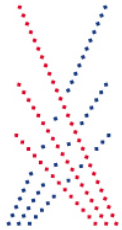

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# Understanding the antecedents of uncertainty in projects through reviews


## Abstract

Uncertainty is an increasingly central topic in management theories, and notably in project management. This paper seeks to understand through reviews on the antecedents of uncertainty in projects. To reach our goals, we conducted a systematic review and critical analysis of 190 articles published over the last five decades in peer-reviewed academic journals on the topic of uncertainty in projects. We study the antecedents and categorize them according to individual, relational, group, organizational, project oriented, and managerial. Furthermore, through this paper, we also open new avenues for future research studies.


## Introduction

A large amount of literature exists on the discipline of project management (PM) since last three decades (Soderland, 2011) and it has become a core business process for many firms both on a strategic and operational level (Perminova et al, 2007). Furthermore, PM involves a series of process, planning tool, time, scope, quality and budget for its effective implementation (Padalkar and Gopinath, 2016). However, in recent years, issues in project management have also emerged due to higher levels of volatility, uncertainty, complexity, and ambiguity (VUCA) (e.g. Saley and Watson, 2017). Researchers assert that, when dealing with projects, the uncertainty phenomenon is considered among their general features, occurring in technological, organizational, and social contexts (Bohle et al, 2016); and it is considered a fact of project life (Saunders et al., 2016).

Uncertainty is said to arise due to various ambiguous and complex causal situations underlying the internal operations and external environment of an organization (Colorado, 1999). It may also occur due to project delays, quality, inadequate time and resources spent in the initial pre-planning and planning phases of projects (Ogano and Pretorius, 2014) and due to an incapacity to deal efficiently with unexpected events happening during the execution of the project (Johansen et al, 2016). Uncertainty has been addressed with multiple approaches throughout different disciplines (Saunders et al., 2015) and thus, managing uncertainty is a core element to improving performance (Perminova, 2008). Though it has been a topic of central interest for management scholars (Alvarez

et al., 2018; Teece and Leih, 2016), it is often neglected by practitioners (Martinsuo et al, 2014; De Meyer et al., 2002) and its causal factors in project's is not well understood.

Uncertainty is perceived to be different by different people (Johansen et al., 2016; Wazed et al, 2009). For instance from a situational perspective, where the current state of knowledge is such that (1) the order or nature of things is unknown, (2) the consequences, extent, or magnitude of circumstances, conditions, or events is unpredictable, and (3) credible probabilities to possible outcomes cannot be assigned (see "Knightian uncertainty", Alvarez et al., 2018, based on Knight, 1921); and (4) as an inability to assign probabilities to the likelihood of future events (Starbuck and Milliken, 1988). Lindau (1995) and Saad, (1998) refer to uncertainty as a form of disturbance and "the psychological state of doubt about what current events mean or what future events are likely to occur" (Milliken 1987).

From a knowledge and information perspective, uncertainty is also related to the lack of knowledge. For instance, Funtowicz and Ravetz (1990) describe it as a situation of inadequate information, which can be of three dimensions 1) inexactness 2) unreliability, and 3) border with ignorance. Uncertainty can also manifest itself in situations in which too much information is available (Van Asselt and Rotmans, 2002), and where additional information does not necessarily reduce uncertainty. From project management perspective, uncertainty has been addressed using dependency structure matrix and by performing sensitivity analysis in project scheduling (e.g. Galvez et al, 2017). These have been recognized in recent years through some literature reviews that have been conducted on the relation between uncertainty and PM.

One may find recent literature reviews on uncertainty and risk in PM (e.g., Saunders and de Carvalho, 2017), managing uncertainty in in projects and its gaps and trends (Zheng and de Carvalho, 2016) or literature reviews to define uncertainty in projects and project management (Perminova et al, 2008). However, a structured approach to dealing with uncertainty is required to understand the underlying antecedents that have effect on projects. Further, this can only be achieved if scholars proceed to a systematic investigation of the phenomenon. As many authors underline it: there is a crucial need classification of research on uncertainty and better understanding of uncertainty in projects (Witt et al., 2017; Saunders et al., 2014; Petit et al., 2010). Researchers say that there is a necessity to take a fresh look at uncertainty, since uncertainties often arise during the project, it may be impossible to define them at the outset of the project (Bohle et

al, 2016). For instance, presence of uncertain information maximizes the risk associated with choice (Martin et al, 2017); thus, understanding the sources of project uncertainty and dealing with it can lead to successful project outcomes (Saunders et al, 2015). Uncertainty has many different sources in projects and a manager should try to understand on how to deal with it. This paper contributes to this effort by offering a structured analysis of the existing literature on uncertainty in projects. Therefore, the aim of our research is to understand the antecedents of uncertainty in projects. In doing so, we classify uncertainty in projects according to the various sources, whether they are internal or external to the project; and the element on which its effect is more relevant: individual, project team or organization. By methodologically classifying published researches on uncertainty and its remedies, we contribute to the growing literature and suggest an agenda for future research studies.

## 1.0 Methodology

We first perform a systematic search using various keyword protocols inside the Scopus database, due to its ease of use, quality outcomes, sorting, refining feature (Boyle & Sherman, 2006), and positive influence on research (Chadegani et al, 2013). Whilst various categories of documents appear in Scopus (e.g, book, book chapters, conference papers, weblogs, and journal articles) we selected articles only from journals s suggested by Thyer (2008), because, journal articles are of high prestige and merit within the scientific community, compared to venues such as books, book chapters, weblogs, and presenting papers at conferences. Further, articles were selected from business and management field only and excluded others (eg, medicine, social science, decision science etc. have been excluded).

**Part 1:** We performed keyword search in Scopus using "project uncertainty" and "uncertainty AND project management" and it gave us 694 documents, which is beyond our capacity to review. As it becomes crucial to identify and select those journal publications that are reputed, have good citations, impact factor and rankings (Harzing, 2017), we used first, Scopus metric analysis that categorizes results into 1) CiteScore, 2) SJR Rank, 3) highest number of documents, 4) highest number of citation 5) SNIP ranking etc. from these rankings we selected the two highest ranked Journals viz, international journal of project management and journal of construction engineering and management (Table 2). Second, using the suggestion of Söderlund, 2011, we extended our search beyond the conventional project management journal and selected journals from Financial

Times top 50 (Harzing, 2017) (Table 3). The combination of these journals yielded us 265 documents. The keyword search string is mentioned below with another table showing the list of journals and number of articles extracted.

| **Key Word Protocol** | **Total Articles** |
|---|---|
| ( TITLE-ABS-KEY ( "Project Uncertainty" ) ) OR ( TITLE-ABS-KEY ( "Uncertainty" AND "Project Management" ) ) AND ( LIMIT-TO ( SRCTYPE , "j" ) ) AND ( LIMIT-TO ( DOCTYPE , "ar" ) ) AND ( LIMIT-TO ( SUBJAREA , "BUSI" ) ) AND ( LIMIT-TO ( EXACTSRCTITLE , "International Journal Of Project Management" ) OR LIMIT-TO ( EXACTSRCTITLE , "Journal Of Construction Engineering And Management" ) OR LIMIT-TO ( EXACTSRCTITLE , "Management Science" ) OR LIMIT-TO ( EXACTSRCTITLE , "Journal Of Operations Management" ) OR LIMIT-TO ( EXACTSRCTITLE , "Research Policy" ) OR LIMIT-TO ( EXACTSRCTITLE , "Journal Of Management Information Systems" ) OR LIMIT-TO ( EXACTSRCTITLE , "Manufacturing And Service Operations Management" ) OR LIMIT-TO ( EXACTSRCTITLE , "Production And Operations Management" ) OR LIMIT-TO ( EXACTSRCTITLE , "Accounting Organizations And Society" ) OR LIMIT-TO ( EXACTSRCTITLE , "Journal Of Business Venturing" ) OR LIMIT-TO ( EXACTSRCTITLE , "MIS Quarterly Management Information Systems" ) OR LIMIT-TO ( EXACTSRCTITLE , "MIT Sloan Management Review" ) OR LIMIT-TO ( EXACTSRCTITLE , "Organization Science" ) OR LIMIT-TO ( EXACTSRCTITLE , "Strategic Management Journal" ) ) | 265 |

| **Name of the Journals** | **Number of articles** |
|---|---|
| International Journal of Project Management | 146 |
| Journal of Construction Engineering and Management | 79 |

**Table 2: Journal and number of articles extracted from Scopus metrics**

| | |
|---|---|
| Accounting, Organizations and Society | 1 |
| Journal of Business Venturing | 1 |
| Journal of Management Information Systems | 2 |
| Journal of Operation Management | 9 |
| Management Science | 13 |
| Manufacturing and Service Operation Management | 2 |
| MIS Quarterly | 1 |
| MIT Sloan Management Review | 1 |
| Organization Science | 1 |

| | |
|---|---|
| Production and Operation Management | 2 |
| Research Policy | 4 |
| Strategic Management Journal | 1 |

**Table 3: Journals listed in Financial Times top 50 and number of articles extracted**

**Part 2:** from the obtained articles, we selected only those, a) that are present in journal articles b) articles that explicitly address the concept of uncertainty in projects, either in their title, abstracts or in the keywords c) we then read the abstracts to understand the context of the studies for selecting and deselecting articles d) after, we selected only those articles that are closely related or addressed the concept in organizational, group and individual/or other context. After careful reading and analysis of the obtained 265 articles, we decided to select 190 articles and leave out the rest, as those papers did not match our criteria.

**Part 3:** The retrieved articles were subjected to systematic reviews. In our reviews, we adopt a replicable, scientific, and transparent process to minimize bias and create consensus among scholars (Cooper, 1998; Tranfield et al., 2003). These reviews are concerned with synthesis (Mays, Pope, & Popay, 2005), as synthesis is the core of all the methodological approach we decided to read all the abstracts, take note, and classify them into different categories (e.g. context, variables, methodologies, consequences, and outcomes) and provide meaningful interpretation through tables (Oxman 1994, Walsh and Renaud, 2017). Table matrix helps to organize the information in a logical order, the topics that are in common with authors or articles, methodological similarities and differences, measurement tools (e.g. experiments, narrative inquiry, quantitative methods, qualitative or mixed method etc.), focused group (individual, dyadic or group etc) (Galvan, 2006).

## 3.0 Findings

Our review of literature provides following structured representation of antecedents related to uncertainty. We found, individual, relational, organizational and project specificities. These uncertainty factors seemingly have effect on projects, budgets, project manager, employee performance and overall organization growth.

### *3.1.1 Antecedents of uncertainty in projects*

*1. Individual specificities* include dispositional and personality factors like conscientiousness and openness to experience (Witt et al, 2017), situational behavior (Baloi and Price, 2003), individual belief system (Wong et al, 2009), trust (Karlsen, 2011), confidence - willingness - expectation (Wong et al, 2009). Individuals role in project e.g. type of task (Vaziri et al, 2007), attractiveness towards project (Gil, 2007), perceived view of the project (Olsson, 2007) lack of commitment (Gällstedt, 2003), lack of motivation (Lehner, 2009), adaptability and co-ordination (Emblemsvag, 2017), may have influence towards uncertainty. During execution of project, stress due to time pressure (Leung et al, 2008), participation (Jun et al, 2011), involvement (Gales and, Mansour-Cole, 1995) and communication (Karlsen, 2011) cause uncertainty in projects.

*2. Relational specificities* include, relation with manager and other stake holders with employees may create uncertain situation in projects. E.g. project managers behavior towards employees (Kutsch and Hall, 2005), lack of leadership values (Wouters et al, 2009), senior executives relations with employee (Phua, 2007) working relations with other employees, (Mitropoulos and Howell, 2001), leader's attitude towards group (Tysseland 2008), relationship with project owner (Günhan and Arditi, 2007), relation with contractors (Vaziri et al 2007) relation between clients (Pesmaa et al. 2009). information feedback, face to face meetings, time and attention from project participants (Sakka et al, 2016), user participation (Jun et al, 2011), and user involvement (Gales and, Mansour-Cole, 1995), formal leadership (Sicotte and Langley, 2000), and stakeholder's motives (Ward and Chapman, 2008).

*3. Group specificities* include, team diversity, functional diversity (Dayan et al, 2017) From group perspective the antecedents to uncertainty are, functional diversity (Dayan et al, 2017), group values, norms (Wong et al. 2010), (Naveh 2007) group cultures, lack of effective interaction (Balcud et al. 2009), lack of efficient cooperation (Pesmaa et al. 2009), lack of involvement by group members (Verworn, 2009), group and managerial conflicts (Laslo and Goldberg, 2008), lack of interpersonal performance (Leung et al 2008), group culture practices (van Marrewijk et al 2008), lack of being active members (Olsson 2007), lack of experience (Mitchell and Nault B.R. 2007), trust & relationships (Wong et al 2008), lack of financial feasibility (Farrell, 1995), reference power and influence (Singh, 2009).

*4. Organizational specificities* for implementing projects, e.g. human resources (Zwikael and Sadeh 2007) lack of schedule control (Wang and Liu 2005), lack of information (Danilovic et al 2005), lack of clear communication (Verworn, 2009) support (Olsson 2007), time spent on transfer of information (De Treville et al 2004), tasks duration, resources allocation (Vaziri et 2007), subjective judgments (Choi et al 2004), bidding decisions in projects (Lin and Chen 2004), decision making (Kutsch and Hall 2005), adapting to new technology and rate of return with projects (Nobelius D.2004), management styles and project infrastructures (De Meyer et al, 2002). Further, time pressure (Leung et al 2008) dynamic social structure and procurement decisions (Tysseland 2008), project design and cooperation (van Marrewijk et al 2008) are found to influence uncertainty in projects. Organization structure (Laslo and Goldberg, 2008), and climate also found to create uncertainty in projects e.g. project operation environment (Laslo and Goldberg, 2008), organizational environment (Jensen et al 2006; Olsson 2007), corporate culture (Chapman 2006). Further any organizational change and flexibility in projects (Olsson 2006) may also create uncertainty. Furthermore, contracting issues (Wong et al 2008) and customer satisfaction (Naveh, 2007) have influence on uncertainty. Furthermore, work, capital cost, decision making (Sundararajan and Tseng, 2017), two exogenous variables - mediated power and non-mediated power of client - and three endogenous variables - client integration, contractor integration and project performance. Also, organizational culture (Karlsen, 2011), cost information, price competition (Christen 2005) budget contingency, schedule contingency, management reserve, quality issues (Bushuyev and Sochnev 1999), international transactions - bid behaviour (Han et al 2005) from organization have influence on uncertainty in projects. Some authors assert that, organization role in assessing employee contribution can also have impact on projects, e.g. evaluation methods, project appraisal (Pohl and Mihaljek, 1992). Organizational maturity (Zwikael and Sadeh 2007), Aggressive/passive management strategies on cost, timeliness and facility value (Ford 2002) and adequate resources and funding supply conditions (Yang and Chang 2005) can cause uncertainty in projects.

*5. Project specificities* include the antecedents influencing uncertainty are the different stages involved in project (Gálvez et al, 2012), type of project and project management approaches (Howell D et al, 2010), the duration of project, size and estimate (Gálvez et al, 2012; Gálvez et al, 2017;Lee et al, 2009; Hoermann et al, 2015), project portfolio (Martinsuo et al, 2014), project operational goals (Petter et al, 2013), project design (Ramasesh and Browning, 2014), project

delays, (Mitchell and Nault 2007), project characteristics and Information technology (Heim et al, 2012). Other characteristics like, project cost, (Oshodi et al, 2017), project budget (Günhan and Arditi, 2007), project estimation (Chapman 2006), project rescheduling cost (Adida and Joshi, 2009), accounting information (Van Der et al, 2002), performances or in decision environment (e.g., criteria weights, total budget) (Mavrotas and Pechak, 2012), overlapping strategies, workforce control policies, and schedule adjustments (Pena-Mora and Park, 2001), development schedules and costs (Nightingale, 2000), project-specific style (Shenhar, 2001), organizational process factors, product development capabilities, critical uncertainties, and operational/market performance in product development projects (Tatikonda and Montoya-Weiss 2001), the process of delivery of project with price (Turner and Simister 2001), project cost estimation (Elkjaer, 2000), project duration overrun, loss of key project personnel, absence of recognition and allowance (Chapman, 1998), cost estimating procedures (Diekmann and Featherman, 1998), project situations and planning (Laufer and cohenca, 1990) the circumstances under which projects operates (Chapman et al, 1985), project schedule and manhour variance (Laufer, 1991) and role of project manager, project manager performance (Turner and Müller, 2003). Further, Dawson and Dawson (1994) and Pillai and Tiwari (1995), suggested that, network structure in the project activity can cause uncertainty. Further, complexity of the methods involved and the lack of easy to use tools to support them (Dawson and Dawson, 1998), project resources (Padilla and Carr 1991), project initiation, postponed to avoid unfavorable restoration conditions, (Hwang et al, 2016), probability estimation (Moret and Einstein, 2012) lack of information, ambiguity, characteristics of project parties, tradeoffs between trust and control mechanisms, (Atkinson et al 2006), lack of project contingency (Dey et al, 1996) effectiveness and efficiency, and human resource adequacy (Sicotte and Bourgault, 2008), create uncertainties in project.

*6. Managerial specificities* among the uncertainty effects on projects are seen in management practices (Herstatt et al, 2004), management flexibility (Santiago et al, 2005; Rese and Baier, 2007) management control systems (Davila, 2000), control modes and control mechanism (Dahlgren and Söderlund, 2010), fairness, culture (Kadefors, 2005), integration mechanisms, planning and process specification (Sicotte and Langley, 2000), organizational climate and culture (Singh, 2009), decision-making regarding the choice of alternative actions in response to the situation (Perminova et al, 2008). Further, technological, organizational, and social contexts (Böhle, et al, 2016), socio-technical environments, sense of balancing competing demands, and provided

evidence of learning, acting mindfully, avoiding over-rigid processes, and of upholding constructive tensions, conceptual slack and close interdisciplinary working (Saunders et al, 2016), variable compensation, organizational structure (Davila, 2003), co-ordination between clients and consultants (Liberatore and Luo, 2010), political behaviour (Dayan et al, 2012), exogenous technological change, failure to search strategy (Chandrasekaran et al, 2016), client integration, contractor integration and project performance (Jagtap et al, 2017) found influence uncertainty in projects. Further, managerial flexibility, market payoffs, project budgets, product performance, market requirements, and project schedules create uncertainties in projects (Huchzermeier and Loch, 2002).

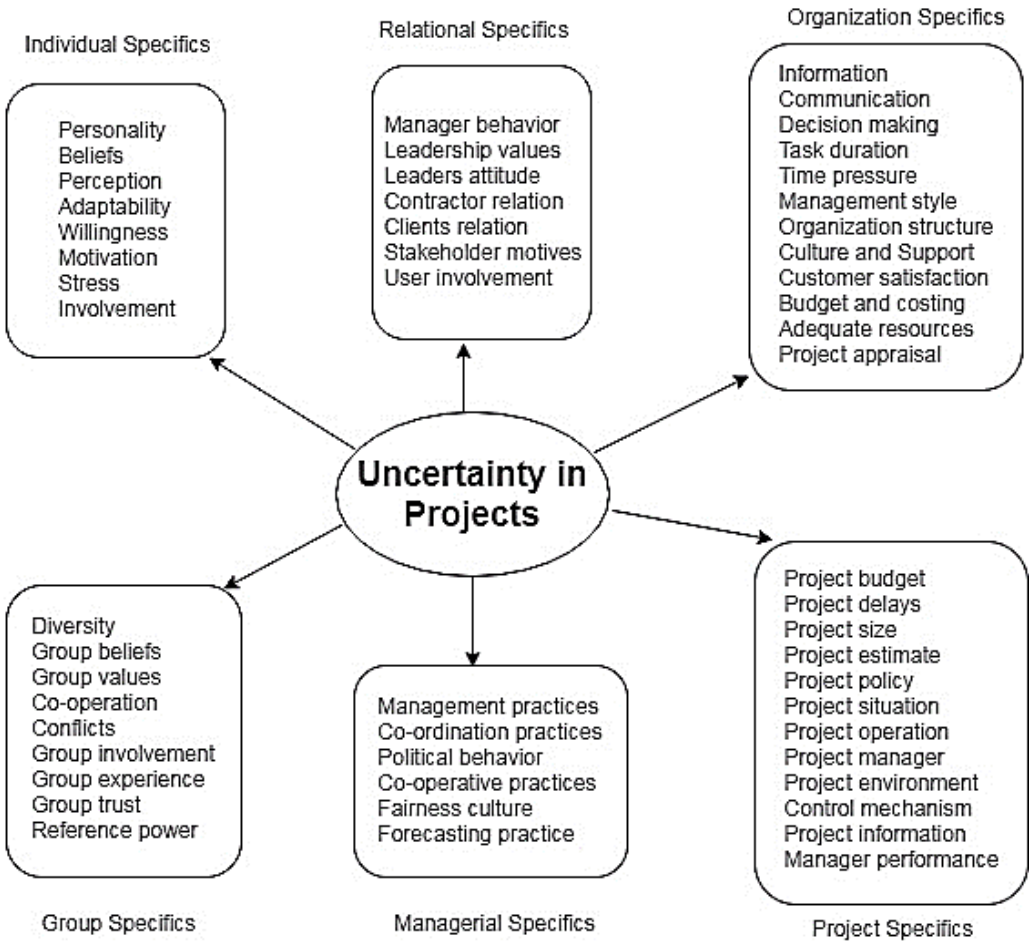


**Fig 1: Antecedents of uncertainty in projects**

**Conclusions and discussions**

This paper presented a systematic review of the antecedents to uncertainties in projects. The project manager faces a dilemma during uncertainties in projects (Marinho et al, 2014) and thus our findings of literature brought us to six broad sources of uncertainty in projects, which can help project manager to better equip to cope with the unknown on the various antecedents that may occur. The performed review of 190 articles demonstrated various antecedents of uncertainty in projects resulting from individual specificities like personality, character and role, group specificities like, cohesion, group spirit, planning, role and task assignment. Organizational specificities seem to be more as it depends on the execution of projects, the organization role, including, communication, climate, infrastructure, facilities and resources seems to have effect, However, the managerial and project related specificities have more variables found from our study include project manager role, project budget, project cost, project delay, project circumstance etc. These antecedents can be determining factor for project success. Further, the research demonstrates that the concepts of uncertainty is closely associated or sometimes interchangeability used as complexity and risk by some authors. We argue that, uncertainty is relatively vague and often overlaps with risk and complexity and it also differs based on the size of the project, context and industry domain of the project e.g. construction, pipeline, oil and gas etc. Thus, in this study, some variables can be like studies done on the topic of risk and uncertainty (Meyer et al., 2002). This work contributes to the growing literature on uncertainties and provides more comprehensive overview with a new methodology adopted. This can help future researchers to better plan and cope with uncertainties and on the probability of how to better manage projects within the context of changing nature of projects.

The paper along with the list of various antecedents through reviews, also demonstrated the methodological contributions in conducting a systematic review of literature, which can be followed by other researchers for other reviews. Finally, the results of this research contribute to the project in two ways. Firstly, the results of the systematic review provide scholars to advance and better understand the antecedents from six different perspective. Further, dealing with such challenges and gaps may provide better opportunities to future research. Secondly, to better deal with uncertainties, the antecedents presented can support practitioners and researchers in identifying relevant challenges and developing solutions for projects.

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