



ISSN: 2230-9926

Available online at <http://www.journalijdr.com>

# IJDR

*International Journal of Development Research*  
Vol. 12, Issue, 07, pp. 57320-57331, July, 2022  
<https://doi.org/10.37118/ijdr.24730.07.2022>



RESEARCH ARTICLE

OPEN ACCESS

## INTER-ORGANIZATIONAL UNCERTAINTY: A PROPOSITION OF CONCEPTUAL DEFINITION AND ITS CONSTITUENT ATTRIBUTES

\*Edimilson Cavalcante da Fonseca

Ph.D. student at Business School of Unisinos University, Brazil

### ARTICLE INFO

#### Article History:

Received 15<sup>th</sup> April, 2022  
Received in revised form  
19<sup>th</sup> May, 2022  
Accepted 08<sup>th</sup> June, 2022  
Published online 25<sup>th</sup> July, 2022

#### Key Words:

Uncertainty, Attributes, Conceptual definition, Inter-Organizational and Innovation Management.

#### \*Corresponding author:

Edimilson Cavalcante da Fonseca

### ABSTRACT

Studies on innovation management have demonstrated that organizations adopt more open and collaborative attitudes to develop innovations in an increasingly dynamic and competitive environment. Technological, regulatory, and marketing changes arise that raise doubts about the return on investments in R&D projects. However, there is still a lack of insights into how to manage uncertainty, lack of insights into how to mitigate inter-organizational uncertainty, and how this can impact collaborative practices during the project lifecycle. Antecedent studies present confusing results, this may be a reflection of the generic conceptual application of uncertainty without considering that uncertainty is a phenomenon constructed from attributes. The proposal of the conceptual definition of inter-organizational uncertainty was elaborated from the conceptual bibliographic method based on the primary uncertainty to cover the organizational, inter-organizational, and collective levels. The results show four equivalence terms to uncertainty and sixteen attributes that can characterize uncertainty in organizations. These results provide a better understanding of how to deal with uncertainty by combining strategies for each attribute identified in innovative projects.

Copyright © 2022, Edimilson Cavalcante da Fonseca. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Citation: Edimilson Cavalcante da Fonseca. "Inter-organizational uncertainty: A proposition of conceptual definition and its constituent attributes", *International Journal of Development Research*, 12, (07), 57320-57331.

## INTRODUCTION

The literature on innovation management is characterized by its pragmatic nature. This nature is due to the process of applying new ideas to create, deliver and capture innovative results through a dynamic combination of resources, capabilities, and skills of organizations (DODGSON *et al.*, 2014). In this field, the capture by returns of innovation is a concern for innovation managers, because, depending on the type of innovation, the return on investments can be highly distorted (SCHERER *et al.*, 2000) and the distribution of profits can be asymmetric among innovators (FLEMING, 2007). This distortion, in part, is the result of the uncertainty inherent in the innovation process, because the returns on investments in innovation are unknown and sometimes time-consuming, such as investments in R&D projects (SALTER; ALEXY, 2014). In this sense, organizations create different structures to develop the most radical innovations, while maintaining organizational routines for incremental improvements of less disruptive ideas (TUSHMAN; O'REILLY, 1996). This has been an ambidextrous practice adopted by fractal organizations that develop innovations in exploitation and exploitation (NONAKA *et al.*, 2014). Organizations have adopted more collaborative attitudes to develop open innovations with external partners (CHESBROUGH, 2003; RANDHAWA *et al.*, 2016).

These ambidextrous practices for developing innovations were refined by Faccin and Balestrin (2018), who discovered a series of collaborative knowledge creation practices that can strategically be adopted throughout the life cycle of an R&D project. It is noticed that these strategies are important for the management of innovation because as managers seek to accumulate knowledge through collaborative arrangements (KAPOOR; MCGRATH, 2014), a favorable environment is created to face uncertainties during the process of innovation. This happens because the dynamics of innovation in collaborative projects are increasingly competitive and heterogeneous, new technologies, knowledge, and highly innovative resources emerge that cause technological discontinuity and market changes (GRANT, 1996; LAVIE; LECHNER; SINGH, 2007; BOUNCKEN; KRAUS, 2007; BOUNCKEN; KRAUS, 2013; FRISHAMMAR; ERICSSON; PATEL, 2015; MAJURI; NYLUND; LANZ, 2016; ZHANG; LI; LI, 2021) and because of this environmental dynamism, the interdependence between the actors of a collaborative project will cause the need to make mutual adjustments in the capacity of partners, more time to correct and require other capabilities that go beyond those existing in the alliance (DYER; SINGH; HESTERLY, 2018). In this sense, this study corroborates the need for new scientific approaches that contribute to managing collaborative projects (SYDOW; BRAUN, 2018), since the literature provides few

insights into how to manage uncertainties in collaborative projects (FANOUSSE, NAKANDALA; LAN, 2021), there is a lack of refined evidence on how inter-organizational uncertainty can be mitigated and evaluated (DE VASCONCELOS GOMES; LOPEZ-VEJA; FACIN, 2021) and how uncertainty can impact collaborative practices in R&D projects (FACCIN; BALESTRIN, 2018). It is argued that such gaps remain unclear empirically due to the lack of more refined approaches to uncertainty and therefore make the results inconsistent and confusing to interpret. It is at this point that this article proposes to elucidate the confusion of the generic and simplified conceptual use of uncertainty in the scope of innovation management studies. Uncertainty is a phenomenon that has been changing over time (SMALES, 2021; BUNN *et al.*, 2021; MUMTAZ; THEODORIDIS, 2018), new attributes arise that challenge innovation management to manage uncertainty during projects. Thus, this article sought to answer the question: What is inter-organizational uncertainty, and what attributes constitute it? Therefore, the objective is to provide a proposition of conceptual definition of uncertainty at the organizational and inter-organizational level and to identify which attributes are recurrent in the studies of this field. The importance of this research is justified by the need to gain insights for innovation managers and field researchers to establish links between the attributes of uncertainty at the organizational and inter-organizational level and collaborative practices in innovation projects.

This article was structured in the following form: in the next section, it is intended for a literature review of uncertainty. The method used to develop this research is then described. Then, the results of the collected data are presented, organized, and analyzed. Finally, the answer to the research question was generated with considerations and recommendations for future research.

**THEORETICAL BACKGROUND:** The classical literature constituted the concept of uncertainty by immeasurable, unquantifiable, and cloudy attributes, and the risk by attributes that can be probabilities and measurements (KNIGHT, 1921). For decades, many organizational literature theorists have developed research to explain the antecedents, implications, and consequences of uncertainty in organizations. And because of this, different perspectives have emerged to demonstrate that environmental uncertainty can have a volatile and objective effect on organizations (MARCH; SIMON, 1958; DILL, 1958; THOMPSON, 1967.) Another perspective of uncertainty arose through the perception of organizational managers (DUNCAN, 1972; LAWRENCE; LORSCH, 1969). At this time, theorists began to conceptualize organizations as an open and adaptive system (THOMPSON, 1967; KATZ; KAHN, 1966), and this was the driving force to understand that exchange with the environment was essential for the survival of organizations (BUCKLEY, 1967). This vision triggered a movement for the formation of alliances to make exchanges, mutual help, and the search for perfect knowledge to reduce uncertainties (THOMPSON, 1967; LAWRENCE; LORSCH, 1967; COOK, 1977). Subsequently, the perspective of the effect of uncertainty on decision-making emerged, based on the control of resources, including human resources, to achieve the purposes of organizations (PFEFFER *et al.*, 1976; COOK, 1977). In addition to these perspectives, Milliken (1987) highlighted the "perceived environmental uncertainty" within a conceptual "umbrella" to add other types of uncertainties: state uncertainty, the uncertainty of the effect, and uncertainty of response, which administrators experience in organizations in a complex and dynamic way.

This movement has boosted an agenda of scientific investigations that seek to explain the dynamics of uncertainty in organizations (GOLDMAN; VAN HOUTEN, 1980; SHUKLA, 1982; Hui; LEE, 2000; PARNELL *et al.*, 2000; CLAMPITT *et al.*, 2000; SHENHAV; WEITZ, 2000; WONG *et al.*, 2010; CEGIELSKI *et al.*, 2012; STURDY *et al.*, 2013; DESAI, 2014; ZHANG, 2016; DONG, 2016; Liu; LIN, 2018; HEROLD *et al.* 2021); interorganizational uncertainty (PERRY *et al.*, 2004; KREYE, 2017a-b; Hernandez; KREYE, 2020; KREYE, 2022); collective uncertainty (GEERSBRO; RITTER, 2010; DE VASCONCELOS GOMES *et al.*, 2021),

uncertainty in innovative projects (DAGHFOUS, 2004; HALL; MARTIN, 2005; MELANDER, MELANDER. TELL, 2014; ESLAMI; MELANDER, 2019; DOLD; SPECK, 2021) and uncertainty in innovation ecosystems (ADNER, 2006; Russell, RUSSELL, SMORODINSKAYA, 2018; DE VASCONCELOS GOMES, *et al.*, 2018). These studies commonly treat uncertainty in specific empirical contexts that often make it difficult to replicate the results in other studies. In addition, different authors adopt generic, concurrent, and disparate concepts of attributes that are important to manage inter-organizational uncertainty in the empirical context, in this study, collaborative projects to develop innovations, for example, authors (PFEFFER, 1985; MCKELVIE *et al.*, 2011). As stated in the introduction, this asymmetry of understanding seems to reflect the adoption of the generic concept of uncertainty, that is, the use of primary uncertainty without considering the type, level, or category of uncertainty being researched. This practice underestimates the attributes inherent in the types of uncertainty and makes it difficult to combine to manage uncertainty in innovation projects. This problem was also signaled by the organizational theorists of the time, for example, Thompson (1967) sought to conceptualize organizational uncertainty because of the taxonomy necessary to aggregate other types of attributes that link power to the absorption of uncertainty, for example, belief, conflict, cognition, and level of knowledge. Shukla (1982) sought to reconceptualize organizational uncertainty in a decision-making context, incorporating the size and degree of interdependence of the group of participants because of the complexity of the decision environment. This is because the use of the term "uncertainty" is popular and used in many situations (DOWNEY; SLOCUM, 1975) and this assumption may cause researchers not to pay much attention to the conceptual definition and its operability (MILLIKEN, 1987). About this theoretical background, it is argued that the absence of conceptual rigor of uncertainty at the organizational and inter-organizational level is the obstacle to understanding how uncertainty can be managed by managers during the life cycle of innovation projects.

## METHODOLOGY

Initially, a literature review was conducted on organizational uncertainty to identify the contributions and gaps in these studies. The bibliographic search was performed in the databases "Web of Science, Scopus, and Science Direct" by the term "organizational uncertainty", filtering by topics in the articles published in the area of business and management. The articles that were repeated were excluded, resulting in a total of 40 studies published from 1980 to 2022. All articles were read to understand how uncertainty was addressed at the organizational and inter-organizational level and, among these studies, it was possible to find the classic publications of organizational theorists from the 1950s to the 1980s, which did not appear in the search. Given the conceptual gap of uncertainty at the organizational and inter-organizational level identified in the literature review, this study proceeded to reverse search for the primary conceptual definition of uncertainty. The procedures consisted of logical steps through the conceptual bibliographic method, which was divided into four stages: 1) formulation of the research question; 2) data collection; 3) organization and analysis of data and 4) generating a response to the research question. In the first stage, the research problem questions what inter-organizational uncertainty is, and what attributes it, is based on the conceptual gap as exposed. In the second stage, literary data collection was performed through the databases "Web of Science, Scopus, and Science Direct" by the following terms: "uncertainty is understood", "uncertainty is defined", "uncertainties are defined", "uncertainties are known as", "uncertainty is dealt with", "definition of uncertainty", "uncertainty if referred", "uncertainty refer" and "uncertainty can be defined" to find as much uncertainty-setting data as possible. Filters were applied by searching for articles, the terms can be found in any part of the documents and published in English, resulting in 569 publications. Then, the bibliographic data were analyzed to verify if the results presented conceptual definitions of uncertainty, and the Foxit Reader software was used to search for the keywords in the articles in pdf

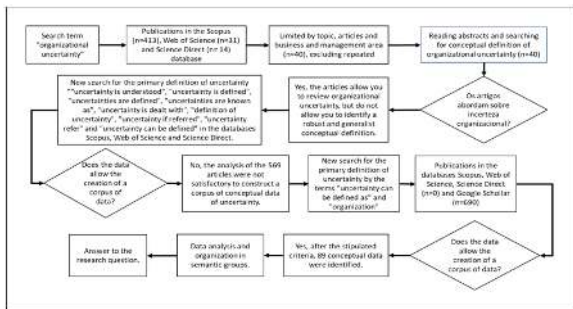
format. The preliminary results of this analysis were not satisfactory because most of the data did not represent a concept of uncertainty, making it impossible to create a corpus of data for future semantic analysis. In this sense, a new search for literary data was established in Google Scholar by the following terms: "uncertainty can be defined as "and "organization", resulting in 690 publications. The first term was defined to have a response pattern and the second term was inserted to obtain results that deal with uncertainty in the organizational context. No filters were applied by the business and management area because uncertainty is a phenomenon that is very addressed in the field of innovation, technology, engineering, health, and the sciences that involve management decision-making. To ensure the quality of the literary data collected, we adopted only the primary conceptual definitions of uncertainty at the organizational and inter-organizational level of peer-reviewed articles with impact factors A1, A2, and B1 and other levels of uncertainty that do not add to the conceptual proposition according to the objective of this study, in the end, a total of 88 conceptual data resulted. In the third stage, the organization and analysis of data, first, a corpus of data was created in a table with two columns, one with the names of the authors and the other with the answers identified (conceptual definitions). After that, the terms equivalent to uncertainty were identified and grouped, which is the first term that arises at the beginning of a response. Next, we identified the attributes that characterize the term equivalent and that constitute uncertainty in organizations. Then, semantic groups of attributes were grouped, i.e., grouping by linguistic meanings. Thus, with the equivalent terms and the attributes identified, the last phase consisted of the answer to the research question proposed by this study. The paraphrastic structure adopted to generate the response was through the formula:  $f(\text{phenomenon}) = \text{equivalence terms} + \text{attributes}$ . The methodological design used in this research is represented in Figure 1 below.

to propose the definition at the inter-organizational level and differentiate it from the collective level, avoiding asymmetric use.

## RESULTS AND DISCUSSION

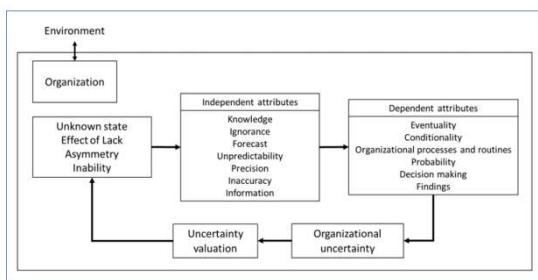
This section presents the results obtained in the research, as well as the discussion of the results based on a literature review and the conceptual bibliographic method. The findings are divided into two parts: terms of equivalence and attributes of uncertainty.

**Uncertainty equivalence term:** The term equivalence is a term that can replace another term without modifying its meaning or meaning (SCHUBERT, 1976). Thus, the equivalent term can be found at the beginning of the conceptual definition, usually, it is the first term that appears in the answer to the question. For example, uncertainty can be defined as a manager's perceived inability to predict something accurately (MILLIKEN, 1987). In this case, the equivalent term is disability. The following results were organized into semantic groups of linguistic meanings: unknown state, asymmetry, lack, and disability, as shown in Table 1. The first semantic grouping refers to the unknown state in which organizations face adverse situations. The term state is an indication that uncertainty can be seen with a state that is not known or the understanding of happenings is limited (DOWNEY; SLOCUM, 1975; KOH; SAAD, 2002; KOH; SIMPSON, 2005; KOH; GUNASEKARAN, 2006; EMBLEMSVÄG, 2010; GOSLING *et al.*, 2013; WAGNER; DE HILAL, 2014; HUBBARD, 2014; GUJAR, 2014; MESROBIAN *et al.*, 2015; Shankar, 2010. RAMULU, 2016; RUSSEL *et al.*, 2021). The distribution of a state under uncertainty occurs through situations that cannot be predicted (GABALDON, 1993; FLANAGAN; NORMAN, 1993; SCHRADER *et al.*, 1993; LEE, 2002; LEMPERT, 2003; BAIRAMZADEH *et al.*, 2018; DIKMEN *et al.*, 2021) due to the degree of difficulty perceived by the organization (PAVLOU *et al.*, 2007; WIEGMANS *et al.*, 2007). In this semantic group, other terms were identified that corroborate the unknown state, for example, chance, chance, effect, risk, form, and probability of analyzing events (MURRAY, 1961; TAFTI *et al.*, 2012; SMITH, SMITH, SMITH, MERNA, 2014; JAAFARI, 2001; LANDEMORE, 2014; DENIS, 1991). Asymmetry is another term that can be equivalent to uncertainty. This group consists of deviation, this term refers to the effect of change of what was planned (DAVIS; KELLER, 1997; WALKER *et al.*, 2003), this deviation occurs due to verification of the difference in values and/or information, according to the studies by Galbraith (1973), Navy (1995), Thiry (2002), Meyers and Kromer (2008), Finnveden *et al.* (2009) and Sinaga *et al.* (2021). Generally, this discrepancy can be perceived by measuring the values (CHOW *et al.*, 1995; BHARATH: ARUL MOZHI SELVAN, 2021), which manifests itself through doubt (BORDIA *et al.*, 2006; MARTIN *et al.*, 2017) or, for ambiguities and inaccuracies (BRASHERS, 2001; KINKELDEY *et al.*, 2017). In this group, uncertainty may be equivalent to the parameter that is associated with the dispersion of values that causes asymmetries (VIM, 2004; CHIUMIENTO *et al.*, 2015).



Source: Prepared by the author

Figure 1. Search designer



Source: Prepared by the author

Figure 2. Logical design of uncertainty in organizations

Finally, the units of analysis used in this research were the conceptual definitions identified in the literature. The unit of analysis is the central object of scientific research (PADHY *et al.*, 2021). This means that the object will be subject to analysis, where the researcher "breaks down in parts" to understand the object being observed, investigated, and researched (AHMAD; KHAN, 2019; YIN, 2001; PADHY *et al.*, 2021). In this study, the objects investigated were the conceptual definitions of uncertainties. Another fundamental point was the level of analysis chosen, the organizational level was covered

The third semantic group refers to the effect of the lack. This effect is related to a lack of knowledge and information, the recurrence of this equivalent term can be observed in the studies by Duncan (1972), NRC (1983), March and Olsen (1976), Aubert *et al.* (1996), Crawford (1997), Zimmermann (2001), Kirby (2001), Weaver *et al.* (2006), Ramsey (2009), Daft *et al.* (2010), Kreye *et al.* (2012), Hale (2012), Kettler *et al.* (2015), Hortal *et al.* (2015), and Mironova and Ibragimov (2021). Another term that makes up this group is the gap, which is related to the knowledge, data, and information gap (TUSHMAN; NADLER, 1978; TREVINO, 1990; CHENG, 1992; SCHNEIDER *et al.*, 2021), due to the lack of precise information (ROWE, 1994; POBLETE; BENGTON, 2020), sometimes due to the imperfection of knowledge and information (MCBEAN; RODGERS, 2010; AVEN *et al.*, 2018), and/or the incompleteness of knowledge (AYYUB, 2001; AYYUB *et al.*, 2002; PEYGHAMI *et al.*, 2020). The last term of equivalence to uncertainty identified in the literature is a disability.

Table 1. Terms of equivalence to uncertainty

Authors	Equivalent Term	Semantic Groups	
DOWNEY; SLOCUM (1975) KOH; SAAD (2002) KOH; SIMPSON (2005) KOH; GUNASEKARAN (2006) EMBLEMSVÅG (2010) GOSLING <i>et al.</i> (2013) WAGNER; DE HILAL (2014) HUBBARD (2014) GUJAR (2014) HUBBARD (2014) MESROBIAN <i>et al.</i> (2015) SHANKAR; RAMULU (2016) RUSSEL <i>et al.</i> (2021)	State	Unknown state	
PAVLOU <i>et al.</i> (2007); WIEGMANS <i>et al.</i> (2007)	Degree		
GABALDON (1993); FLANAGAN; NORMAN (1993); SCHRADER <i>et al.</i> (1993); LEE (2002); LEMPERS (2003); BAIRAMZADEH <i>et al.</i> (2018); DIKMEN <i>et al.</i> (2021)	Situation		
MURRAY (1961); TAFTI <i>et al.</i> (2012); SMITH; MERNA (2014); JAAFARI (2001); LANDEMORRE (2014); DENIS (1991)	Accident, chance, effect, risk, form, and probability		
DAVIS; KELLER (1997); WALKER <i>et al.</i> (2003)	Detour	Asymmetry	
GALBRAITH (1973); NAVY (1995); THIRY (2002); MEYERS; KROMER (2008); SINAGA <i>et al.</i> (2021); FINNVEDEN <i>et al.</i> (2009)	Difference/ Discrepancy		
CHOW <i>et al.</i> (1995); BHARATH; ARUL MOZHI SELVAN (2021)	Measure		
BORDIA <i>et al.</i> (2006); MARTIN <i>et al.</i> (2017)	Doubts		
KINKELDEY <i>et al.</i> (2017); BRASHERS (2001)	Inaccuracy/Ambiguity		
VIM (2004); CHIUMIENTO <i>et al.</i> (2015)	Parameter	Lack	
DUNCAN (1972); NRC (1983); MARCH; OLSEN (1976); AUBERT <i>et al.</i> (1996); CRAWFORD (1997); ZIMMERMANN (2001); KIRBY (2001); WEAVER <i>et al.</i> (2006); RAMSEY (2009); DAFT <i>et al.</i> (2010); KREYE <i>et al.</i> (2012); HALE (2012); KETTLER <i>et al.</i> (2015); HORTAL <i>et al.</i> (2015); MIRONOVA; IBRAGIMOV (2021)	Lack		
TUSHMAN; NADLER (1978); TREVINO (1990); CHENG (1992); SCHNEIDER <i>et al.</i> (2021)	Gap		
ROWE (1994); POBLETE; BENGTON (2020)	Absence		
MCBEAN; RODGERS (2010); AVEN <i>et al.</i> (2018)	Imperfection		
AYYUB (2001); AYYUB <i>et al.</i> (2002); PEYGHAMI <i>et al.</i> (2020)	Incompleteness		
MILLIKEN (1987); SHELANSKI; KLEIN (1995); DICKSON; WEAVER (1997); SOMMER; LOCH (2004); WALDEN; BROWNE (2009); WONG <i>et al.</i> (2011)	Inability		Inability
BECKMAN <i>et al.</i> (2004); BAPTISTA <i>et al.</i> (2020)	Difficulty/Inexperience		

Table 2. Attributes of uncertainty

Authors	Attributes	Semantic Groups
DOWNEY; SLOCUM (1975); MARCH; OLSEN (1976); NRC (1983); ROWE (1994); SCHRADER <i>et al.</i> (1993); DAVIS; KELLER (1997); KIRBY (2001); AYYUB (2001); AYYUB <i>et al.</i> (2002); WALKER <i>et al.</i> (2003); RAMSEY (2009); MCBEAN; RODGERS (2010); GOH <i>et al.</i> (2010); GOSLING <i>et al.</i> (2013); XU <i>et al.</i> (2012); HUBBARD (2014); KETTLER <i>et al.</i> (2015); PEYGHAMI <i>et al.</i> (2020); MIRONOVA; IBRAGIMOV (2021); SCHNEIDER <i>et al.</i> (2021).	Knowledge	Knowledge
AYYUB (2001); AYYUB <i>et al.</i> (2002); PEYGHAMI <i>et al.</i> (2020)	Knowledge acquisition	
WAGSTAFF <i>et al.</i> (2015); MCBEAN; RODGERS (2010); MARCH; OLSEN (1976); MILLIKEN (1987); TAFTI <i>et al.</i> (2012); DENIS (1991); KREYE <i>et al.</i> (2012)	Understanding, perception, and understanding	
MURRAY (1961); NAVY (1995); DAVIS; KELLER (1997); HALE (2012); KREYE <i>et al.</i> (2012); LANDEMORRE (2014); SMITH; MERNA (2014); MESROBIAN <i>et al.</i> (2015); HORTAL <i>et al.</i> (2015); HORTAL <i>et al.</i> (2015); BAPTISTA <i>et al.</i> (2020)	Unknown/ Ignorance	Ignorance
LEE (2002); LEMPERS (2003); MCBEAN; RODGERS (2010); SHANKAR; RAMULU (2016)	Not knowing	
BECKMAN <i>et al.</i> (2004); HUBBARD (2014); AVEN <i>et al.</i> (2018); RUSSEL <i>et al.</i> (2021)	Incomplete knowledge	
SHANKAR; RAMULU (2016); LEE (2002); MEYERS; KROMER (2008); HALE (2012); GOH <i>et al.</i> (2010); XU <i>et al.</i> (2012)	Happening/ possibility	Eventuality
DICKSON; WEAVER (1997) AVEN <i>et al.</i> (2018); DORIA-BELENGUER <i>et al.</i> 2020	Occurrences	
SHELANSKI; KLEIN (1995); DICKSON; WEAVER (1997); LEE (2002); DAFT <i>et al.</i> (2010); WAGSTAFF <i>et al.</i> (2015); GUJAR (2014); BAIRAMZADEH <i>et al.</i> (2018) POBLETE; BENGTON (2020)	Changes	
CRAWFORD (1997); BORDIA <i>et al.</i> (2006); LEMPERS (2003); WONG <i>et al.</i> (2011); WAGNER; DE HILAL (2014); LANDEMORRE (2014); SMITH; MERNA (2014); SHANKAR; RAMULU (2016); AVEN <i>et al.</i> (2018); DIKMEN <i>et al.</i> (2021)	Upcoming Events/ Events	
DUNCAN (1972) FLANAGAN; NORMAN (1993) NAVY (1995) BRASHERS (2001)	Situation	Conditionality
HUBBARD (2014); PAVLOU <i>et al.</i> (2007)	State	

Continue ....

MURRAY (1961); MARCH; OLSEN (1976); DENIS (1991); KOH; SAAD (2002); KOH; SIMPSON (2005); WALDEN; BROWNE (2009); WAGNER; DE HILAL (2014); MESROBIAN <i>et al.</i> (2015); WAGSTAFF <i>et al.</i> (2015); RUSSEL <i>et al.</i> (2021)	Climate sensitivity, turbulence, accidental speculation, tension, <b>perturbation, insecurity, and psychosis</b>	
MURRAY (1961); XU <i>et al.</i> (2012); WAGNER; DE HILAL (2014); BAPTISTA <i>et al.</i> (2020)	Doubts	
DUNCAN (1972); DOWNEY; SLOCUM (1975); TAFTI <i>et al.</i> (2012); MILLIKEN (1987); DICKSON; WEAVER (1997); PAVLOU <i>et al.</i> (2007); GUJAR (2014); KOH; SAAD (2002)	Environment	Environment
MILLIKEN (1987); SHELANSKI; KLEIN (1995); BECKMAN <i>et al.</i> (2004); MEYERS; KROMER (2008); WALDEN; BROWNE (2009); DAFT <i>et al.</i> (2010); WONG <i>et al.</i> (2011); XU <i>et al.</i> (2012); HUBBARD (2014); HORTAL <i>et al.</i> (2015); SHANKAR; RAMULU (2016); OZMEL <i>et al.</i> (2020); POBLETE; BENGTON (2020); DIKMEN <i>et al.</i> (2021)	Predict/Forecast	Forecast
GABALDON (1993); PAVLOU <i>et al.</i> (2007)	Anticipation	
BORDIA <i>et al.</i> (2006) BECKMAN <i>et al.</i> (2004); BAIRAMZADEH <i>et al.</i> (2018)	Future	
WILLIAMSON (1985); CHOW <i>et al.</i> (1995); CRAWFORD (1997); LEE (2002); BRASHERS (2001) KOH; SAAD (2002); KOH; SIMPSON (2005); KOH; GUNASEKARAN (2006); PAVLOU <i>et al.</i> (2007)	Unpredictable	Unpredictability
DUNCAN (1972); GALBRAITH (1973); MILLIKEN (1987); DENIS (1991); DICKSON; WEAVER (1997); KOH; SAAD (2002); SOMMER; LOCH (2004); BECKMAN <i>et al.</i> (2004); DAFT <i>et al.</i> (2010); TAFTI <i>et al.</i> (2012); OZMEL <i>et al.</i> (2020)	Organization/ Enterprise	Organization
BRASHERS (2001); SHELANSKI; KLEIN (1995); LEMPERT (2003)	Actions	Organizational processes and routines
GALBRAITH (1973); TUSHMAN; NADLER (1978); KOH; SAAD (2002); KOH; SIMPSON (2005); GOH <i>et al.</i> (2010); XU <i>et al.</i> (2012)	Activities, <b>Operations, and</b> Tasks	
GOH <i>et al.</i> (2010); XU <i>et al.</i> (2012); TAFTI <i>et al.</i> (2012); WAGNER; DE HILAL (2014); MARTIN <i>et al.</i> (2017); POBLETE; BENGTON (2020)	Processes	
NRC (1983); DAVIS; KELLER (1997); DICKSON; WEAVER (1997); LEE (2002); PAVLOU <i>et al.</i> (2007); RAMSEY (2009); WONG <i>et al.</i> (2011); HUBBARD (2014); KETTLER <i>et al.</i> (2015); OZMEL <i>et al.</i> (2020); DORIA-BELENQUER <i>et al.</i> (2020)	Accuracy/ Precise	Precision
FINNVEDEN <i>et al.</i> (2009); LANDEMORÉ (2014); HUBBARD (2014); HORTAL <i>et al.</i> (2015); MIRONOVA; IBRAGIMOV (2021)	Calculated/ Accuracy/ Unequivocal	
NRC (1983); KIRBY (2001); GOSLING <i>et al.</i> (2013); HALE (2012); GUJAR (2014)	Sure/Reality	
SHELANSKI; KLEIN (1995); DUNCAN (1972); XU <i>et al.</i> (2012); WEAVER <i>et al.</i> (2006)	Reliability	
Murray (1961); XU <i>et al.</i> (2012); KINKELDEY <i>et al.</i> (2017)	Inaccuracy	Inaccuracy
Murray (1961); KREYE <i>et al.</i> (2012)	Distrust	
WAGNER; DE HILAL (2014); KINKELDEY <i>et al.</i> (2017); BORDIA <i>et al.</i> (2006)	Ambiguity	
KINKELDEY <i>et al.</i> (2017); BHARATH; ARUL MOZHI SELVAN (2021); BAPTISTA <i>et al.</i> (2020); VAN DER DUIN; DE GRAAF (2010); BRASHERS (2001); KINKELDEY <i>et al.</i> (2017); KIRBY (2001); VIM (2004); CHIUMIENTO <i>et al.</i> (2015); XU <i>et al.</i> (2012)	Error, uncontrolled, uncertain, inconsistent, inaccuracy, difference, dispersion, and random.	
Murray (1961); KREYE <i>et al.</i> (2012); BAPTISTA <i>et al.</i> (2020)	indefiniteness	
Murray (1961); DUNCAN (1972); WONG <i>et al.</i> (2011); MARTIN <i>et al.</i> (2017); MCBEAN; RODGERS (2010); BAIRAMZADEH <i>et al.</i> (2018)	Decision making	
DOWNEY; SLOCUM (1975); MARCH; OLSEN (1976); DENIS (1991) FLANAGAN; NORMAN (1993); GABALDON (1993); SHELANSKI; KLEIN (1995); DICKSON; WEAVER (1997); ZIMMERMANN (2001); LEE (2002); LEMPERT (2003); MCBEAN; RODGERS (2010); TAFTI <i>et al.</i> (2012); WAGNER; DE HILAL (2014); MESROBIAN <i>et al.</i> (2015)	Decision-makers, managers, individuals, human agents, participants, and people.	Decision making
DOWNEY; SLOCUM (1975); LEMPERT (2003); SOMMER; LOCH (2004)	Relationships	
TREVINO (1990); CHENG (1992); SCHRADER <i>et al.</i> (1993)	Solve problems	
DUNCAN (1972); WALKER <i>et al.</i> (2003); SINAGA <i>et al.</i> (2021); RUSSEL <i>et al.</i> (2021); BAPTISTA <i>et al.</i> (2020).	Determination	
GOH <i>et al.</i> (2010); XU <i>et al.</i> (2012); LEMPERT (2003); CRAWFORD (1997); VAN DER DUIN; DE GRAAF (2010)	Modeling, model, and alternatives	
LEMPERT (2003); WONG <i>et al.</i> (2011); LANDEMORÉ (2014); SMITH; MERNA (2014)	Probability	Probability
DUNCAN (1972); GALBRAITH (1973); TUSHMAN; NADLER (1978); WILLIAMSON (1985); ROWE (1994); AUBERT <i>et al.</i> (1996); CRAWFORD (1997); BRASHERS (2001); ZIMMERMANN (2001); THIRY (2002); DAFT <i>et al.</i> (2010); EMBLEMSVÄG (2010); KREYE <i>et al.</i> (2012); WAGSTAFF <i>et al.</i> (2015); AVEN <i>et al.</i> (2018); POBLETE; BENGTON (2020); DIKMEN <i>et al.</i> (2021); MIRONOVA; IBRAGIMOV (2021)	Information	Information
PAVLOU <i>et al.</i> (2007); WALDEN; BROWNE (2009); BAIRAMZADEH <i>et al.</i> (2018)	Imperfect information	
SCHRADER <i>et al.</i> (1993); DAVIS; KELLER (1997); JAAFARI (2001); VIM (2004); FINNVEDEN <i>et al.</i> (2009); CHIUMIENTO <i>et al.</i> (2015); SINAGA <i>et al.</i> (2021); BHARATH; ARUL MOZHI SELVAN (2021)	Values	Uncertainty valuation
TREVINO (1990); CHENG (1992); FLANAGAN; NORMAN (1993); THIRY (2002)	Data	
VIM (2004); CHIUMIENTO <i>et al.</i> (2015); HORTAL <i>et al.</i> (2015); DORIA-BELENQUER <i>et al.</i> (2020); BHARATH; ARUL MOZHI SELVAN (2021)	Measurement	
SCHRADER <i>et al.</i> (1993); ZIMMERMANN (2001); SOMMER; LOCH (2004); GOSLING <i>et al.</i> (2013)	Variables	
GALBRAITH (1973); NRC (1983); ZIMMERMANN (2001); FINNVEDEN <i>et al.</i> (2009); RAMSEY (2009) KETTLER <i>et al.</i> (2015); AVEN <i>et al.</i> (2018)	Qualitative/ Quantitative	
TUSHMAN; NADLER (1978); ZIMMERMANN (2001); VIM (2004); WONG <i>et al.</i> (2011); HUBBARD (2014); CHIUMIENTO <i>et al.</i> (2015)	Attributes/ Description	
DUNCAN (1972); WILLIAMSON (1985) GABALDON (1993) CHOW <i>et al.</i> (1995); CRAWFORD (1997); KIRBY (2001); BRASHERS (2001); VIM (2004); MEYERS; KROMER (2008); VAN DER DUIN; DE GRAAF (2010); WONG (2011); HALE (2012); GOSLING <i>et al.</i> (2013); HUBBARD (2014); LANDEMORÉ (2014); CHIUMIENTO <i>et al.</i> (2015); MESROBIAN <i>et al.</i> (2015); BHARATH; ARUL MOZHI SELVAN (2021); DIKMEN <i>et al.</i> (2021)	Results	Results
LEMPERT (2003); MCBEAN; RODGERS (2010)	Consequences	
DUNCAN (1972); KOH; GUNASEKARAN (2006); KOH; SAAD (2002); KOH; SIMPSON (2005) WAGNER; DE HILAL (2014); HUBBARD (2014)	Performance/ Development	

When managers realize that they are facing unexpected happenings, they feel unable to determine actions to face uncertainty (MILLIKEN, 1987; SHELANSKI; KLEIN, 1995; DICKSON, WEAVER, 1997; SOMMER; LOCH, 2004; Walden; BROWNE, 2009; WONG *et al.*, 2011). This feeling of disability is caused by a lack of experience or by the difficulty of managers in choosing alternatives to solve the problems caused by uncertainty (BECKMAN *et al.*, 2004; BAPTISTA *et al.*, 2020). The analysis of these results showed that the most recurrent equivalence term to uncertainty is the unknown state, then comes the effect of lack, asymmetry, and finally, disability. These results represent the first part of the proposition of the conceptual definition of organizational uncertainty. This means that these terms cannot be used in isolation if a complement must make sense of the construction of the concept. Thus, in the next section, the attributes that complement the term equivalence and that characterize uncertainty in organizations will be presented.

**Attributes of uncertainty:** In the organizational field, there is evidence that uncertainty has changed overtime (SMALES, 2021; BUNN *et al.*, 2021; MUMTAZ; THEODORIDIS, 2018). New factors, attributes, and challenges emerge as managers fail to deal with uncertainty in innovative organizations and projects. The results of the attributes identified in the literature were: 1) Knowledge; 2) Ignorance; 3) Eventuality; 4) Conditionality; 5) Environment; 6) Forecast; 7) Unpredictability; 8) Organizational; 9) Organizational processes and routines; 10) Accuracy; 11) Inaccuracy; 12) Decision-making; 13) Probability; 14) Information; 15) Uncertainty valuation and 16) Results. The attributes were organized into semantic groups of meanings, according to Table 2, and constitute the second part of the conceptual proposition.

Uncertainty is characterized by its epistemic nature. This nature is due to the realization that uncertainty is caused by a lack of knowledge. Knowledge, therefore, is one of its main attributes, as shown by the studies by Downey and Slocum (1975), March and Olsen (1976), NRC (1983), Rowe (1994), Schrader *et al.* (1993), Davis and Keller (1997), Ayyub (2001), Kirby (2001), Ayyub *et al.* (2002), Walker *et al.* (2003), Gosling *et al.* (2013), Ramsey (2009), McBean and Rodgers (2010), Goh *et al.* (2010), Xu *et al.* (2012); Kettler *et al.* (2015), Hubbard (2014), Peyghami *et al.* (2020), Mironova and Ibragimov (2021) and Schneider *et al.* (2021). Thus, organizations seek knowledge to solve incompleteness, through the acquisition of knowledge, therefore, another attribute identified in the literature (AYYUB, 2001; AYYUB *et al.*, 2002; PEYGHAMI *et al.*, 2020). The reason for this is that complete knowledge enables organizational managers, understanding, understand and perception of events that cause organizational uncertainty (WAGSTAFF *et al.*, 2015; MCBEAN; RODGERS, 2010; MARCH; OLSEN, 1976; MILLIKEN, 1987; TAFTI *et al.*, 2012; DENIS, 1991; KREYE *et al.*, 2012). The analysis of these attributes demonstrated that when organizational managers have complete knowledge, they have a greater understanding of the environment, understanding of changes, and cognitive perception of happening, therefore, knowledge reduces organizational uncertainty.

In counterpoint to knowledge, ignorance increases uncertainty. This contrast is due to evidence that ignorance is one of the main attributes inherent to uncertainty, as shown by the studies by Murray (1961), Navy (1995), Davis and Keller (1997), Hale (2012), Kreye *et al.* (2012), Landemore (2014), Smith and Merna (2014), and Mesrobian *et al.* (2015), this means that Ignorance is the materialization of the lack of experience of managers who do not know how to explain the facts (HORTAL *et al.*, 2015; BAPTISTA *et al.*, 2020). Generally, ignorance is perceived by the organization when managers do not know or do not know the happening and events (LEE, 2002; LEMPert, 2003; MCBEAN; RODGERS, 2010; SHANKAR; RAMULU, 2016). For this reason, incomplete knowledge also makes it difficult to determine actions to manage uncertainty (BECKMAN *et al.*, 2004, HUBBARD, 2014; AVEN *et al.*, 2018; RUSSEL *et al.*, 2021). In literature, ignorance is often associated with uncertainty, because of this, innovations are being developed more openly and collaboratively to strategically accumulate, access, and create a stock

of partners' knowledge in an R&D alliance, for example, Kapoor and McGrath (2014), Dietrich *et al.* (2010), and Faccin and Balestrin (2018), according to the nature of the uncertainty. Eventuality is another essential attribute of all uncertainty. In this semantic group, it was identified that happening arises unexpectedly, and the possibilities are confusing (LEE, 2002; MEYERS; KROMER, 2008; HALE, 2012; GOH *et al.*, 2010; XU *et al.*, 2012; Shankar, 2010. RAMULU, 2016). Some authors refer to the attribute of occurrences, which also challenge organizational managers because of their unpredictable character (DICKSON; WEAVER, 1997; AVEN *et al.*, 2018; DORIA-BELENGUER *et al.*, 2020). This eventual and unlikely character is provoked by the changes, another attribute evidenced in the studies of Shelanski and Klein (1995), Dickson and Weaver (1997), Lee (2002), Daft *et al.* (2010), Wagstaff *et al.* (2015), Gujar (2014), Bairamzadeh *et al.* (2018), and Poblete and Bengtson (2020). Finally, the most recurrent attribute in the literature is events that managers do not know what to be by vim (CRAWFORD, 1997; BORDIA *et al.*, 2006; LEMPert, 2003; WONG *et al.*, 2011; WAGNER; DE HILAL, 2014; LANDEMORRE, 2014; SMITH; MERNA, 2014; SHANKAR; RAMULU, 2016; AVEN *et al.*, 2018; DIKMEN *et al.*, 2021). Thus, the eventuality challenges the ability of organizational managers to predict how such events can impact the innovation process. These events can arise as market, technological and regulatory changes, causing the need to make adaptations (MCCARTHY *et al.*, 2010) and when the interdependence between project participants is high, there will be a need for mutual adjustments and capabilities that may be beyond the alliance (DYER *et al.*, 2018). This evidence also corroborates the environmental nature of uncertainty. This nature is due to the dynamic environment in which it causes uncertainty to organizations (DUNCAN, 1972; DOWNEY; SLOCUM, 1975; TAFTI *et al.*, 2012; MILLIKEN, 1987; DICKSON; WEAVER, 1997; KOH; SAAD, 2002; PAVLOU *et al.*, 2007; GUJAR, 2014). This means that changes in the environment are dynamic, and managers should adjust to minimize the impacts caused by the environment and ensure that the results will not be affected by the uncertainty arising from the environment. Conditionality is another attribute inherent in uncertainty. This conditional aspect is due to the attributes that characterize uncertainty in organizations. The situation is an attribute that characterizes and qualifies uncertainty (DUNCAN, 1972; FLANAGAN; NORMAN, 1993; NAVY, 1995; BRASHERS, 2001), for example, asking about the situation of an occurrence is usually the first question that an agent/manager asks in the face of uncertainty. Managers need to understand what state a happening is in (PAVLOU *et al.*, 2007; HUBBARD, 2014). Generally, these conditions are related to contexts involving wars, catastrophes, and instabilities, identified in the literature as a climate of sensitivity, tension, turbulence, speculation, disturbance, insecurity, and/or psychosis (MURRAY, 1961; MARCH; OLSEN, 1976; DENIS, 1991; KOH; SAAD, 2002; KOH; SIMPSON, 2005; WALDEN; BROWNE, 2009; WAGNER; DE HILAL, 2014; MESROBIAN *et al.*, 2015; WAGSTAFF *et al.*, 2015; RUSSEL *et al.*, 2021). Doubt is another attribute that supports the idea that all uncertainty has a specific condition, which challenges the investigation of organizational managers (MURRAY, 1961; XU *et al.*, 2012; WAGNER; DE HILAL, 2014; BAPTISTA *et al.*, 2020). These data reveal that uncertainty can be qualified by constraints that, in turn, attribute characteristics to the conception of uncertainty at the organizational and inter-organizational levels.

Predictability is a fundamental attribute of uncertainty management. This characteristic was identified in the literature through the attributes of prediction, anticipation, and future. In this semantic group, prediction is the most recurrent attribute in the literature, according to the studies by Milliken (1987), Shelanski and Klein (1995), Beckman *et al.* (2004), Meyers and Kromer (2008), Walden and Browne (2009), Daft *et al.* (2010), Wong *et al.* (2011), Xu *et al.* (2012), Hubbard (2014), Hortal *et al.* (2015), Shankar and Ramulu (2016), Ozmel *et al.* (2020), Poblete and Bengtson (2020), and Dikmen *et al.* (2021). Managers find it difficult to predict changes in the environment in advance (GABALDON, 1993; PAVLOU *et al.*, 2007), because of this, the future is an uncertain attribute in

organizations (BORDIA *et al.*, 2006; BECKMAN *et al.*, 2004; BAIRAMZADEH *et al.*, 2018). The analysis of this data denotes that forecasting is an essential attribute for managing uncertainty at the organizational and inter-organizational level, because of this, managers should be able to find data, information, and knowledge to determine the most realistic forecast possible, anticipating events that arise unexpectedly over time. In counterpoint to the prediction, unpredictability is an attribute identified in the literature, according to the studies by Williamson (1985), Chow *et al.* (1995), Crawford (1997), Lee (2002), Brashers (2001), Koh and Saad (2002), Koh and Simpson (2005), Koh and Gunasekaran (2006), and Pavlou *et al.* (2007). Analysis of data shows that unpredictability is the result of the manager's inability to predict events that may generate uncertainty during the R&D project. Whereas turbulence in uncertainty challenges organizations and their managers (DUNCAN, 1972; GALBRAITH, 1973; MILLIKEN, 1987; DENIS, 1991; DICKSON; WEAVER, 1997; KOH; SAAD, 2002; SOMMER; LOCH, 2004; BECKMAN *et al.*, 2004; DAFT *et al.*, 2010; TAFTI *et al.*, 2012; OZMEL *et al.*, 2020). This turbulence is usually perceived by the organization through the eventuality attribute (SMITH; MERNA, 2014; SHANKAR; RAMULU, 2016), in business performance (KOH; SAAD, 2002) and organizational results (WONG *et al.*, 2011; HALE, 2012). The analysis of these data demonstrated that uncertainty is a phenomenon present in organizations and in the routine of managers who need to determine appropriate strategies to ensure the survival of the organization through innovation. Therefore, the organization is an attribute subject to uncertainty. Thus, the attribute of organizational processes and routines that characterize and constitute uncertainty in organizations was identified in the literature. This semantic group consisted of the attributes of action, activity, operation, tasks, and processes. Actions, activities, operations, and tasks are attributes performed by managers, who generally have direct relationships with ambiguous or planned results by the organization (GALBRAITH, 1973; TUSHMAN; NADLER, 1978; KOH; SAAD, 2002; KOH; SIMPSON, 2005; GOH *et al.*, 2010; XU *et al.*, 2012). The execution of these attributes takes place within the scope of established steps, routines, and organizational objectives called the process. Organizational processes are related to decision-making subprocesses, management, strategy elaboration, and modeling process (GOH *et al.*, 2010; XU *et al.*, 2012; TAFTI *et al.*, 2012; WAGNER; DE HILAL, 2014; MARTIN *et al.*, 2017; POBLETE; BENGTSON, 2020). The analysis of these data shows that the realization of these actions and operations facilitates the creation of organizational processes and routines to obtain the competitive advantage of the innovations developed. The relational view proposed that the routines of sharing knowledge between partners maintain an interdependent relationship, generate relational gains, and create value that others outside the alliance do not obtain individually (DYER; SINGH, 1998; DYER *et al.*, 2018). These routines occur through the transfer, combination, and creation of valuable knowledge at the end of the life cycle of the collaborative R&D project. Precision is another attribute that reduces uncertainty. This semantic group consisted of the attributes precision, accuracy, calculation, certainty, and reliability identified in the literature. Accuracy refers to the ability to assign precise probabilities about events and their consequences (NRC, 1983; DAVIS; KELLER, 1997; DICKSON; WEAVER, 1997; LEE, 2002; PAVLOU *et al.*, 2007; RAMSEY, 2009; WONG *et al.*, 2011; HUBBARD, 2014; KETTLER *et al.*, 2015; OZMEL *et al.*, 2020; DORIA-BELENGUER *et al.*, 2020). The attributes of calculation, accuracy, and unequivocal, which in the literature are adopted to express the need to calculate the measures accurately to avoid decision-making with mistaken data and information (FINNVEDEN *et al.*, 2009; LANDEMORRE, 2014; HUBBARD, 2014; HORTAL *et al.*, 2015; Mironova; IBRAGIMOV, 2021). These attributes are important for organizations because as managers obtain certainty and reality of what can be done, clarity about decisions becomes more evident, according to authors NRC (1983), Kirby (2001), Gosling *et al.* (2013), Hale (2012), and Gujar (2014). In turn, reliability assigns a degree of confidence in organizational processes and decisions (SHELANSKI; KLEIN, 1995; DUNCAN, 1972; XU *et al.*, 2012; WEAVER *et al.*, 2006). The analysis of this data is assumed that reliability is a necessary attribute

for the organization to have dominion over happening that can impact the innovative processes of organizations.

In counterpoint, inaccuracy is another attribute that sustains uncertainty. Inaccuracy refers to insufficient data, information, and reliable values to make an assertive decision. This insufficiency can be characterized by the attributes of the inaccuracy of information (MURRAY, 1961; XU *et al.*, 2012; KINKELDEY *et al.*, 2017), mistrust (MURRAY, 1961; KREYE *et al.*, 2012), and ambiguous events and occurrences (BRASHERS, 2001; BORDIA *et al.*, 2006; WAGNER; DE HILAL, 2014; KINKELDEY *et al.*, 2017). Occasionally, these attributes arise with evidence of data errors, uncontrolled situations, uncertain information, inconsistent results, imprecision, difference, dispersion of values, and random variables that disturb the organization's processes and routines (BRASHERS, 2001; KIRBY, 2001; VIM, 2004; VAN DER DUIN; DE GRAAF, 2010; XU *et al.*, 2012; CHIUMIENTO *et al.*, 2015; KINKELDEY *et al.*, 2017; KINKELDEY *et al.*, 2017; BAPTISTA *et al.*, 2020; Bharath; ARUL MOZHI SELVAN, 2021). Finally, the attribute of uncertainty causes a lack of understanding and experience of ignorance for organizational managers (MURRAY, 1961; KREYE *et al.*, 2012; BAPTISTA *et al.*, 2020). These data show that inaccuracy is related to managers' inability to obtain accurate information in a state of uncertainty, so organizations should seek reliable and accurate sources of knowledge to be used in the decision-making process. It was identified that all uncertainty involves a decision. This relationship is due to the finding that uncertainty is a phenomenon that provokes the need for a resolution. Decision-making, therefore, is one of its main attributes, as shown by the studies by Murray (1961), Duncan (1972), Bairamzadeh *et al.* (2018), Wong *et al.* (2011), Martin *et al.* (2017), and Saidi-Mehrabad and Pishvae (2018). To make a decision, the action of a dirtier is necessary to conduct the process. Those who assume this role in organizations are the agent takers, also known as managers, humans, human agents, participants, and people. (DOWNEY; SLOCUM, 1975; MARCH; OLSEN, 1976; DENIS, 1991; FLANAGAN; NORMAN, 1993; GABALDON, 1993; SHELANSKI; KLEIN, 1995; Dickson, DICKSON, DICKSON, WEAVER, 1997; ZIMMERMANN, 2001; LEE, 2002; LEMPert, 2003; MCBEAN; RODGERS, 2010; TAFTI *et al.*, 2012; WAGNER; BY HILAL, 2014; MESROBIAN *et al.*, 2015). During the decision-making process, relationships arise between participants (DOWNEY; SLOCUM, 1975; LEMPert, 2003; SOMMER; LOCH, 2004) with the joint objective of solving the problems caused by uncertainty (TREVINO, 1990; CHENG, 1992; SCHRADER *et al.*, 1993). In this sense, decision-makers should determine what actions should be implemented in the organization to solve the problems (DUNCAN, 1972; WALKER *et al.*, 2003; SINAGA *et al.*, 2021; RUSSEL *et al.*, 2021; BAPTISTA *et al.*, 2020). For this, decision-makers adopt modeling processes and/or are based on management models, because uncertainty causes doubts when choosing the best alternative to reduce it (GOH *et al.*, 2010; XU *et al.*, 2012; LEMPert, 2003; CRAWFORD, 1997; VAN DER DUIN; DE GRAAF, 2010). The analysis of these attributes showed that the resolution of the problems caused by uncertainty in organizations is, therefore, the attribution of innovation managers who should adopt precise measures to avoid losses of investments in projects (CHEN, 2004), and more collaborative postures with the people involved in the decision-making process. This semantic group includes, therefore, the attributes of decision-making, managers, problem-solving, relationships, determination, and modeling that characterize and constitute uncertainty in organizations that develop innovations.

Probability is another attribute that constitutes uncertainty. Assigning probabilities to future events is a generally difficult task for decision-makers. This difficulty is perceived when there is no mastery over the information, the variables are unknown and, much less, there is agreement among managers about a probabilistic future (LEMPert, 2003; WONG *et al.*, 2011; LANDEMORRE, 2014; SMITH, MERNA, 2014). Thus, decision-makers are unable to determine probabilities in a favorable perspective of what may occur. The analysis of this information shows that uncertainty is not probability able. This is because there is no complete information or a history of event

frequency to assign the probabilities. However, under organizational uncertainty, managers seek to mitigate this inability by exchanging experiences with partners facing uncertainty, for example, the institutions that established decision-making through panels with other members, as stated by Pfeffer *et al.* (1976), although this possibility may generate another uncertainty when companies create relationships to exchange information, however, the specific capabilities of each partner create a climate of doubt about capturing the value of another partner, e.g., Kreye (2017a). Uncertainty is often characterized by problems with information. This recurrence comes from evidence that shows that when managers have complete information of happening, the greater chance of making a decision capable of reducing uncertainty (DUNCAN, 1972; GALBRAITH, 1973; TUSHMAN; NADLER, 1978; WILLIAMSON, 1985; ROWE, 1994; AUBERT *et al.*, 1996; CRAWFORD, 1997; BRASHERS, 2001; ZIMMERMANN, 2001; THIRY, 2002; DAFT *et al.*, 2010; EMBLEMSVÅG, 2010; KREYE *et al.*, 2012; WAGSTAFF *et al.*, 2015; AVEN *et al.*, 2018; POBLETE; BENGTSON, 2020; DIKMEN *et al.*, 2021; MIRONOVA; IBRAGIMOV, 2021). On the other hand, managers are unable to decide precisely when information is imperfect (PAVLOU *et al.*, 2007; WALDEN; BROWNE, 2009; BAIRAMZADEH *et al.*, 2018). Information is essential for managing uncertainty, managers feel more reliable to make decisions, solve problems, and anticipate events that can impair organizational performance. These results corroborate the study by Lasso *et al.* (2020) that identified an uncertain situation where customers received limited information at the beginning of the project to establish contact with R&D to discuss technical issues. This study contributes to providing more characteristics of how information can be combined to avoid misinformation in the project. All uncertainty expresses a value resulting from events. This expression is characterized by the evaluation of the values, data, measurements, and quantifiable and qualifying variables that constitute the semantic group called uncertainty valuation. The value, therefore, is one of its main attributes as observed in the studies by Schrader *et al.* (1993), Davis and Keller (1997), Jaafari (2001), Vim (2004), Finnveden *et al.* (2009), Chiumiento *et al.* (2015), Sinaga *et al.* (2021), and Bharath and Arul Mozhi Selvan (2021). The data, in turn, are necessary to attribute values to the happening (TREVINO, 1990; CHENG, 1992; FLANAGAN; NORMAN, 1993; THIRY, 2002). This attribution happens through the measurement of data (VIM, 2004; CHIUMIENTO *et al.*, 2015; HORTAL *et al.*, 2015; DORIA-BELENGUER *et al.*, 2020; BHARATH; ARUL MOZHI SELVAN, 2021). Another attribute identified is the variables, this attribute is used by the organization from the moment it recognizes the relevant variables to decide on uncertainty (SCHRADER *et al.*, 1993; ZIMMERMANN, 2001; SOMMER; LOCH, 2004; GOSLING *et al.*, 2013) and these variables are obtained by qualitative or quantitative data records (GALBRAITH, 1973; NRC, 1983; ZIMMERMANN, 2001; FINNVEDEN *et al.*, 2009; RAMSEY, 2009; KETTLER *et al.*, 2015; AVEN *et al.*, 2018). Finally, the literature demonstrated that the value of uncertainty is expressed by descriptive attributes to evaluate the events as it was properly occurred and were measured. The analysis of these findings shows that uncertainty causes valuation resulting from the subtraction of the value reached and the value planned by the organization. This discovery is important for uncertainty management studies because as the value of innovation is subtracted by uncertainty it will lead to low financial return, loss of valuable assets, and increased transaction costs that could be avoided by decision-makers if there was an accurate assessment of uncertainty. These results contribute to evaluating the spread of uncertainty in innovation projects (DE VASCONCELOS GOMES; LOPEZ-VEGA; FACIN, 2021). These attributes note that the spread of uncertainty reflects the valuation of uncertainty resulting from the difference between the planned value and the value created and the profits achieved by the development of innovation.

All uncertainty causes a result to the organization. This characteristic is verified by identifying the attributes of the results, consequences, performance, and development, which together constitute the semantic group of the results of the organization. Therefore, the result appears as the main attribute in all kinds of uncertainty and marks its

worrying character in organizations, as can be measured in the studies of Duncan (1972), Williamson (1985), Gabaldon (1993), Chow *et al.* (1995), Crawford (1997), Kirby (2001), Brashers (2001), Vim (2004), Meyers and Kromer (2008), Van Der Duin and De Graaf (2010), Wong *et al.* (2011), Hale (2012), Gosling *et al.* (2013), Hubbard (2014), Landmore (2014), Chiumiento *et al.* (2015), Mesrobian *et al.* (2015), Bharath and Arul Mozhi Selvan (2021), and Dikmen *et al.* (2021). The results can be seen as the consequence of the choices and decisions that managers make during uncertainty (LEMPERT, 2003; MCBEAN; RODGERS, 2010), because of this, the consequences directly affect the performance and development process of organizations (DUNCAN, 1972; KOH; GUNASEKARAN, 2006; KOH; SAAD, 2002; KOH; SIMPSON, 2005; WAGNER; DE HILAL, 2014; HUBBARD, 2014). The analysis of these attributes demonstrates that organizational results depend on the decision-taker to face uncertainty during an innovation project. Therefore, the result must be seen as an attribute that depends on the collaboration of the participants in the decision-making process and, thus, obtains organizational results according to what was planned. These results seem to suggest the idea that uncertainty is a logical scheme that begins with the existing dynamics between the external environment and the organizational environment (including interdependent and independent relationships) and ends with an evaluation of uncertainty by organizations, as shown in Figure 2. This dynamic is often not explicit in innovation management studies, so there will always be a need to understand how this dynamic will imply in the organization. It is what the literature calls the perception of managers. However, in terms of unexpected changes, the starting point is to understand how these dynamics arise to establish actions to cope with uncertainty. This problem with uncertainty is called here in the decision-making scheme.

The decision-making process often depends on the decision-maker's knowledge of the happening caused by dynamics, that is, it is a relationship between dependent and independent attributes. Independent attributes are related to knowledge, forecasting, accuracy, information, and environment. This means that these attributes are independent of other factors, on the contrary, ignorance, unpredictability, inaccuracy, and misinformation will cause changes in other factors. In the logical schema, there are also dependent attributes, they are eventuality, conditionality, organizational processes and routines, probability, decision making, and results. These attributes depend on the independent attributes for an effect. For example, in the face of an unknown state, managers need to have complete information about which event was triggered, what conditions of these events, how this impacts the organization's processes, and verify that the information is sufficient to establish probabilities based on other events, which decision-making will be adopted to address uncertainty, and how this may impact the organization's results. A consistent assessment of uncertainty can generate experiences for the innovation project and its managers. This means that the unknown state may be better known, the lack can be reduced, the asymmetry may be less discrepant, and disability may be reduced. In this case, uncertainty would become a risk consisting of attributes that can be forecasted, accurate, and probabilities. Thus, this study advances previous studies that marginalized the attributes of organizational and inter-organizational uncertainty that are necessary for innovation managers to make combinations to manage uncertainty during the life cycle of innovation projects.

## CONCLUSION

This study sought to answer what inter-organizational uncertainty is and what its constituent attributes are, through a conceptual proposition developed from the bibliographic method. According to the results presented, the formula adopted to generate the conceptual proposition was:  $f(\text{phenomenon}) = \text{equivalence term} + \text{attributes}$ . Therefore, we have:  $f(\text{inter-organizational uncertainty}) = (\text{unknown state} / \text{lack} / \text{asymmetry} / \text{or incapacity}) + \text{independent attributes} (\text{knowledge, lack of knowledge, prediction, unpredictability, precision, imprecision, information, and environment}) + \text{dependent attributes} (\text{eventuality, conditionality, processes and routines,}$



probability, decision making and outcome) + evaluative attribute (valuation of uncertainty). In response to the research question, inter-organizational uncertainty can be defined as a state unknown to partners who develop collaborative innovations, which are not immune to unexpected events, under unpredictable conditions, and which make it impossible to assign probabilities. And because of interdependence, decisions are taken together to avoid negative results and losses of invested assets. At the organizational level, the main difference is the absence of interdependence and mobilization with external partners to manage organization-specific uncertainties. In this way, organizational uncertainty can be defined by the lack of knowledge about future events that can impact organizational routines, processes, and results. And that causes the need for managers to make accurate decisions to face uncertainty and ensure the survival of the organization in the dynamic and competitive environment. At the collective level, the main difference is the independence between organizations because uncertainty can impact companies in different ways, which can be positive and negative depending on the nature of the uncertainty. So, based on the attributes, collective uncertainty can be defined by the asymmetry of information that different organizations perceive in the face of an unexpected event. In this way, each organization chooses its strategy to face uncertainty independently according to its nature. This study contributed to clarifying the understanding of how to measure uncertainty (DE VASCONCELOS GOMES; LOPEZ-VEJA; FACIN, 2021). It was found that the propagation of uncertainties in innovation projects reflects the valuation of uncertainty. Future studies should validate that the valuation of uncertainty is obtained through the difference between the estimated value creation and the value created in collaborative R&D projects. Future research is needed to explain how collaborative practices and routines are mobilized according to the nature of uncertainty and its attributes. Finally, it is recommended that studies adopt the conceptual proposition in their empirical studies to confirm the conceptual framework and the attributes of uncertainty identified in this study.

### Acknowledgment

This study was sponsored by the Coordination for the Improvement of Higher Education Personnel (CAPES) Brazil, process code [88887.242075/2018-00]. Acknowledgment to Instituto Federal do Amazonas for financial and institutional support.

## REFERENCES

- Adner, R. 2006. Match your innovation strategy to your innovation ecosystem. *Harvard business review*, 844, 98.
- Ahmad, W., & Khan, S. 2019. CSR, from perception to role in performance: a case study of SMEs in industrial estate Peshawar, Pakistan. *International Journal of Experiential Learning & Case Studies*, 41, 172-192.
- Aubert, B. A., Rivard, S., & Patry, M. 1996. Development of measures to assess dimensions of IS operation transactions. *Omega*, 246, 661-680.
- Aven, T., Ben-Haim, Y., Boje Andersen, H., Cox, T., Drogue, E. L., Greenberg, M., ... & Thompson, K. M. 2018. August. Society for risk analysis glossary. In *Society for Risk Analysis*.
- Ayyub, B. M. 2001. *Elicitation of expert opinions for uncertainty and risks*. CRC press.
- Ayyub, B. M., Beach, J. E., Sarkani, S., & Assakkaf, I. A. 2002. Risk analysis and management for marine systems. *Naval Engineers Journal*, 1142, 181-206.
- Bairamzadeh, S., Saidi-Mehrabad, M., & Pishvae, M. S. 2018. Modeling different types of uncertainty in biofuel supply network design and planning: A robust optimization approach. *Renewable energy*, 116, 500-517.
- Baptista, N., Pinho, J. C., & Alves, H. 2020. Social marketing and online social support structure in contexts of treatment uncertainty. *Journal of Nonprofit & Public Sector Marketing*, 1-40.
- Beckman, C. M., Haunschild, P. R., & Phillips, D. J. 2004. Friends or strangers? Firm-specific uncertainty, market uncertainty, and network partner selection. *Organization Science*, 153, 259-275.
- Bharath, B. K., & Arul Mozhi Selvan, V. 2021. An Experimental investigation on rheological and heat transfer performance of hybrid nanolubricant and its effect on the vibration and noise characteristics of an automotive spark-ignition engine. *International Journal of Thermophysics*, 423, 1-30.
- Bordia, P., Jones, E., Gallois, C., Callan, V. J., & DiFonzo, N. 2006. Management are aliens! Rumors and stress during organizational change. *Group & Organization Management*, 315, 601-621.
- Bouncken, R. B., & Kraus, S. 2013. Innovation in knowledge-intensive industries: The double-edged sword of cooperation. *Journal of Business research*, 6610, 2060-2070.
- Brashers, D. E. 2001. Communication and uncertainty management. *Journal of communication*, 513, 477-497.
- Buckley, W. 1967. Sociology and modern systems theory.
- Bunn, P. et al. 2021. COVID-19 uncertainty: A tale of two tails. *University of Chicago, Becker Friedman Institute for Economics Working Paper*, 2021-135.
- Cegielski, C. G., Jones-Farmer, L. A., Wu, Y., & Hazen, B. T. 2012. Adoption of cloud computing technologies in supply chains: An organizational information processing theory approach. *The international journal of logistics management*.
- Chen, C. J. 2004. The effects of knowledge attribute, alliance characteristics, and absorptive capacity on knowledge transfer performance. *R&D Management*, 343, 311-321.
- Cheng, T. S. 1992. *Effects of Communication Media on a Negotiation Task*. The University of Hawai'i at Manoa.
- Chesbrough, H. 2003. The logic of open innovation: managing intellectual property. *California management review*, 453, 33-58.
- Chiumiento, F., D'Aloise, A., Marchegiani, F., & Melai, V. 2015. Determination of EDTA in feed and premix formulations by HPLC-DAD. *Food Chemistry*, 175, 452-456.
- Chow, G., Heaver, T. D., & Henriksson, L. E. 1995. Strategy, structure, and performance: a framework for logistics research. *Logistics and Transportation Review*, 314, 285.
- Clampitt, P. G., DeKoch, R. J., & Cashman, T. 2000. A strategy for communicating about uncertainty. *Academy of Management Perspectives*, 144, 41-57.
- Cook, K. S. 1977. Exchange and power in networks of inter-organizational relations. *The sociological quarterly*, 181, 62-82.
- Crawford, G. A. 1997. Information as a strategic contingency: Applying the strategic contingencies theory of intraorganizational power to academic libraries. *College & research libraries*, 582, 145-155.
- Daft, R. L., Murphy, J., & Willmott, H. 2010. *Organization theory and design* Vol. 10. Mason, OH: South-Western Cengage Learning.
- Daghfous, A. 2004. An empirical investigation of the roles of prior knowledge and learning activities in technology transfer. *Technovation*, 2412, 939-953.
- Davis, T. J., & Keller, C. P. 1997. Modeling uncertainty in natural resource analysis using fuzzy sets and Monte Carlo simulation: slope stability prediction. *International Journal of Geographical Information Science*, 115, 409-434.
- De Vasconcelos Gomes, L. A., Lopez-Vega, H., & Facin, A. L. F. 2021. Playing chess or playing poker? Assessment of uncertainty propagation in open innovation projects. *International Journal of Project Management*, 392, 154-169.
- De Vasconcelos Gomes, L. A., Salerno, M. S., Phaal, R., & Probert, D. R. 2018. How entrepreneurs manage collective uncertainties in innovation ecosystems. *Technological Forecasting and Social Change*, 128, 164-185.
- Denis, H. 1991. The complexity of technological disaster management: technical, sociopolitical and scientific issues. *Industrial crisis quarterly*, 51, 1-18.
- Desai, V. M. 2014. Imitate Others? Not if We Have the Chance: Competitive Differentiation in Medical Malpractice Insurers' Pricing Decisions under Uncertainty. *British Journal of Management*, 253, 589-606.

- Dickson, P. H., & Weaver, K. M. 1997. Environmental determinants and individual-level moderators of alliance use. *Academy of Management Journal*, 40(2), 404-425.
- Dikmen, I., Qazi, A., Erol, H., & Birgonul, M. T. 2021. Meta-modeling of complexity-uncertainty-performance triad in construction projects. *Engineering Management Journal*, 33(1), 30-44.
- Dill, W. R. 1958. Environment as an influence on managerial autonomy. *Administrative science quarterly*, 409-443.
- Dodgson, M., Gann, D. M., & Phillips, N. 2014. Perspectives on innovation management. *The Oxford handbook of innovation management*, 3-25.
- Dold, L., & Speck, C. 2021. Resolving the productivity paradox of digitalized production. *International Journal of Production Management and Engineering*, 9(2), 65-80.
- Dong, J. Q. 2016. On the contingent rent-generating potential of firm-specific managerial experience. *Journal of Business Research*, 69(10), 4358-4362.
- Doria-Belenguer, S., Youssef, M. K., Böttcher, R., Malod-Dognin, N., & Pržulj, N. 2020. Probabilistic graphlets capture biological functions in probabilistic molecular networks. *Bioinformatics*, 36(Supplement\_2), i804-i812.
- Downey, H. K., & Slocum, J. W. 1975. Uncertainty: Measures, research, and sources of variation. *Academy of Management Journal*, 18(3), 562-578.
- Duncan, R. B. 1972. Characteristics of organizational environments and perceived environmental uncertainty. *Administrative science quarterly*, 313-327.
- Dyer, J. H., & Singh, H. 1998. The relational view: Cooperative strategy and sources of interorganizational competitive advantage. *Academy of management review*, 23(4), 660-679.
- Dyer, J. H., Singh, H., & Hesterly, W. S. 2018. The relational view revisited: A dynamic perspective on value creation and value capture. *Strategic management journal*, 39(12), 3140-3162.
- Emblemsvåg, J. 2010. The augmented subjective risk management process. *Management Decision*.
- Eslami, M. H., & Melander, L. 2019. Exploring uncertainties in collaborative product development: Managing customer-supplier collaborations. *Journal of Engineering and Technology Management*, 53, 49-62.
- Faccin, K., & Balestrin, A. 2018. The dynamics of collaborative practices for knowledge creation in joint R&D projects. *Journal of Engineering and Technology Management*, 48, 28-43.
- Fanousse, R. I., Nakandala, D., & Lan, Y. C. 2021. Reducing uncertainties in innovation projects through intra-organizational collaboration: a systematic literature review. *International Journal of Managing Projects in Business*.
- Finnveden, G., Hauschild, M. Z., Ekvall, T., Guinée, J., Heijungs, R., Hellweg, S., ... & Suh, S. 2009. Recent developments in life cycle assessment. *Journal of environmental management*, 91(1), 1-21.
- Flanagan, R. & Norman, G. 1993. Risk Management and Construction, Blackwell Science, London.
- Fleming, L. 2007. Breakthroughs and the "long tail" of innovation. *MIT Sloan Management Review*, 49(1), 69.
- Frishammar, J., Ericsson, K., & Patel, P. C. 2015. The dark side of knowledge transfer: Exploring knowledge leakage in joint R&D projects. *Technovation*, 41, 75-88.
- Gabaldon, L. G. 1993. Police Violence and Uncertainty in Latin America: Linking the Macro-and Micro-Levels of Analysis. *International Criminal Justice Review*, 3(1), 44-59.
- Galbraith, J. 1973. Designing complex organizations. Reading, Mass.
- Geersbro, J., & Ritter, T. 2010. External performance barriers in business networks: uncertainty, ambiguity, and conflict. *Journal of Business & Industrial Marketing*.
- Goh, Y. M., Newnes, L. B., Mileham, A. R., McMahon, C. A., & Saravi, M. E. 2010. Uncertainty in through-life costing—review and perspectives. *IEEE Transactions on Engineering Management*, 57(4), 689-701.
- Goldman, P., & Van Houten, D. R. 1980. Uncertainty, Conflict, and Labor Relations in the Modern Firm I: Productivity and Capitalism's Human Face'. *Economic and Industrial Democracy*, 11, 63-98.
- Gosling, J., Naim, M., & Towill, D. 2013. Identifying and categorizing the sources of uncertainty in construction supply chains. *Journal of Construction Engineering and Management*, 139(1), 102-110.
- Grant, R. M. 1996. Toward a knowledge-based theory of the firm. *Strategic management journal*, 17(2), 109-122.
- Gujar, A. J. 2014. Supplier-Buyer Relationships In Indian Manufacturing Environment: An Empirical Study. *International Journal of Engineering Research*, 3(3).
- Hale, A. R. 2012. *Dimensions of Uncertainty in Presidential Decision-Making Involving the Use of Force*. TRIANGLE INST FOR SECURITY STUDIES DURHAM NC.
- Hall, J. K., & Martin, M. J. 2005. Disruptive technologies, stakeholders and the innovation value-added chain: a framework for evaluating radical technology development. *R&D Management*, 35(3), 273-284.
- Hernandez, T. R., & Kreye, M. E. 2020. Uncertainty profiles in engineering-service development: exploring supplier co-creation. *Journal of Service Management*.
- Herold, D. M., Saberi, S., Kouhizadeh, M., & Wilde, S. 2021. Categorizing transaction costs outcomes under uncertainty: a blockchain perspective for government organizations. *Journal of Global Operations and Strategic Sourcing*.
- Hortal, J., de Bello, F., Diniz-Filho, J. A. F., Lewinsohn, T. M., Lobo, J. M., & Ladle, R. J. 2015. Seven shortfalls that beset large-scale knowledge of biodiversity. *Annual Review of Ecology, Evolution, and Systematics*, 46, 523-549.
- Hubbard, D. W. 2014. *How to measure anything: Finding the value of intangibles in business*. John Wiley & Sons.
- Jaafari, A. 2001. Management of risks, uncertainties, and opportunities on projects: time for a fundamental shift. *International journal of project management*, 19(2), 89-101.
- Kapoor, R., & McGrath, P. J. 2014. Unmasking the interplay between technology evolution and R&D collaboration: evidence from the global semiconductor manufacturing industry, 1990–2010. *Research Policy*, 43(3), 555-569.
- Katz, D., & Kahn, R. L. 1966. The social psychology of organizations.
- Kettler, S., Kennedy, M., McNamara, C., Oberdörfer, R., O'Mahony, C., Schnabel, J., ... & Tennant, D. 2015. Assessing and reporting uncertainties in dietary exposure analysis: mapping of uncertainties in a tiered approach. *Food and Chemical Toxicology*, 82, 79-95.
- Kinkeldey, C., MacEachren, A. M., Riveiro, M., & Schiewe, J. 2017. Evaluating the effect of visually represented geodata uncertainty on decision-making: systematic review, lessons learned, and recommendations. *Cartography and Geographic Information Science*, 44(1), 1-21.
- Kirby, M. R. 2001. *A methodology for technology identification, evaluation, and selection in conceptual and preliminary aircraft design*. Georgia Institute of Technology.
- Knight, F. H. 1921. *Risk, uncertainty, and profit* Vol. 31. Houghton Mifflin.
- Koh, S. C. L., Saad, S. M., & Jones, M. H. 2002. Uncertainty under MRP-planned manufacture: review and categorization. *International journal of production research*, 40(10), 2399-2421.
- Koh, S. L., & Gunasekaran, A. 2006. A knowledge management approach for managing uncertainty in manufacturing. *Industrial Management & Data Systems*.
- Koh, S. L., & Simpson, M. 2005. Change and uncertainty in SME manufacturing environments using ERP. *Journal of manufacturing technology management*.
- Kreye, M. E. 2017a. Relational uncertainty in service dyads. *International Journal of Operations & Production Management*.
- Kreye, M. E. 2017b. Can you put too much on your plate? Uncertainty exposure in serviced triads. *International Journal of Operations & Production Management*.
- Kreye, M. E. 2022. Uncertainty driving the dynamic development of inter-organizational relationships in engineering services over time. *Industrial Marketing Management*, 101, 33-44.

- Kreye, M. E., Goh, Y. M., Newnes, L. B., & Goodwin, P. 2012. Approaches to displaying information to assist decisions under uncertainty. *Omega*, 406, 682-692.
- Landmore, H. 2014. Democracy as heuristic: The ecological rationality of political equality. *The Good Society*, 232, 160-178.
- Lavie, D., Lechner, C., & Singh, H. 2007. The performance implications of the timing of entry and involvement in multipartner alliances. *Academy of Management Journal*, 503, 578-604.
- Lawrence, P. R., & Lorsch, J. W. 1969. Developing organizations: Diagnosis and action.
- Lee, H. L. 2002. Aligning supply chain strategies with product uncertainties. *California management review*, 443, 105-119.
- Lempert, R. J. 2003. Shaping the next one hundred years: new methods for quantitative, long-term policy analysis.
- Liu, C. M., & Lin, C. P. 2018. Assessing the effects of responsible leadership and ethical conflict on behavioral intention. *Review of Managerial Science*, 124, 1003-1024.
- March, J. G., & Olsen, J. P. 1976. Ambiguity and Choice in Organizations Bergen, Norway: Universitetsforlaget. *March Ambiguity and Choice in Organizations*.
- March, J. G., & Simon, H. A. 1958. Organizations John Wiley & Sons. New York.
- Martin, H., Lewis, T. M., Petersen, A., & Peters, E. 2017. Cloudy with a chance of fuzzy: Building a multicriteria uncertainty model for construction project delivery selection. *Journal of Computing in Civil Engineering*, 311, 04016046.
- McBean, G., & Rodgers, C. 2010. Climate hazards and disasters: the need for capacity building. *Wiley Interdisciplinary Reviews: Climate Change*, 16, 871-884.
- McKelvie, A., Haynie, J. M., & Gustavsson, V. 2011. Unpacking the uncertainty construct: Implications for entrepreneurial action. *Journal of Business Venturing*, 263, 273-292.
- Melander, L., & Tell, F. 2014. Uncertainty in collaborative NPD: Effects on the selection of technology and supplier. *Journal of Engineering and Technology Management*, 31, 103-119.
- Mesrobian, S. K., Bader, M., Götte, L., Villa, A. E., & Lintas, A. 2015. Imperfect decision-making and risk-taking are affected by personality. In *Decision making: uncertainty, imperfection, deliberation, and scalability* pp. 145-184. Springer, Cham.
- Meyers, S., & Kromer, S. 2008. Measurement and verification strategies for energy savings certificates: meeting the challenges of an uncertain world. *Energy Efficiency*, 14, 313-321.
- Milliken, F. J. 1987. Three types of perceived uncertainty about the environment: State, effect, and response uncertainty. *Academy of Management Review*, 121, 133-143.
- Mironova, M. D., & Ibragimov, L. G. 2021. Financial risk management of companies operating in the oil sector in the context of globalization based on the COVID-19 economic impact. *International Journal of Engineering Research and Technology*, 1312, 4500-4504.
- Mumtaz, H., & Theodoridis, K. 2018. The changing transmission of uncertainty shocks in the US. *Journal of Business & Economic Statistics*, 362, 239-252.
- Murray, J. 1961. Definition of uncertainty, The Oxford English Dictionary. Oxford, UK: Clarendon Press XI.
- Navy, U. S. 1995. Naval Doctrine Publication 6: Naval Command and Control. *Department of the Navy, Washington DC*, 19.
- Nonaka, I., Kodama, M., Hirose, A., & Kohlbacher, F. 2014. Dynamic fractal organizations for promoting knowledge-based transformation—A new paradigm for organizational theory. *European Management Journal*, 321, 137-146.
- NRC, U. 1983. Risk assessment in the federal government: managing the process. *National Research Council, Washington DC*, 113.
- Ozmel, U., Yavuz, D., Trombley, T., & Gulati, R. 2020. Interfirm ties between ventures and limited partners of venture capital funds: Performance effects in financial markets. *Organization Science*, 313, 698-719.
- Padhy, L. P., Satpathy, I. & Patnaik, B. C. M. 2021. Understanding the internal marketing orientation and its consequences in small finance bank: A case study analysis. *Eurasian Chemical Communications*, 33, 162-169, 2021.
- Parnell, J. A., Lester, D. L., & Menefee, M. L. 2000. Strategy as a response to organizational uncertainty: an alternative perspective on the strategy-performance relationship. *Management Decision*.
- Pavlou, P. A., Liang, H., & Xue, Y. 2007. Understanding and mitigating uncertainty in online exchange relationships: A principal-agent perspective. *MIS Quarterly*, 105-136.
- Perry, M. L., Sengupta, S., & Krapfel, R. 2004. Effectiveness of horizontal strategic alliances in technologically uncertain environments: are trust and commitment enough? *Journal of Business Research*, 579, 951-956.
- Peyghami, S., Wang, Z., & Blaabjerg, F. 2020. A guideline for reliability prediction in power electronic converters. *IEEE Transactions on Power Electronics*, 3510, 10958-10968.
- Pfeffer, J. 1985. Organizational demography: Implications for management. *California management review*, 281, 67-81.
- Pfeffer, J., Salancik, G. R., & Leblebici, H. 1976. The effect of uncertainty on the use of social influence in organizational decision making. *Administrative science quarterly*, 227-245.
- Poblete, L. A., & Bengtson, A. 2020. "I want you back": On the strategic roles of boundary spanners in supplier switching-back processes. *Industrial Marketing Management*, 91, 234-245.
- Ramsey, M. H. 2009. Uncertainty in the assessment of hazard, exposure, and risk. *Environmental geochemistry and health*, 312, 205-217.
- Randhawa, K., Wilden, R., & Hohberger, J. 2016. A bibliometric review of open innovation: Setting a research agenda. *Journal of Product Innovation Management*, 336, 750-772.
- Rowe, W. D. 1994. Understanding uncertainty. *Risk analysis*, 145, 743-750.
- Russel, S. M., Geraghty, J. R., Renaldy, H., Thompson, T. M., & Hirshfield, L. E. 2021. Training for professional uncertainty: Socialization of medical students through the residency application process. *Academic Medicine*, 9611S, S144-S150.
- Russell, M. G., & Smorodinskaya, N. V. 2018. Leveraging complexity for ecosystemic innovation. *Technological Forecasting and Social Change*, 136, 114-131.
- Salter, A., & Alexy, O. 2014. The nature of innovation. *The Oxford handbook of innovation management*, 26-52.
- Scherer, F. M., Harhoff, D., & Kukies, J. 2000. Uncertainty and the Size Distribution of Rewards from Innovation. *Journal of Evolutionary Economics*, 101-2, 175-200.
- Schneider, J. V., Alavi, S., Guba, J. H., Wieseke, J., & Schmitz, C. 2021. When do forecasts fail and when not? Contingencies affecting the accuracy of sales managers' forecasts regarding the future business situation. *Journal of Personal Selling & Sales Management*, 413, 218-232.
- Schrader, S., Riggs, W. M., & Smith, R. P. 1993. Choice over uncertainty and ambiguity in technical problem-solving. *Journal of Engineering and Technology Management*, 101-2, 73-99.
- Schubert, L. K. 1976. Extending the expressive power of semantic networks. *Artificial intelligence*, 72, 163-198.
- SHANKAR, C., & RAMULU, K. 2016. A CONCEPTUAL PAPER ON RISK. *International Journal of Research in Business Management*, 44, 89-94.
- Shelanski, H. A., & Klein, P. G. 1995. Empirical research in transaction cost economics: a review and assessment. *Journal of Law, Economics, & Organization*, 335-361.
- Shenhav, Y., & Weitz, E. 2000. The roots of uncertainty in organization theory: A historical constructivist analysis. *Organization*, 73, 373-401.
- Shukla, R. K. 1982. Influence of power bases in organizational decision making: A contingency model. *Decision Sciences*, 133, 450-470.
- Sinaga, N., Nisar, K. S., & Kaood, A. 2021. Second law efficiency analysis of air injection into inner tube of double tube heat exchanger. *Alexandria Engineering Journal*, 601, 1465-1476.
- Smale, L. A. 2021. Policy uncertainty in Australian financial markets. *Australian Journal of Management*, 463, 523-547.

- Sommer, S. C., & Loch, C. H. 2004. Selectionism and learning in projects with complexity and unforeseeable uncertainty. *Management Science*, 50(10), 1334-1347.
- Sturdy, A., Wylie, N., & Wright, C. 2013. Management consultancy and organizational uncertainty: The case of internal consultancy. *International Studies of Management & Organization*, 43(3), 58-73.
- Sydow, J., & Braun, T. 2018. Projects as temporary organizations: An agenda for further theorizing the inter-organizational dimension. *International Journal of Project Management*, 36(1), 4-11.
- Tafti, S. F., Jahani, M., & Emami, S. A. 2012. Explaining evolutionary trend of strategic planning from traditional economy to innovation economy. *Procedia-Social and Behavioral Sciences*, 58, 56-65.
- Smith, N. J., Merna, T., & Jobling, P. 2014. *Managing risk in construction projects*. John Wiley & Sons.
- Thiry, M. 2002. Combining value and project management into an effective programme management model. *International journal of project management*, 20(3), 221-227.
- Thompson, J. D. 1967 *Organizations in action*. New York.
- Trevino, L. K., Lengel, R. H., Bodensteiner, W., Gerloff, E. A., & Muir, N. K. 1990. The richness imperative and cognitive style: The role of individual differences in media choice behavior. *Management Communication Quarterly*, 4(2), 176-197.
- Tushman, M. L., & Nadler, D. A. 1978. Information processing as an integrating concept in organizational design. *Academy of management review*, 3(3), 613-624.
- Tushman, M. L., & O'Reilly III, C. A. 1996. Ambidextrous organizations: Managing evolutionary and revolutionary change. *California management review*, 38(4), 8-29.
- Van der Duin, P., & De Graaf, R. 2010. Innovating for the future? An external assessment of the future-oriented governance of the Dutch innovation system. *Foresight*.
- Vim, I. S. O. 2004. International vocabulary of basic and general terms in metrology VIM. *International Organization*, 2004, 09-14.
- Wagner, B., & de Hilal, A. V. G. 2014. The human factor: A successful acquisition in Brazil. *Management Research Review*.
- Wagstaff, C. R. D., Gilmore, S., & Thelwell, R. C. 2015. Sports medicine and sport science practitioners' experiences of organizational change. *Scandinavian Journal of Medicine & Science in Sports*, 25(5), 685-698.
- Walden, E. A., & Browne, G. J. 2009. Sequential adoption theory: a theory for understanding herding behavior in early adoption of novel technologies. *Journal of the Association for Information Systems*, 10(1), 1.
- Walker, W. E., Harremoës, P., Rotmans, J., Van Der Sluijs, J. P., Van Asselt, M. B., Janssen, P., & Kraayer von Krauss, M. P. 2003. Defining uncertainty: a conceptual basis for uncertainty management in m Galbraith, J. 1973. Designing complex organizations. *Reading, Mass.* model-based decision support. *Integrated assessment*, 4(1), 5-17.
- Weaver, R., Kelly, T., & Mayo, P. 2006. Gaining confidence in goal-based safety cases. In *Developments in Risk-based Approaches to Safety* pp. 277-290. Springer, London.
- Wiegman, B. W., Hekkert, M., & Langstraat, M. 2007. Can innovations in rail freight transshipment be successful? *Transport Reviews*, 27(1), 103-122.
- Williamson, O. E. 2007. The economic institutions of capitalism. Firms, markets, relational contracting. In *Das Summa Summarum des Management* pp. 61-75. Gabler.
- Wong, C. Y., Boon-Itt, S., & Wong, C. W. 2011. The contingency effects of environmental uncertainty on the relationship between supply chain integration and operational performance. *Journal of Operations Management*, 29(6), 604-615.
- Wong, K., Unsal, H., Taylor, J. E., & Levitt, R. E. 2010. Global dimension of robust project network design. *Journal of construction engineering and management*, 136(4), 442-451.
- Xu, Y., Elgh, F., Erkoyuncu, J. A., Bankole, O., Goh, Y., Cheung, W. M., ... & Roy, R. 2012. Cost Engineering for manufacturing: Current and future research. *International Journal of Computer Integrated Manufacturing*, 25(4-5), 300-314.
- Yin, R. K. 2001. Case study: planning and methods, 287-298.
- Zhang, S., Li, J., & Li, N. 2022. Partner technological heterogeneity and innovation performance of R&D alliances. *R&D Management*, 52(1), 3-21.
- Zhang, X. 2016. Co-evolution between institutional environments and organizational change: The mediating effects of managers' uncertainty. *Journal of Organizational Change Management*.
- Zimmermann, H. J. 2001. *Fuzzy Set Theory and its Applications*. Boston, USA: Kluwer Nijhoff Publishing.

\*\*\*\*\*