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A conceptual framework for tackling knowable unknown unknowns in project management

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ABSTRACT

Understanding and dealing with the unknown is a major challenge in project management. An extensive body of knowledge—theory and technique—exists on the "known unknowns," i.e., uncertainties which can be described probabilistically and addressed through the conventional techniques of risk management. Although some recent studies have addressed projects where the existence of unknown unknowns (unk unks) is readily apparent or may be assumed given the type of project—e.g., new product development or new process implementation—very little work has been reported with respect to projects in general on how a project manager might assess its vulnerability to unk unks. In this paper, we present a conceptual framework to deal with (i.e., recognize and reduce) knowable unk unks in project management. The framework is supported by insights from a variety of theories, case analyses, and experiences. In this framework, we first present a model of the key factors—relating to both project design and behavioral issues—that increase the likelihood of unk unks and a set of propositions linking these factors to unk unks. We then present a set of design and behavioral approaches that project managers could adopt to reduce knowable unk unks. Our framework fills a gap in the project management literature and makes a significant practical contribution: it helps project managers diagnose a project to recognize and reduce the likelihood of unk unks and thus deal more effectively with the otherwise unrecognized risks and opportunities.

1. Introduction

On June 4, 1996, the massive *Ariane 5* rocket, launched on its maiden voyage from the European Space Agency's center in French Guiana, exploded 39 s into flight, destroying four satellites on board (Lions, 1996). How could such an unexpected outcome befall a project that took ten years, $7 billion, and tens of millions of hours of human labor and expertise? In a postmortem analysis, the Agency noted that the problem was due to a malfunction in the rocket's guidance system software, and it acknowledged that the system was not fully analyzed or understood, perhaps because the software had worked successfully with *Ariane 4*. More generally, the disastrous outcome was due to an uncertainty of which the Agency was unaware prior to the launch—an unknown unknown (or "unk unk" in common industry parlance). Yet, was this uncertainty truly unknowable, or was it potentially knowable but just escaped recognition by the project management team? In this paper our basic premise is that just because something is unforeseen does not necessarily mean that it is unforeseeable. Through appropriate analysis, it is possible to recognize and reduce some unk unks which are actually knowable. We examine the factors that drive knowable unk unks in a project and present a conceptual framework to deal with (i.e., recognize and reduce) them in project management. Our framework is based on several key factors—relating to both project (system) design and behavioral (organizational) issues—and a set of propositions linking these factors to the increased likelihood of unk unks. We then present a set of design and behavioral approaches that project managers could adopt to reduce unk unks—i.e., to convert the knowable unk unks to known unknowns.

A project is "a temporary endeavor undertaken to create a unique product, service, or result" (PMI, 2013). Two characteristics distinguish projects from operations in general. First, whereas most organizations and operations are ongoing concerns, a project is relatively temporary and finite. Second, projects are by definition "unique," meaning that they are trying to produce a new result that has not been produced before, at least not exactly. The decreased time frame and increased novelty of projects relative to other operations brings heightened challenges with respect to unk unks. The emerging landscape of business management

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is dominated by new products and services with shorter life cycles, rapid introductions of new technologies, and continuously changing markets, regulations, and security threats, all of which lead to hyper-competition and high-velocity environments (e.g., D'Aveni, 1994; Eisenhardt, 1989). Such environments, which create unfamiliar and less well-understood uncertainties, are typical for many projects. In contra-distinction, much other organizational decision-making takes place in relatively stable and better-defined environments and is often managed by contingency plans.

A major challenge in project management is dealing with the uncertainties within and surrounding a project that give rise to outcomes that are unknown or known only imprecisely. Uncertainties can have a positive or negative effect on one or more project objectives. Positive or upside outcomes create opportunities while negative or downside outcomes present risks (Hubbard, 2009). Successful project management involves risk and opportunity management, which entails identifying, assessing, prioritizing, handling, and monitoring both risks and opportunities effectively (Hillson, 2002; PMI, 2013). Risks and opportunities are context-specific, depending on the project's objectives and the perspectives of its stakeholders. In this paper, we focus on uncertainties or *unknowns*, which are value-neutral and may lead to both risks and opportunities. Also, we focus on unknowns from the point of view of the project manager (PM), an individual or team responsible for making managerial decisions that affect the outcome of the project. Unknowns exist in the PM's knowledge base. As more information is collected over project time, some of these unknowns become known, whereas others remain hidden. The project's unknowns may be divided into two types:

Known unknowns: Uncertainties of which the PM is aware and to which the techniques of conventional risk and opportunity management can be applied. Examples may include the cost and duration of defined activities, the quality of their outcomes, the availability of planned resources, and the expected possibilities of changes or rework. Known unknowns can be estimated in a *probabilistic* sense.

Unknown unknowns: Unrecognized uncertainties of which the PM is unaware. When unexpected, surprising outcomes (more often ones with negative or disastrous consequences) are encountered, these are attributed to unk unks. An extreme, catastrophic, or dramatically surprising outcome is *not* an unk unk if it had been envisioned but deemed too unlikely or too costly for which to prepare.

By definition, unk unks are not known. However, the knowledge that unk unks are probably "out there" can motivate the application of appropriate search strategies. Just because something is currently unknown does not mean that it is unknowable. Therefore, we divide unk unks into two sub-categories:

Unknowable unk unks: These unk unks or unexpected surprises cannot be anticipated by the PM. No amount of action by the PM will be able to convert unknowable unk unks to known unknowns. For example, the tsunami in the Indian Ocean in 2004 disrupted many construction projects in India, Indonesia, Thailand, and elsewhere; these projects could not have known to plan for such an extreme event.

Knowable unk unks: These unk unks could be foreseen by the PM but for some reason (e.g., barriers to cognition) are not (yet). Many retrospective studies of project failures suggest that a large amount of unk unks could have been anticipated given due diligence by the PM. For example, the well-publicized problems with the automated baggage-handling system at Denver International Airport in 1995 could have been anticipated but were not until the project was well past its deadline (Montealegre et al., 1996).

From the perspective of a PM, key questions are: *What are the driving factors in a project that increase the likelihood of its encountering unk unks? Where should I invest in uncovering knowable unk unks? What approaches can I take to reduce the likelihood of unk unks?* Answers to these questions can help a PM allocate appropriate resources toward the conversion of knowable unk unks to known unknowns (e.g., risk identification). Our contribution in this paper is to present a conceptual framework to address these questions. We introduce the factors constituting the framework and a set of propositions that enable a PM to recognize that unk unks are likely to be lurking in particular aspects of a project, thus providing some guidance on where to look and why. We then discuss a variety of project design and behavioral approaches that a PM may adopt to reduce unk unks in the most promising areas.

Since unk unks are unanticipated outcomes they bear some connection to accidents, safety and reliability, especially in hazardous industries, which have been the subject of prominent sociological theories such as the *normal accident theory* (NAT) and the theory of *high reliability organizations* (HRO). NAT holds that regardless of the intensity of organizational efforts, accidents in complex and tightly coupled systems (such as nuclear power plants) are inevitable or "normal" as they cannot be foreseen or prevented (Perrow, 1984). NAT deals with system accidents (defined as those caused by unanticipated interactions of failures) and offers society the juncture to accept uncertainty (unknowable unk unks) or not use a technology. Thus, NAT is concerned with the unknowable unknowns associated with risky technologies at a macro or societal level. It does not address knowable unk unks at a project level. HRO, on the other hand, asserts that accidents—even in complex organizations that operate hazardous technologies (such as air traffic control and aircraft carriers)—are avoidable by creating appropriate behaviors and attitudes that would increase "heedful interrelations and mindful comprehension" and with emphasis on safety, attention to problems, and learning (Weick and Roberts, 1993). HRO theory is based on practices observed in operations with "recognized hazards" and nearly full knowledge of their technical aspects, low levels of uncertainty, and stable technical processes (Roberts, 1990). While these broad, sociological theories do not directly tackle the unk unks question in the context of a project as we do, they offer useful insights in developing our framework. For example, since the absence of HRO characteristics might work as barriers to recognizing unk unks, HRO theory motivates some of the sub-factors in our framework. Our paper focuses specifically on PM, and directly addresses unk unks in greater depth. By accounting for several key factors to recognize and reduce knowable unk unks in project management, our framework makes a significant contribution beyond NAT and HRO.

To the best of our knowledge, ours is the first paper to distinguish the *knowable* unk unks from unk unks in general, conceptualize a framework of the driving factors, and thereby provide specific guidance into the areas for recognizing and reducing knowable unk unks in a project. Our framework has significant implications for PM, including the following:

- If a PM knows that unk unks are more likely (and where and why) in a project, then the PM may choose appropriate strategies and investments for uncovering them—i.e., converting them to known unknowns. The emerging trend toward hyper-competition and high-velocity environments in PM underscores the importance of a theory of unk unks (although our proposed framework is not limited to such contexts).
- Some unk unks may be analogous to Taleb's (2010) "black swans"—large events that are both unexpected and highly consequential. An awareness of the likelihood of potential unk unks enables a PM to design project results, processes, organizations, tool sets, and goals that will not fall apart when they encounter black swans, or that might even benefit from these unexpected events (Taleb, 2012).