42	to deal with uncertainty	heightened uncertainty	degree of uncertainty
43	to deal with uncertainty	high uncertainty	degree of uncertainty
44	to define uncertainty	high uncertainty	degree of uncertainty
45	to diminish uncertainty	high uncertainty	degree of uncertainty
46	to discuss uncertainty	high uncertainty	demand uncertainty
47	to discuss uncertainty	high uncertainty	dimension of uncertainty

48	to disregard uncertainty	high uncertainty	dimension of uncertainty
49	to dissipate uncertainty	higher uncertainty	discussion of uncertainty
50	to distinguish uncertainty	high-level of uncertainty	dominance of uncertainty
51	to dominate uncertainty	hydrological uncertainty	effect of uncertainty
52	to eliminate uncertainty	inadequate uncertainty	emphasis on uncertainty
53	to emphasize	increased uncertainty	emphasis on uncertainty
54	to engage with uncertainty	increased uncertainty	emphasis on uncertainty
55	to entail uncertainty	increasing uncertainty	evaluation of uncertainty
56	to evaluate uncertainty	incredible uncertainty	example of uncertainty
57	to exhibit uncertainty	inevitable uncertainty	example of uncertainty
58	to experience uncertainty	inevitable uncertainty	extent of uncertainty
59	to explicate uncertainty	inherent uncertainty	face of uncertainty
60	to face uncertainty	inherent uncertainty	face of uncertainty
61	to face uncertainty	inherent uncertainty	fact of uncertainty
62	to face uncertainty	inherent uncertainty	factor of uncertainty
63	to face uncertainty	inherent uncertainty	fear of uncertainty
64	to face uncertainty	internal uncertainty	feature of uncertainty
65	to face with uncertainty	larger uncertainty	focus on uncertainty
66	to fear uncertainty	less uncertainty	form of uncertainty
67	to gauge uncertainty	less uncertainty	fraught with uncertainty
68	to generate uncertainty	linguistic uncertainty	handling uncertainty
69	to highlight uncertainty	long-run uncertainty	higher level of uncertainty
70	to identify uncertainty	low uncertainty	identification of uncertainty
71	to ignore uncertainty	low uncertainty	identifying uncertainty
72	to ignore uncertainty	low uncertainty	impact of uncertainty
73	to include uncertainty	low uncertainty	impact of uncertainty
74	to incorporate uncertainty	macro uncertainty	importance of uncertainty
75	to incorporate uncertainty	major uncertainty	in relation to uncertainty
76	to interpret uncertainty	many uncertainties	incorporation of uncertainty
77	to interpret uncertainty	medical uncertainty	increase in uncertainty
78	to interpret uncertainty	methodological uncertainty	increase in uncertainty
79	to introduce uncertainty	micro uncertainty	influence of uncertainty
80	to introduce uncertainty	more uncertainty	interpretation of uncertainty
81	to investigate uncertainty	novel uncertainty	introducing uncertainty
82	to involve uncertainty	numerical uncertainty	inverse of uncertainty
83	to involve uncertainty	ontological uncertainty	issue of uncertainty
84	to live with uncertainty	ontological uncertainty	key uncertainty
85	to maintain uncertainty	paramount uncertainty	kind of uncertainty
86	to manage uncertainty	perceived uncertainty	kind of uncertainty
87	to manage uncertainty	personal uncertainty	knowledge uncertainty
88	to manage uncertainty	pervasive uncertainty	leadership and uncertainty
89	to manifest uncertainty	political uncertainty	level of uncertainty
90	to master uncertainty	potential uncertainty	level of uncertainty
91	to measure uncertainty	primary uncertainty	level of uncertainty
92	to minimize uncertainty	primary uncertainty	level of uncertainty
93	to mitigate uncertainty	procedural uncertainty	level of uncertainty
94	to model uncertainty	procedural uncertainty	living with uncertainty
95	to move from uncertainty	pure uncertainty	location of uncertainty
96	to navigate uncertainty	quantified uncertainty	locus of uncertainty
97	to overcome uncertainty	random uncertainty	making decision under uncertainty
98	to perceive uncertainty	real uncertainty	management of uncertainty
99	to prevent uncertainty	recognized uncertainty	management under uncertainty

100	to produce uncertainty	reducible uncertainty	management under uncertainty
101	to recognize uncertainty	regulative uncertainty	managing uncertainty
102	to recognize uncertainty	relative uncertainty	market uncertainty
103	to recognize uncertainty	residual uncertainty	measure of uncertainty
104	to reduce uncertainty	secondary uncertainty	measurement uncertainty
105	to reduce uncertainty	significant uncertainty	model uncertainty
106	to reduce uncertainty	specific uncertainty	model uncertainty
107	to reduce uncertainty	statistical uncertainty	multiplication of uncertainty
108	to reflect upon uncertainty	statistical uncertainty	nature of uncertainty
109	to represent uncertainty	stochastic uncertainty	nature of uncertainty
110	to resolve uncertainty	strategic uncertainty	nature of uncertainty
111	to respond uncertainty	strong uncertainty	negotiation of uncertainty
112	to separate out uncertainty	strong uncertainty	nuances of uncertainty
113	to shape uncertainty	strong uncertainty	onset of uncertainty
114	to show uncertainty	strong uncertainty	openness to uncertainty
115	to show uncertainty	structural uncertainty	outcome uncertainty
116	to specify uncertainty	substantive uncertainty	parameter uncertainty
117	to stem from uncertainty	substantive uncertainty	period of uncertainty
118	to study uncertainty	technical uncertainty	pervasiveness of uncertainty
119	to suggest uncertainty	technical uncertainty	picture of uncertainty
120	to suggest uncertainty	technological uncertainty	policy uncertainty
121	to suppress uncertainty	technological uncertainty	politics of uncertainty
122	to take uncertainty	time changing uncertainty	presence of uncertainty
123	to take uncertainty	time-varying uncertainty	presence of uncertainty
124	to take uncertainty into account	total uncertainty	primacy of uncertainty
125	to take up uncertainty	underappreciated uncertainty	problem of uncertainty
126	to treat uncertainty	unknowable uncertainty	problem of uncertainty
127	to treat uncertainty	unproblematic uncertainty	productivity uncertainty
128	to trig uncertainty	various uncertainties	proxy for uncertainty
129	to underly uncertainty	weak uncertainty	proxy of uncertainty
130	to underly uncertainty	weak uncertainty	quality of uncertainty
131	to underly uncertainty		quantification of uncertainty
132	to understand uncertainty		range of uncertainty
133	to understand uncertainty		range of uncertainty
134	to understand uncertainty		rationality-in-uncertainty
135	to use uncertainty		recognition of uncertainty
136	to use uncertainty		reduction of uncertainty
137	to view uncertainty		regulatory uncertainty
138	to yield to uncertainty		relevance of uncertainty
139			replete with uncertainty
140			research on uncertainty
141			research-based uncertainty
142			resolving uncertainty
143			resource uncertainty
144			response to uncertainty
145			retooling of uncertainty
146			risk and uncertainty
147			role of uncertainty
148			sand of uncertainty
149			scale of uncertainty
150			scale of uncertainty
151			scenario uncertainty

152		set of uncertainty
153		situation of uncertainty
154		situation of uncertainty
155		situation of uncertainty
156		some of uncertainty
157		source of uncertainty
158		source of uncertainty
159		source of uncertainty
160		source of uncertainty
161		source of uncertainty
162		source of uncertainty
163		spectrum of uncertainty
164		state of uncertainty
165		state of uncertainty
166		structure uncertainty
167		study of uncertainty
168		study of uncertainty
169		subset of uncertainty
170		supplier uncertainty
171		surrounded by uncertainty
172		system uncertainty
173		taxonomy of uncertainty
174		training for uncertainty
175		treatment of uncertainty
176		type of uncertainty
177		type of uncertainty
178		type of uncertainty
179		typology of uncertainty
180		unavoidability of uncertainty
181		uncertainty about
182		uncertainty about
183		uncertainty about
184		uncertainty about future
185		uncertainty approach
186		uncertainty around
187		uncertainty attitude
188		uncertainty concept
189		uncertainty concept
190		uncertainty concerning
191		uncertainty in assumption
192		uncertainty in data
193		uncertainty in process
194		uncertainty in regulation
195		uncertainty in system
196		uncertainty in system
197		uncertainty in theory
198		uncertainty management
199		uncertainty of data
200		uncertainty of development
201		uncertainty of ethics
202		uncertainty of future
203		uncertainty of future

204			uncertainty of something
205			uncertainty principle
206			uncertainty process
207			uncertainty regarding
208			uncertainty regarding
209			uncertainty shock
210			uncertainty surrounding
211			uncertainty surrounding
212			uncertainty surrounding
213			uncertainty surrounding
214			uncertainty surrounding
215			uncertainty theory
216			under uncertainty
217			under uncertainty
218			under uncertainty
219			under uncertainty
220			understanding uncertainty
221			update of uncertainty
222			updating of uncertainty
223			use of uncertainty
224			variability uncertainty
225			writing on uncertainty

Table 59*Seventh Decade VAC (Verb, Adjective, Concept) List*

	Verb	Adjective	Concept
1	to accept uncertainty	absolute uncertainty	about uncertainty
2	to acknowledge uncertainty	accompanying uncertainty	absence of uncertainty
3	to adapt to uncertainty	accumulated uncertainty	accepting uncertainty
4	to add uncertainty	aleatoric uncertainty	account of uncertainty
5	to address uncertainty	all uncertainty	acknowledgement of uncertainty
6	to address uncertainty	analogical uncertainty	acknowledgement of uncertainty
7	to address uncertainty	associated uncertainty	admitting uncertainty
8	to address uncertainty	associated uncertainty	amount of uncertainty
9	to address uncertainty	bad uncertainty	amount of uncertainty
10	to address uncertainty	basic uncertainty	amount of uncertainty
11	to address uncertainty	certain uncertainty	analysis of uncertainty
12	to admit uncertainty	cognitive uncertainty	analysis of uncertainty
13	to affect uncertainty	cognitive uncertainty	analysis uncertainty
14	to allocate uncertainty	commercial uncertainty	analyzing uncertainty
15	to ameliorate uncertainty	compared uncertainty	appreciation of uncertainty
16	to analyze uncertainty	complete uncertainty	approach for uncertainty
17	to analyze uncertainty	compounded uncertainty	approach to uncertainty
18	to anticipate uncertainty	conceptual uncertainty	area of uncertainty
19	to apply uncertainty	conceptual uncertainty	aspect of uncertainty
20	to argue uncertainty	considerable uncertainty	aspect of uncertainty
21	to arise uncertainty	considerable uncertainty	aspect of uncertainty
22	to arise uncertainty	continued uncertainty	aspect of uncertainty
23	to arise uncertainty	counterfactual uncertainty	aspect of uncertainty
24	to arise uncertainty	critical uncertainty	aspect of uncertainty
25	to assess uncertainty	current uncertainty	assessment of uncertainty
26	to assess uncertainty	deep uncertainty	assessment of uncertainty
27	to assess uncertainty	deep uncertainty	attention to uncertainty
28	to assess uncertainty	deep uncertainty	attitude towards uncertainty
29	to assess uncertainty	deep uncertainty	aware of uncertainty
30	to assess uncertainty	deeper uncertainty	aware of uncertainty
31	to assess uncertainty	dimensional uncertainty	aware of uncertainty
32	to associate with uncertainty	double uncertainty	awareness of uncertainty
33	to associate with uncertainty	economic uncertainty	awareness of uncertainty
34	to assume uncertainty	economic uncertainty	awareness of uncertainty
35	to avoid uncertainty	empirical uncertainty	awareness of uncertainty
36	to be aware of uncertainty	environmental uncertainty	away with uncertainty
37	to bring about uncertainty	epistemic uncertainty	background of uncertainty
38	to call uncertainty	epistemic uncertainty	barrier of uncertainty

39	to call uncertainty	epistemic uncertainty	basis of uncertainty
40	to call uncertainty	epistemic uncertainty	behind uncertainty
41	to capture uncertainty	epistemic uncertainty	case of uncertainty
42	to capture uncertainty	epistemological uncertainty	case of uncertainty
43	to categorize uncertainty	erratic uncertainty	categorization of uncertainty
44	to categorize uncertainty	estimated uncertainty	category of uncertainty
45	to characterize uncertainty	ethical uncertainty	cause of uncertainty
46	to characterize uncertainty	external uncertainty	cause of uncertainty
47	to characterize uncertainty	factual uncertainty	change in uncertainty
48	to characterize uncertainty	full uncertainty	characteristic of uncertainty
49	to characterize uncertainty	fundamental uncertainty	characteristic of uncertainty
50	to characterize uncertainty	fundamental uncertainty	characteristic of uncertainty
51	to choose uncertainty	future uncertainty	characterization of uncertainty
52	to claim uncertainty	future uncertainty	characterization of uncertainty
53	to clarify uncertainty	generic uncertainty	choice under uncertainty
54	to classify uncertainty	genuine uncertainty	circumstance of uncertainty
55	to classify uncertainty	good uncertainty	class of uncertainty
56	to classify uncertainty	great uncertainty	classification of uncertainty
57	to cluster uncertainty	greater uncertainty	classification of uncertainty
58	to combine uncertainty	greater uncertainty	comment on uncertainty
59	to communicate uncertainty	heightened uncertainty	component of uncertainty
60	to conceptualize uncertainty	high uncertainty	concept of uncertainty
61	to conceptualize uncertainty	high uncertainty	concept of uncertainty
62	to conceptualize uncertainty	high uncertainty	concept of uncertainty
63	to concern with uncertainty	high uncertainty	concept of uncertainty
64	to confuse uncertainty	high uncertainty	conceptualization of uncertainty
65	to consider uncertainty	high uncertainty	conceptualization uncertainty
66	to consider uncertainty	high uncertainty	condition of uncertainty
67	to consider uncertainty	high uncertainty	condition on uncertainty
68	to consider uncertainty	high uncertainty	condition uncertainty
69	to consider uncertainty	historical uncertainty	cone of uncertainty
70	to consider uncertainty	important uncertainty	consideration of uncertainty
71	to consider uncertainty	increased uncertainty	construction of uncertainty
72	to consider uncertainty	increasing uncertainty	context of uncertainty
73	to constrain uncertainty	independent uncertainty	context of uncertainty
74	to construct uncertainty	indeterminable uncertainty	credit uncertainty
75	to contain uncertainty	indeterminate uncertainty	critical thinking about uncertainty
76	to contribute to uncertainty	indistinguishable uncertainty	deal of uncertainty
77	to contribute uncertainty	inevitable uncertainty	decision making under uncertainty
78	to contribute uncertainty	inference uncertainty	decision making under uncertainty
79	to contribute uncertainty	inherent uncertainty	decision making under uncertainty
80	to contribute uncertainty	inherent uncertainty	decision making under uncertainty
81	to convert uncertainty	inherent uncertainty	decision making under uncertainty

82	to cope with uncertainty	inherent uncertainty	decision making under uncertainty
83	to cope with uncertainty	innovative uncertainty	definition of uncertainty
84	to correspond uncertainty	institutional uncertainty	definition of uncertainty
85	to create uncertainty	internal uncertainty	definition of uncertainty
86	to create uncertainty	interpreted uncertainty	degree of uncertainty
87	to criticize uncertainty	intractable uncertainty	degree of uncertainty
88	to deal with uncertainty	intractable uncertainty	degree of uncertainty
89	to deal with uncertainty	intrinsic uncertainty	degree of uncertainty
90	to deal with uncertainty	intrinsic uncertainty	degree of uncertainty
91	to deal with uncertainty	intrinsic uncertainty	degree of uncertainty
92	to deal with uncertainty	intrinsic uncertainty	degree of uncertainty
93	to deal with uncertainty	irreducible uncertainty	degree of uncertainty
94	to deal with uncertainty	irreducible uncertainty	degree of uncertainty
95	to deal with uncertainty	irreducible uncertainty	degree of uncertainty
96	to deal with uncertainty	irreducible uncertainty	degree of uncertainty
97	to deal with uncertainty	irremediable uncertainty	denial of uncertainty
98	to deal with uncertainty	key uncertainty	denial of uncertainty
99	to deal with uncertainty	large uncertainty	description of uncertainty
100	to deal with uncertainty	large uncertainty	development in uncertainty
101	to decide uncertainty	large uncertainty	dimension of uncertainty
102	to decompose uncertainty	largest uncertainty	dimension of uncertainty
103	to decompose uncertainty	less uncertainty	dimension of uncertainty
104	to decrease uncertainty	less uncertainty	dimension to uncertainty
105	to define uncertainty	less uncertainty	discussion of uncertainty
106	to define uncertainty	little uncertainty	discussion on uncertainty
107	to define uncertainty	long term uncertainty	downplaying of uncertainty
108	to define uncertainty	low uncertainty	driver of uncertainty
109	to demonstrate uncertainty	low uncertainty	effect of uncertainty
110	to denote uncertainty	low uncertainty	effect of uncertainty
111	to denote uncertainty	low uncertainty	effect of uncertainty
112	to describe uncertainty	low uncertainty	element of uncertainty
113	to describe uncertainty	macro uncertainty	emphasis on uncertainty
114	to describe uncertainty	major uncertainty	emphasis on uncertainty
115	to describe uncertainty	major uncertainty	estimate of uncertainty
116	to describe uncertainty	major uncertainty	evaluation of uncertainty
117	to detail uncertainty	mathematical uncertainty	expression of uncertainty
118	to determine uncertainty	maximal uncertainty	expression of uncertainty
119	to determine uncertainty	maximum uncertainty	extent of uncertainty
120	to determine uncertainty	methodological uncertainty	extreme of uncertainty
121	to determine uncertainty	mild uncertainty	face of uncertainty
122	to differentiate uncertainty	minimal uncertainty	face of uncertainty
123	to discuss uncertainty	modal uncertainty	factor of uncertainty
124	to discuss uncertainty	more uncertainty	factor of uncertainty

125	to discuss uncertainty	more uncertainty	factor to uncertainty
126	to discuss uncertainty	more uncertainty	feature of uncertainty
127	to discuss uncertainty	most uncertainty	feeling of uncertainty
128	to discuss uncertainty	much uncertainty	finding from uncertainty
129	to discuss uncertainty	multi-faceted uncertainty	force of uncertainty
130	to display uncertainty	multi-faceted uncertainty	form of uncertainty
131	to display uncertainty	natural uncertainty	form of uncertainty
132	to distinguish uncertainty	negligible uncertainty	form of uncertainty
133	to distinguish uncertainty	no uncertainty	form of uncertainty
134	to draw attention to uncertainty	non-negligible uncertainty	formalization uncertainty
135	to draw uncertainty	non-numeric uncertainty	format of uncertainty
136	to drive uncertainty	non-probabilistic uncertainty	framework for uncertainty
137	to eclipse uncertainty	normative uncertainty	framework for uncertainty
138	to eliminate uncertainty	normative uncertainty	function of uncertainty
139	to embed uncertainty	objective uncertainty	history of uncertainty
140	to embody uncertainty	ontological uncertainty	idea of uncertainty
141	to embrace uncertainty	ontological uncertainty	identification of uncertainty
142	to emphasize uncertainty	organizational uncertainty	identification of uncertainty
143	to engage with uncertainty	organizational uncertainty	identification of uncertainty
144	to engage with uncertainty	parameter uncertainty	identification of uncertainty
145	to entail uncertainty	parameter uncertainty	identification of uncertainty
146	to entrench uncertainty	parameter uncertainty	ignoring uncertainty
147	to enumerate uncertainty	parametric uncertainty	image of uncertainty
148	to estimate uncertainty	perceived uncertainty	impact of uncertainty
149	to estimate uncertainty	perceived uncertainty	impact of uncertainty
150	to estimate uncertainty	political uncertainty	impact of uncertainty
151	to estimate uncertainty	political uncertainty	impact of uncertainty
152	to evaluate uncertainty	potential uncertainty	implication for uncertainty
153	to evaluate uncertainty	prior uncertainty	importance of uncertainty
154	to exacerbate uncertainty	probabilistic uncertainty	importance of uncertainty
155	to examine uncertainty	probabilistic uncertainty	improvement in uncertainty
156	to examine uncertainty	produced uncertainty	in terms of uncertainty
157	to examine uncertainty	proxy uncertainty	indication of uncertainty
158	to exist uncertainty	pure uncertainty	industry uncertainty
159	to experience uncertainty	quantified uncertainty	influence of uncertainty
160	to experience uncertainty	radical uncertainty	innovation uncertainty
161	to explain uncertainty	radical uncertainty	issue of uncertainty
162	to explore uncertainty	random uncertainty	issue of uncertainty
163	to explore uncertainty	real uncertainty	issue of uncertainty
164	to explore uncertainty	real uncertainty	kind of uncertainty
165	to express uncertainty	recognized uncertainty	kind of uncertainty
166	to express uncertainty	reduced uncertainty	kind of uncertainty
167	to express uncertainty	reduced uncertainty	legitimacy uncertainty

168	to express uncertainty	reducible uncertainty	level of uncertainty
169	to express uncertainty	relative uncertainty	level of uncertainty
170	to express uncertainty	relevant uncertainty	level of uncertainty
171	to face uncertainty	represented uncertainty	level of uncertainty
172	to face uncertainty	residual uncertainty	level of uncertainty
173	to face uncertainty	residual uncertainty	level of uncertainty
174	to face uncertainty	residual uncertainty	level of uncertainty
175	to facilitate uncertainty	resultant uncertainty	level of uncertainty
176	to focus on uncertainty	scaling uncertainty	level of uncertainty
177	to focus on uncertainty	scientific uncertainty	level of uncertainty
178	to focus on uncertainty	second-order uncertainty	level of uncertainty
179	to focus on uncertainty	separable uncertainty	level of uncertainty
180	to focus uncertainty	severe uncertainty	literature on uncertainty
181	to frame uncertainty	shallow uncertainty	location of uncertainty
182	to generate uncertainty	shallow uncertainty	location of uncertainty
183	to generate uncertainty	significant uncertainty	magnitude of uncertainty
184	to grasp uncertainty	simple uncertainty	managing uncertainty
185	to grow uncertainty	small uncertainty	managing uncertainty
186	to handle uncertainty	small uncertainty	managing uncertainty
187	to handle uncertainty	social uncertainty	managing uncertainty
188	to handle uncertainty	social uncertainty	managing uncertainty
189	to handle uncertainty	social uncertainty	managing uncertainty
190	to handle uncertainty	spatial uncertainty	market uncertainty
191	to highlight uncertainty	specific uncertainty	market uncertainty
192	to highlight uncertainty	statistical uncertainty	meaning of uncertainty
193	to highlight uncertainty	stochastic uncertainty	measure of uncertainty
194	to identify uncertainty	stochastic uncertainty	measure of uncertainty
195	to identify uncertainty	structural uncertainty	measure of uncertainty
196	to identify uncertainty	structural uncertainty	measuring uncertainty
197	to identify uncertainty	subjective uncertainty	mismanagement of uncertainty
198	to ignore uncertainty	subjective uncertainty	model uncertainty
199	to ignore uncertainty	subjective uncertainty	modelling uncertainty
200	to ignore uncertainty	substantial uncertainty	nature of uncertainty
201	to illustrate uncertainty	surface uncertainty	nature of uncertainty
202	to imply uncertainty	surface uncertainty	nature of uncertainty
203	to improve uncertainty	tamable uncertainty	nature of uncertainty
204	to improve uncertainty	technical uncertainty	nature of uncertainty
205	to impute uncertainty	technical uncertainty	negotiation on uncertainty
206	to include uncertainty	technological uncertainty	notion of uncertainty
207	to include uncertainty	technological uncertainty	object of uncertainty
208	to include uncertainty	temporary uncertainty	occurrence of uncertainty
209	to increase uncertainty	total uncertainty	opt for uncertainty
210	to increase uncertainty	total uncertainty	origin of uncertainty

211	to increase uncertainty	total uncertainty	outcome of uncertainty
212	to increase uncertainty	total uncertainty	parameter of uncertainty
213	to increase uncertainty	unique uncertainty	parameterization uncertainty
214	to increase uncertainty	unknown uncertainty	pattern of uncertainty
215	to increase uncertainty	variability uncertainty	phenomenon of uncertainty
216	to indicate uncertainty		pitfall of uncertainty
217	to indicate uncertainty		place of uncertainty
218	to influence uncertainty		placement of uncertainty
219	to interpret uncertainty		planning uncertainty
220	to introduce uncertainty		precision of uncertainty
221	to introduce uncertainty		presence of uncertainty
222	to investigate uncertainty		presence of uncertainty
223	to investigate uncertainty		problem of uncertainty
224	to involve uncertainty		process of uncertainty
225	to judge uncertainty		prompting for uncertainty
226	to lay out uncertainty		property of uncertainty
227	to lead uncertainty		quality of uncertainty
228	to limit uncertainty		quantification of uncertainty
229	to manage uncertainty		quantification of uncertainty
230	to manage uncertainty		quantification of uncertainty
231	to manage uncertainty		range of uncertainty
232	to manage uncertainty		realm of uncertainty
233	to manage uncertainty		reduction in uncertainty
234	to manage uncertainty		reduction of uncertainty
235	to manage uncertainty		reduction of uncertainty
236	to manage uncertainty		region of uncertainty
237	to manifest uncertainty		representation for uncertainty
238	to map onto uncertainty		representation of uncertainty
239	to map uncertainty		representation of uncertainty
240	to mean uncertainty		representation of uncertainty
241	to measure uncertainty		requirement for uncertainty
242	to measure uncertainty		research of uncertainty
243	to measure uncertainty		resolution of uncertainty
244	to mediate uncertainty		response to uncertainty
245	to mention uncertainty		response to uncertainty
246	to minimize uncertainty		result of uncertainty
247	to minimize uncertainty		result uncertainty
248	to minimize uncertainty		review of uncertainty
249	to mitigate uncertainty		role of uncertainty
250	to model uncertainty		role of uncertainty
251	to motivate uncertainty		room for uncertainty
252	to name uncertainty		room for uncertainty
253	to neglect uncertainty		scale of uncertainty

254	to open to uncertainty	scenario uncertainty
255	to open up for uncertainty	scope of uncertainty
256	to overcome uncertainty	scope of uncertainty
257	to overcome uncertainty	scope of uncertainty
258	to pay attention uncertainty	self-uncertainty
259	to perceive uncertainty	sense of uncertainty
260	to perform uncertainty	sense of uncertainty
261	to plan uncertainty	severity of uncertainty
262	to point at uncertainty	significance of uncertainty
263	to predict uncertainty	significance of uncertainty
264	to present uncertainty	significance of uncertainty
265	to present uncertainty	situation of uncertainty
266	to present uncertainty	sort of uncertainty
267	to present uncertainty	source of uncertainty
268	to produce uncertainty	source of uncertainty
269	to propose uncertainty	source of uncertainty
270	to provide uncertainty	source of uncertainty
271	to provide uncertainty	source of uncertainty
272	to quantify uncertainty	source of uncertainty
273	to quantify uncertainty	sources of uncertainty
274	to quantify uncertainty	sources of uncertainty
275	to quantify uncertainty	specification of uncertainty
276	to quantify uncertainty	stage of uncertainty
277	to quantify uncertainty	standardization of uncertainty
278	to range uncertainty	state of uncertainty
279	to react to uncertainty	state uncertainty
280	to recognize uncertainty	state uncertainty
281	to recognize uncertainty	study of uncertainty
282	to recognize uncertainty	target of uncertainty
283	to recognize uncertainty	task uncertainty
284	to recognize uncertainty	taxonomy of uncertainty
285	to recognize uncertainty	taxonomy of uncertainty
286	to recognize uncertainty	term of uncertainty
287	to recognize uncertainty	theme of uncertainty
288	to reconfirm uncertainty	thought of uncertainty
289	to reduce uncertainty	time of uncertainty
290	to reduce uncertainty	topic of uncertainty
291	to reduce uncertainty	toward uncertainty
292	to reduce uncertainty	treatment of uncertainty
293	to reduce uncertainty	treatment of uncertainty
294	to reduce uncertainty	treatment of uncertainty
295	to reduce uncertainty	type of uncertainty
296	to reduce uncertainty	type of uncertainty

297	to reduce uncertainty		type of uncertainty
298	to reduce uncertainty		type of uncertainty
299	to reduce uncertainty		type of uncertainty
300	to reduce uncertainty		type of uncertainty
301	to reduce uncertainty		type of uncertainty
302	to reduce uncertainty		typology of uncertainty
303	to reduce uncertainty		typology of uncertainty
304	to reduce uncertainty		typology of uncertainty
305	to reduce uncertainty		uncertainty about
306	to reduce uncertainty		uncertainty analysis
307	to refer uncertainty		uncertainty analysis
308	to refer uncertainty		uncertainty analysis
309	to reference to uncertainty		uncertainty analysis
310	to reflect uncertainty		uncertainty assessment
311	to reflect uncertainty		uncertainty assessment
312	to remark uncertainty		uncertainty assessment
313	to report uncertainty		uncertainty aversion
314	to report uncertainty		uncertainty aversion
315	to represent uncertainty		uncertainty awareness
316	to represent uncertainty		uncertainty combination
317	to represent uncertainty		uncertainty debate
318	to represent uncertainty		uncertainty inventory
319	to resolve uncertainty		uncertainty management
320	to resolve uncertainty		uncertainty management
321	to resolve uncertainty		uncertainty management
322	to respect to uncertainty		uncertainty measure
323	to respond to uncertainty		uncertainty measurement
324	to reveal uncertainty		uncertainty of conclusion
325	to review uncertainty		uncertainty of future
326	to rise uncertainty		uncertainty of management
327	to rise uncertainty		uncertainty of struggle
328	to robust uncertainty		uncertainty overlaps
329	to role uncertainty		uncertainty overlaps
330	to see uncertainty		uncertainty quantification
331	to see uncertainty		uncertainty regarding
332	to show uncertainty		uncertainty representation
333	to show uncertainty		uncertainty representation
334	to show uncertainty		uncertainty situations
335	to shroud uncertainty		uncertainty surrounding
336	to situate uncertainty		uncertainty typology
337	to solve uncertainty		uncertainty visualization
338	to stress uncertainty		uncertainty visualization
339	to striate uncertainty		uncomfortable with uncertainty

340	to strip uncertainty		under uncertainty
341	to struggle with uncertainty		under uncertainty
342	to summarize uncertainty		understanding of uncertainty
343	to suppose uncertainty		understanding of uncertainty
344	to suppose uncertainty		validation uncertainty
345	to tackle uncertainty		value of uncertainty
346	to take account of uncertainty		value of uncertainty
347	to take into account uncertainty		value uncertainty
348	to take into account uncertainty		variety of uncertainty
349	to take on uncertainty		variety of uncertainty
350	to take uncertainty		version of uncertainty
351	to take uncertainty		view of uncertainty
352	to tame uncertainty		view of uncertainty
353	to term uncertainty		view on uncertainty
354	to test uncertainty		wealth of uncertainty
355	to think about uncertainty		
356	to transform into uncertainty		
357	to transform uncertainty		
358	to treat uncertainty		
359	to uncover uncertainty		
360	to underplay uncertainty		
361	to understand uncertainty		
362	to understand uncertainty		
363	to understand uncertainty		
364	to understand uncertainty		
365	to understand uncertainty		
366	to understand uncertainty		
367	to understand uncertainty		
368	to understand uncertainty		
369	to understand uncertainty,		
370	to understate uncertainty		
371	to use uncertainty		
372	to vary uncertainty		
373	to view uncertainty		
374	to visualize uncertainty		
375	to voice uncertainty		
376	to weigh uncertainty		

APPENDIX F

Table 60

NVIVO – Verb Frequency List

PARENT-VERB	Frequency	PARENT-VERB	Frequency
address uncertainty	3	indicate uncertainty	2
analyze uncertainty	1	interpret uncertainty	1
argue uncertainty	3	introduce uncertainty	3
arise uncertainty	1	investigate uncertainty	2
assess uncertainty	3	involve uncertainty	1
associate with uncertainty	1	manage uncertainty	8
avoid uncertainty	1	measure uncertainty	10
capture uncertainty	2	minimize uncertainty	2
characterize uncertainty	3	perceive uncertainty	3
classify uncertainty	1	present uncertainty	2
conceptualize uncertainty	3	quantify uncertainty	4
concern uncertainty	12	recognise uncertainty	1
consider uncertainty	3	reduce uncertainty	16
contribute to uncertainty	1	reflect uncertainty	2
cope with uncertainty	4	represent uncertainty	5
create uncertainty	1	resolve uncertainty	3
deal with uncertainty	8	respond uncertainty	4
define uncertainty	4	show uncertainty	2
describe uncertainty	3	take uncertainty	4
determine uncertainty	2	take uncertainty into account	2
discuss uncertainty	1	treat uncertainty	3
distinguish uncertainty	25	underlying uncertainties	4
eliminate uncertainty	4	understand uncertainty	2
entailing uncertainty	1	use uncertainty	5
estimate uncertainty	2	view uncertainty	11
examine uncertainty	14		
experience uncertainty	4		
express uncertainty	3		
face uncertainty	11		
focus uncertainty	6		
handle uncertainty	3		
highlight uncertainty	1		
identify uncertainty	1		
ignore uncertainty	2		
include uncertainty	1		
incorporate uncertainty	1		
increase uncertainty	5		

Table 61*NVIVO-Adjective Frequency List*

PARENT-ADJ	Frequency
basic uncertainty	2
clinical uncertainty	2
considerable uncertainty	4
deep uncertainty	7
economic uncertainty	3
environmental uncertainty	9
epistemic uncertainty	7
epistemological uncertainty	4
fundamental uncertainty	5
future uncertainty	6
great uncertainty	3
greater uncertainty	11
high uncertainty	11
increased uncertainty	4
inherent uncertainty	7
intrinsic uncertainty	1
irreducible uncertainty	3
large uncertainty	2
less uncertainty	4
low uncertainty	7
major uncertainty	7
more uncertainty	7
objective uncertainty	7
ontological uncertainty	4
parameter uncertainty	4
perceived uncertainty	11
political uncertainty	2
real uncertainty	2
residual uncertainty	3
significant uncertainty	2
situation of uncertainty	1
strong uncertainty	3
structural uncertainty	3
subjective uncertainty	9
technical uncertainty	6
technological uncertainty	6
total uncertainty	9

Table 62*NVIVO-Concept Frequency List*

PARENT-CONCEPT	Frequency	PARENT-CONCEPT	Frequency
about uncertainty	7	nature of uncertainty	8
amount of uncertainty	7	parameter of uncertainty	4
analysis of uncertainty	10	perception of uncertainty	3
area of uncertainty	2	presence of uncertainty	4
aspect of uncertainty	3	problem of uncertainty	5
assessment of uncertainty	5	quantification of uncertainty	1
awareness of uncertainty	3	range of uncertainty	3
case of uncertainty	5	reduction of uncertainty	7
characterization of uncertainty	1	representation of uncertainty	10
choice under uncertainty	10	research on uncertainty	5
concept of uncertainty	9	resolution of uncertainty	3
conceptualization of uncertainty	2	response to uncertainty	7
condition of uncertainty	2	scale uncertainty	4
context of uncertainty	1	scope of uncertainty	3
decision under uncertainty	5	sense of uncertainty	7
decision-making under uncertainty	15	significance of uncertainty	1
definition of uncertainty	4	source of uncertainty	15
degree of uncertainty	24	state uncertainty	10
dimension of uncertainty	1	study of uncertainty	6
discussion of uncertainty	3	treatment of uncertainty	6
effect of uncertainty	7	type of uncertainty	10
emphasis on uncertainty	2	typology of uncertainty	3
face of uncertainty	11	uncertainty about	7
factor of uncertainty	1	uncertainty analysis	10
form of uncertainty	7	uncertainty assessment	8
identification of uncertainty	2	uncertainty management	11
impact of uncertainty	5	uncertainty regarding	10
importance of uncertainty	1	uncertainty surrounding	5
increase in uncertainty	5	under uncertainty	7
influence of uncertainty	1	value of uncertainty	3
issue of uncertainty	2	variety of uncertainty	1
kind of uncertainty	5		
level of uncertainty	17		
location of uncertainty	3		
management of uncertainty	9		
managing uncertainty	8		
measure of uncertainty	10		

Table 63*NVIVO-Conceptual Modeling Concepts Frequency List*

CONCEPTUALMODEL	Frequency
absence	41
ambiguity	30
ambiguous	25
bayesian	20
capricious	1
conflicting	14
confused	8
confusion	19
contingent	19
dependable	4
distortion	7
dubious	5
erratic	1
error	41
frequentist	5
fuzziness	3
fuzzy logic	5
ignorance	34
inaccuracy	4
incertitude	1
incompleteness	4
indeterminate	6
irrelevance	41
likelihood	41
outcomes	15
possibilities	39
precaution	4
probabilities	12
probability	5
problematic	20
randomness	12
conflicting	14
scenario	6
sensitivity analysis	11
taboo	1
uncertainty	7
unclear	16
unforeseeable	5
unproblematic	2
vague	19
vagueness	9

APPENDIX G

Table 64

Frequent Verbs Coverage of Articles List

Year	Author	Article	Source	Vol.	No	pg.
1987	Hodges	Uncertainty, Policy Analysis and Statistics	Statistical Science	2	3	259-275
1992	Gerrity et al.	Uncertainty and Professional Work	American Journal of Sociology	97	4	1022-1051
1996	Ludwig	Uncertainty and The Assessment of Extinction Probabilities	Ecological Applications	6	4	1067-1076
1998	Sutcliffe&Zaheer	Uncertainty in The Transaction Environment	Strategic Management Journal	19	1	.10-23.
2001	Hughes	Choices in The Face of Uncertainty	Futures		33	55-62
2002	Regan et al.	A Taxonomy and Treatment of Uncertainty for Ecology and Conservation Biology	Ecological Applications	12	2	618-628
2006	Newman	Change, uncertainty, and futures of sustainable development	Futures		38	633-637
2007	Sollie	Ethics, technology development and uncertainty: an outline for any future ethics of technology	Journal of Information, Communication & Ethics in Society	5	4	293-306
2010	Walker et al.	Addressing deep uncertainty using adaptive policies: introduction to section 2	Technological Forecasting & Social Change		77	917-923
2011	Elahi	Here be dragons ... exploring the 'unknown unknown'	Futures		43	196-201
2011	Tapinos	Perceived environmental uncertainty in scenario planning	Futures		44	338-345
2011	Blau	Uncertainty and the history of ideas	History and Theory	50	3	358-372
2012	Dong & Hayes	Uncertainty Visualization	Journal of Cognitive Engineering and Decision Making	6	1	30-56
2013	Kramer et al.,	Communication, uncertainty, and volunteer membership	Journal of Applied Communication Research	41	1	18-39
2013	Wallentin & Car	A framework for uncertainty assessment in simulation models	International Journal of Geographical Information Science	27	2	408-422
2013	Ross et al.,	New developments in uncertainty assessment and uncertainty management	Experts Systems with Applications		40	964-974
2014	Bradly & Drechsler	Types of Uncertainty	Erkenntnis / Springer	79	6	1225-1248
2015	Parker & Risbey	False precision, surprise, and improved uncertainty assessment	Philosophical Transactions: Mathematical, Physical, and Engineering Sciences	373	2055	.1.-.13.
2016	Veenman & Leroy	Environmental outlooks: how they frame futures and long-term uncertainty	Futures		82	63-75
2018	Dorsser et al.,	Improving the link between the futures field and policy making	Futures		104	75-84

Table 65*Frequent Adjectives Coverage of Articles List*

Year	Author	Article	Source	Vol.	No	pg.
1941	Tintner	The theory of choice under subjective risk and uncertainty	Econometrica	9	3	298-304
1942	Tintner	A contribution to the non-static theory of choice	The Quarterly Journal of Economics	56	2	274-306
1949	Simpson	Neoclassical economics and monetary problems	The American Economic Review	39	5	861-882
1950	Alchian	Uncertainty, evolution, and economic theory	Journal of Political Economy	58	3	211-221
1951	Arrow	Alternative approaches to the theory of choice in risk-taking situations	Econometrica	19	4	404-437
1972	Duncan	Characteristics of organizational environments and perceived environmental uncertainty	Administrative Science Quarterly	17	3	313-327
1985	Bourgeois	Strategic Goals, Perceived Uncertainty, and Economic Performance in Volatile Environments	Academy of Management Journal	28	3	548-573
1987	Hodges	Uncertainty, Policy Analysis and Statistics	Statistical Science	2	3	259-275
1987	Milliken	Three Types of Perceived Uncertainty about The Environment	Academy of Management Review	12	1	133-143
1998	Sutcliffe&Zaheer	Uncertainty in The Transaction Environment	Strategic Management Journal	19	1	.10-23.
1998	Folta	Governance and Uncertainty	Strategic Management Journal	19	11	1007-1028
2002	Regan et al.	A Taxonomy and Treatment of Uncertainty for Ecology and Conservation Biology	Ecological Applications	12	2	618-628
2007	Sollie	Ethics, technology development and uncertainty: an outline for any future ethics of technology	Journal of Information, Communication & Ethics in Society	5	4	293-306
2009	Wilson	Creativity, probability, and uncertainty	Journal of Economic Methodology	16	1	45-56
2010	Walker et al.	Addressing deep uncertainty using adaptive policies: introduction to section 2	Technological Forecasting & Social Change		77	917-923
2011	Fox	Factors in ontological uncertainty related to ICT innovations	International Journal of Managing Projects in Business	4	1	137-149
2011	Tapinos	Perceived environmental uncertainty in scenario planning	Futures		44	338-345
2013	Ross et al.,	New developments in uncertainty assessment and uncertainty management	Experts Systems with Applications		40	964-974
2016	Derbyshire	The implications, challenges, and benefits of a complexity-oriented future studies	Futures		77	45-55
2018	Dorsser et al.,	Improving the link between the futures field and policy making	Futures		104	75-84

Table 66*Frequent Concepts Coverage of Articles List*

Year	Author	Article	Source	Vol.	No	pg.
1941	Tintner	The theory of choice under subjective risk and uncertainty	Econometrica	9	3	298-304
1949	Simpson	Neoclassical economics and monetary problems	The American Economic Review	39	5	861-882
1950	Alchian	Uncertainty, evolution, and economic theory	Journal of Political Economy	58	3	211-221
1951	Arrow	Alternative approaches to the theory of choice in risk-taking situations	Econometrica	19	4	404-437
1972	Kamien&Schwartz	A direct approach to choose under uncertainty	Management Science	18	8	B470-B477
1972	Duncan	Characteristics of organizational environments and perceived environmental uncertainty	Administrative Science Quarterly	17	3	313-327
1987	Milliken	Three Types of Perceived Uncertainty about The Environment	Academy of Management Review	12	1	133-143
1987	Hodges	Uncertainty, Policy Analysis and Statistics	Statistical Science	2	3	259-275
1992	Gerrity et al.	Uncertainty and Professional Work	American Journal of Sociology	97	4	1022-1051
1987	Milliken	Three Types of Perceived Uncertainty about The Environment	Academy of Management Review	12	1	133-143
2002	Regan et al.	A Taxonomy and Treatment of Uncertainty for Ecology and Conservation Biology	Ecological Applications	12	2	618-628
2007	Sollie	Ethics, technology development and uncertainty: an outline for any future ethics of technology	Journal of Information, Communication & Ethics in Society	5	4	293-306
2012	Dong & Hayes	Uncertainty Visualization	Journal of Cognitive Engineering and Decision Making	6	1	30-56
2013	Ross et al.,	New developments in uncertainty assessment and uncertainty management	Experts Systems with Applications		40	964-974
2013	Kramer et al.,	Communication, uncertainty, and volunteer membership	Journal of Applied Communication Research	41	1	18-39
2013	Wallentin & Car	A framework for uncertainty assessment in simulation models	International Journal of Geographical Information Science	27	2	408-422
2014	Bradly & Drechsler	Types of Uncertainty	Erkenntnis / Springer	79	6	1225-1248
2015	Parker & Risbey	False precision, surprise, and improved uncertainty assessment	Philosophical Transactions: Mathematical, Physical, and Engineering Sciences	373	2055	.1.-.13.
2017	Kovacic	Investigating science	Futures		91	81-83
2017	Magruk	Concept of uncertainty in relation to the foresight research	ISMSME	9	1	46-55
2018	Dorsser et al.,	Improving the link between the futures field and policy making	Futures		104	75-84

Table 67*Conceptual Modeling Concepts Coverage of Articles List*

Year	Author	Article	Source	Vol.	No	pg.
1941	Tintner	The theory of choice under subjective risk and uncertainty	Econometrica	9	3	298-304
1942	Tintner	A contribution to the non-static theory of choice	The Quarterly Journal of Economics	56	2	274-306
1949	Simpson	Neoclassical economics and monetary problems	The American Economic Review	39	5	861-882
1949	Moore & Tumin	Some social functions of ignorance	American Sociological Review	14	6	787-795
1950	Alchian	Uncertainty, evolution, and economic theory	Journal of Political Economy	58	3	211-221
1951	Arrow	Alternative approaches to the theory of choice in risk-taking situations	Econometrica	19	4	404-437
1961	Fellner	Distortion of subjective probabilities as a reaction to uncertainty	The Quarterly Journal of Economics	75	4	670-689
1963	Brewer	Decisions under uncertainty: comments	The Quarterly Journal of Economics	77	1	159-161
1986	Tversky & Kahneman	Rational Choice and the Framing of Decisions	The Journal of Business	59	4	S251-S278
1987	Hodges	Uncertainty, Policy Analysis and Statistics	Statistical Science	2	3	259-275
1996	Ellison	An Introduction to Bayesian Inference for Ecological Research and Environmental Decision-Making	Ecological Applications	6	4	1036-1046
1996	Ludwig	Uncertainty and The Assessment of Extinction Probabilities	Ecological Applications	6	4	1067-1076
2002	Regan et al.	A Taxonomy and Treatment of Uncertainty for Ecology and Conservation Biology	Ecological Applications	12	2	618-628
2005	Bradfield et al.	The origins and evolution of scenario techniques in long range business planning	Futures		37	795-812
2006	Börjeson et al.	Scenario types and techniques: Towards a user's guide	Futures		38	723-739
2009	Wilson	Creativity, probability, and uncertainty	Journal of Economic Methodology	16	1	45-56
2010	Varum & Melo	Directions in scenario planning literature- a review of the past decades	Futures		42	355-369
2011	Elahi	Here be dragons ... exploring the 'unknown unknown'	Futures		43	196-201
2013	Blockley	Analyzing Uncertainties	Mechanical Systems and Signal Processing		37	30-42
2017	Derbyshire	The siren call of probability	Futures		88	43-54