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## Crowdsourcing in government

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### Abstract

Government executives continue to face challenges in bringing forth creativity and innovative solutions to create value in the public domain for U.S. citizens. Information Technology (IT) is at the core of new or improved solutions in the public sector. The “wisdom of the crowd” can be a low investment approach to solve even the most complex IT problems for federal agencies. This paper discusses the opportunities and critical success factors associated with the executive decision to undertake crowdsourcing for information technology innovation in the U.S. Federal government. Crowdsourcing can be an integral component of a government agency’s IT innovative strategy.

**Keywords:** Crowdsourcing, Collective Intelligence, Challenge.gov, Innovation in Government

### Introduction

Crowdsourcing is a technique used by private industry to instigate new ideas and innovation by engaging external groups. The wave has even captivated Hollywood with a 2017 television drama about crowdsourcing to solve crimes. The movement to seek new ideas and game changing innovation, both internally within an organization and externally, is becoming the new normal for organizations to find different ways of doing things to survive and grow (Charan & Lafley, 2008). Federal government agencies are beginning to use crowdsourcing to generate new innovative ideas and solve problems. Government crowdsourcing for public involvement in policy and civic matters has become prevalent (Schmidhuber & Hilgers, 2018; Lui, 2017). Crowdsourcing for 311 service for example promotes participation in production of government services (Clark and Brudney, 2018). However, crowdsourcing for information technology innovation continues gradually although The Office of Management and Budget (OMB) directed federal agencies to increase innovation in government.

Howe (2006) defined crowdsourcing as an organization taking a function once performed by employees and outsourcing it to a network of people in the form of an open call, an invitation. Crowdsourcing is a type of participative online activity in which an individual or organization proposes to a group of individuals of varying knowledge via an invitation, the voluntary undertaking of a task (Estellés-Arolas & González-Ladrón-de-Guevara, 2012). Olivera, Ramos and Santos (2010) state that crowdsourcing innovation brings the “wisdom of the crowds” into the company to innovate or to find a new way to do something (p. 413). Love and Hirschhelm (2017) define crowdsourcing as “technology mediated mass collaboration” (p. 317). The National Aeronautics and Space Administration (NASA) known for its pioneering space innovation has leveraged the crowd to stimulate new ideas.

Kaggle, for example, created a business model to offer clients new ideas and solutions to data analytics problems through a data professionals community crowd it employs for projects (Simon, 2013). Kaggle, a Google subsidiary, crowdsources problems to a large network of data scientists and machine learning

engineers. Kaggle taps into the crowd community by establishing a challenge for the crowd to participate in and collaborate on machine learning solutions. Kaggle has leveraged crowdsourcing for projects such as a Netflix machine learning challenge which resulted in 10% improvement in the Netflix selection algorithm.

The purpose of this paper is to understand the receptivity to crowdsourcing as an innovation method in the U.S. federal government, and to research the critical success factors for selecting crowdsourcing to drive innovation in civilian federal agencies.

## Literature Review

Malone, Laubacher and Dellarocas (2010) characterize crowdsourcing as a special case of collective intelligence where groups collaborate to create synergy, something greater than the parts. Howe (2006) popularized the term crowdsourcing building on Surowiecki's (2005) thesis about the collective wisdom of the crowd being more accurate than experts. Estellés-Arolas and González-Ladrón-de-Guevara (2012) conclude that crowdsourcing is a type of participative online activity engaging a group via an invitation to voluntarily undertake a task (p.197). Brabham (2013) and Boudreau and Lakhani (2013) generally describe four crowdsourcing categories for problem-solving: contests, collaboration communities, complementors and labor markets. The definition and understanding of crowdsourcing varies among organizations. This research uses the crowdsourcing definition presented by Estellés-Arolas and González-Ladrón-de-Guevara (2012) and the problem-solving categories from Brabham (2013) to understand crowdsourcing in the federal government.

Crowdsourcing methods for problem solving can be an opportunity for federal agencies to infuse innovative IT solutions to perplexing public problems and internal operations. New technology such as intuitive web browsers and high-speed internet connectivity facilitate boundary less collaboration (Zhao & Zhu, 2012) and create a collaborative platform. In their crowdsourcing study, Shingles and Trichel (2014) observe that technology makes it easy to access people and solicit ideas. Further, the authors state crowdsourcing enables an organization to obtain specialized skills from "anyone, anywhere as needed" (p. 2). In the complex government environment, it is literally impossible to have all the experience internally to address complicated problems. Crowdsourcing has the potential to engage a diverse crowd to solve tough problems. Diversity of the crowd benefits outcomes (Schmidthuber & Hilgers, 2018). For example, the U.S. Navy has conducted "Hack-a-Ship" cybersecurity hackathons, a crowdsourced event, to engage the crowd to hack into the sophisticated software system used to control Navy fleets (Owens, 2017). The Navy conducted an earlier hackathon aimed at gaining unauthorized access and control of the drone operating system that had enabled a single operator to simultaneously fly fifty (50) drones. The Navy hackathons illustrated that crowdsourcing allows the organization, including the federal government, to move beyond its boundaries to find solutions (Shingles & Trichel, 2014).

The Partnership for Public Service report (2011) makes the case for innovation to address the federal leaders' pressure to deliver results as budget and delivery timeframes compress. Additionally, the U.S. Federal Government (USG) has made innovation a national priority, challenging federal agencies to promote new innovative ideas to solve complex public problems and sustain America's competitiveness (U.S. Commerce report (2016)). To address the dilemma, U.S. government leaders are embracing crowdsourcing and other innovation approaches. Information technology is foundational to U.S. Federal Government innovation.

There is limited academic research on how crowdsourcing impacts innovation in federal government agencies. Both Erickson et al (2013) and Zhao and Zhu (2014) state sparse academic research exists on the impact of the crowdsourcing phenomenon. Nakatsu, Grossman, and Iacovou (2014) assert that

crowdsourcing is an area worthy of investigation although most organizations lack the knowledge of where and how it can be implemented. Miah, Hasan, Kerr, and Gammack (2017) assert that crowdsourcing design to optimize the crowdsourcing process is important for growth in the field (p. 2). Although crowdsourcing's utility is growing, Brabham (2013) states that empirical research on crowdsourcing is in the early stages. Crowdsourcing techniques have been adopted in government agencies however, a gap exists in understanding critical success factors for crowdsourcing adoption for IT innovation in federal government agencies. According to Lui (2017) about 18.5% of crowdsourcing studies fall in the organizational category focusing on management. This study aims to add to academic literature on federal government crowdsourcing for IT problem-solving and propose key factors that may increase the efficacious application of crowdsourcing for innovation in government.

## Research Questions

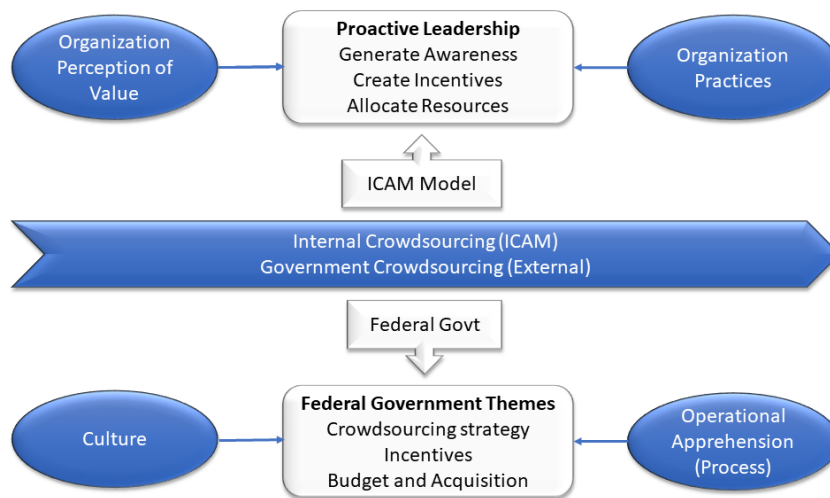
The research hypothesis is crowdsourcing opens the door to another potential solution for increasing innovation in the federal government. This research intends to address the following research question:

RQ: For federal agencies using crowdsourcing for IT innovation, what are the critical success factors?

## Theoretical Base

This research analyzed two theoretical models to support understanding crowdsourcing for IT innovation in federal government agencies. The models are the Internal Crowdsourcing Acceptance Model (Erickson, 2012) and the Collective Intelligence Genome (Malone, Laubacher, & Dellarocas, 2010). Both models assess crowdsourcing across different private sector organizations to understand organizational elements for crowdsourcing to be successful. These models provide a lens to factors that should be represented in federal government IT innovation crowdsourcing initiatives. This research analyzed the factors for successful IT innovation crowdsourcing from the theory and data collected.

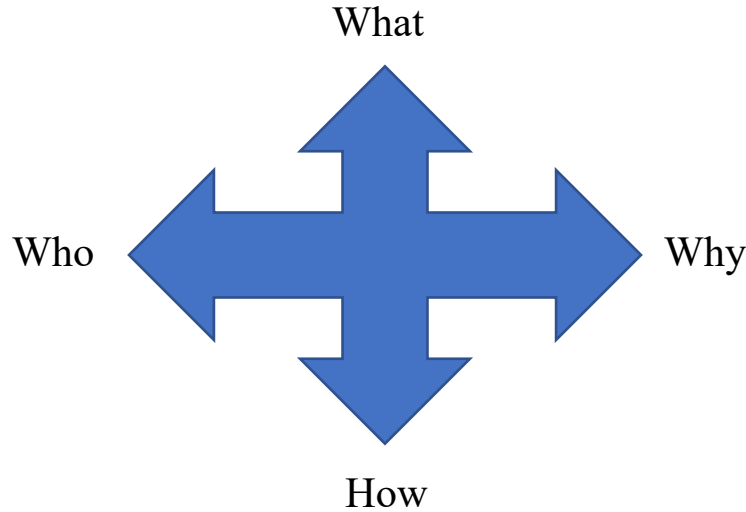
The Internal Crowdsourcing Acceptance Model (ICAM) proposes the factors involved as organizations integrate internal crowds into the innovation process (Erickson, 2013). The ICAM model is a framework for internal crowdsourcing for product or service innovation. Although the model focuses on the challenge inherent in extending the innovation process across a commercial firm, it has applicability to government crowdsourcing for information technology innovation. In Erickson's (2012) study, three innovation challenges were identified that are also applicable to government. These include: 1) resistance to outside ideas 2) realigning organization perceptions of value and 3) reducing barriers created by existing organizational processes and structure (p. 225). In the ICAM model proactive executive leadership is essential to reduce barriers to crowdsourcing for innovation. In this research study, interview themes surfaced that parallel and support the findings in Erickson (2012, 2013) case studies pertaining to product and service innovation and idea generation. Figure 1 depicts the relatedness between the ICAM model and the themes from the data collected in this research.



**Figure 1: Crowdsourcing for Government IT Innovation (Source: Adapted from Internal Crowdsourcing Acceptance Model (ICAM), Erickson (2012))**

In the ICAM model, for example, “organization perception of value” incorporates factors such as organization culture which is a key factor for driving an organizational change such as crowdsourcing adoption. As validated in this study’s data, culture plays a vital role in federal government agencies openness to outside ideas and risk appetite. Organization practices in the ICAM model are related to business processes which are considerations for crowdsourcing’s viability as a vehicle for IT innovation in government. Figure 1 shows the common threads between internal crowdsourcing components and external crowdsourcing in the federal government context.

Malone et al (2010) expanded the theory of collective intelligence to create the Collective Intelligence Genome (CIG) framework which can be applied to design a crowdsourcing system tailored to fit the problem being solved. The Collective Intelligence Genome (CIG) framework uses building blocks referred to as “genes” to answer the what, why, how and who questions necessary to design a crowdsourcing process that fits the problem. The framework facilitates government executives and managers selecting the best fit crowdsourcing design for the problem being solved. For this study the CIG framework was leveraged to develop a hypothetical “government gene” for IT innovation problems. The “government gene” was utilized in this study to understand the critical success attributes for crowdsourcing in government. The Collective Intelligence Genome framework is depicted in Figure 2. The Malone et al (2010) study can be researched for further details on the CIG framework.



**Figure 2: Collective Intelligence Genome (Source: Malone et al (2010))**

## **Methodology**

The study scope was to identify the critical success factors for crowdsourcing to be an effective innovation approach in U.S. federal agencies. The interaction between critical success factors may inform crowdsourcing strategies for IT innovation in the federal government. The Information Systems (IS) critical success factor theory refers to critical success factors as key factors necessary to achieve a goal (Larsen & Eargle, 2015). Critical success factors are an enabler for crowdsourcing.

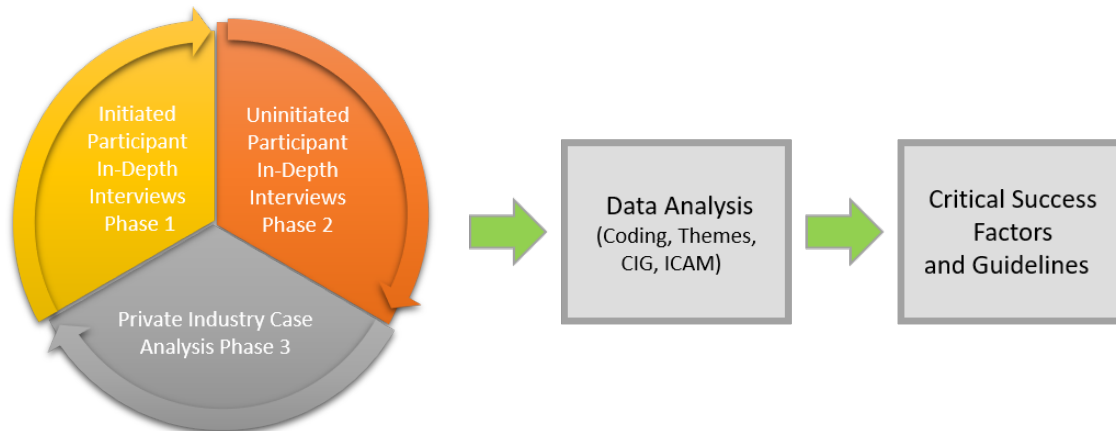
Federal agencies experienced (i.e. initiated) with a crowdsourcing activity directed at problem-solving, as well as those uninitiated to crowdsourcing initiatives were study participants. The study examined three types of crowdsourcing; contests, complementors, and crowd collaboration communities, that align with problem solving and forming innovative, creative ideas (Brabham, 2013). Crowd complementors provide creative solutions to enhance and address problems with a core product (Boudreau & Lakhani, 2013).

## **Data Collection**

The study used an exploratory, qualitative approach to research the growing and evolving crowdsourcing phenomenon. In crowdsourcing literature, Erickson (2012) asserts that explanatory research is critical to expand theoretical knowledge about crowdsourcing and to guide practitioners. The exploratory qualitative methodology was selected because empirical research pertaining to federal government crowdsourcing is limited, and the free-flowing approach gives the researcher flexibility (Stebbins, 2001; Strauss & Corbin, 2015). This study researches the views and perspectives of crowdsourcing decision-makers, both experienced and inexperienced, within federal agencies. The research question guided the selection of the appropriate research method.

Figure 3 presents the general research design. Initially, semi-structured interviews were conducted to gather data on how crowdsourcing can be used for innovation, as well as finding critical success factors for crowdsourcing in the IT innovation domain. Following the interviews, a qualitative analysis was conducted to determine the critical success factors for implementing crowdsourcing to innovate and expose new ideas.

The qualitative analysis included coding the data collected to determine themes. Additionally, a content analysis and interviews with two (2) private industry firms was conducted to obtain insight into differences or similarities between federal agencies and private industry critical success factors.



**Figure 3: Exploratory Qualitative Approach (Source: Shepherd, A (2017))**

The study participants were executives (e.g. Chief Information Officer) and technical advisors who were the decision makers to pursue crowdsourcing in their respective agencies. The researcher used purposive sampling and snowballing techniques to solicit interview participants. Interviews were recorded and transcribed. Seventeen (17) participants were interviewed for the study. A qualitative analysis of the transcribed interviews was completed using the Strauss and Corbin grounded theory data analysis methods (Bryman and Bell (2015), Strauss and Corbin (2015), Saldana (2016)). A purposive sampling approach enabled the researcher to select participants with experiences and information relevant to the study (Creswell, 2013).

Tables 1 and 2 summarize the demographic profile for the 17 research participants. The executive job positions are Chief Information Officer (CIO) and Senior Executive Service (SES). Of the 17 participants, 10 participants had experience employing a crowdsourcing process in developing an information technology solution and 7 were not experienced in crowdsourcing methods. The participants were grouped as initiated (i.e. prior crowdsourcing experience) or uninitiated (i.e. no crowdsourcing experience).

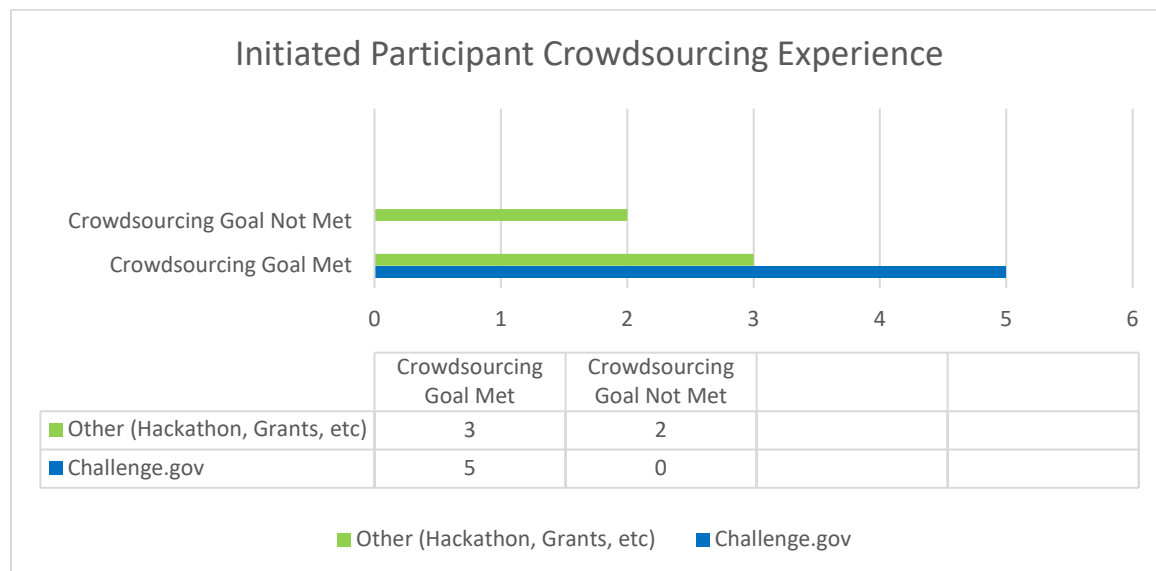
**Table 1: Demographic Profile**

Job Position	Male Participants	Female Participants
Chief Information Officer (CIO)	4	0
Senior Executive Service (SES) Non-CIO	6	2
Technical Advisor (GS15)	1	1
Other (GS-15, Sr. Mgr)	2	1
Total	13	4

**Table 2: Demographic Profile**

Job Position	Initiated	Non-Initiated
Chief Information Officer (CIO)	4	0
Senior Executive Service (SES) Non-CIO	3	5
Technical Advisor (GS15)	1	1
Other (GS-15, Sr.Mgr)	2	1
Total	10	7

Figure 4 presents the participants experience using crowdsourcing for IT innovation. Eight (8) participants who experienced crowdsourcing as a technique for information technology innovation used the government portal Challenge.gov for crowd competitions. Other crowdsourced approaches such as hackathons and monetary grants were also used. Eight (8) of the initiated participants had positive outcomes with crowdsourcing and fulfilled the initiative goals. Initiated participants that did not have success remained encouraged by crowdsourcing for IT innovation.



**Figure 4: Initiated Participant Crowdsourcing Experience**

## Data Analysis

The data analysis was performed using an Excel spreadsheet to capture participant responses and the application query function for identifying repetitive concepts. The data was analyzed for repetitions in the interview data and metaphors such as “lack of control” and “stuck in silos”. Colloquial terminology indigenous to IT professionals in government was also captured such as “fear of optics” and “bake in security”. Initial coding grouped the interview data into categories. The codes were analyzed for relationships between the codes (themes) and to the research question (Strauss and Corbin, 2015). The six steps for developing themes recognized by Braun and Clarke (2006) were used for thematic analysis. The steps are: 1) familiarization with data 2) generating initial codes 3) searching for themes 4) reviewing themes 5) defining and naming themes and 6) producing the report.

According to Bryman and Bell (2015) concepts and categories are key elements in grounded theory (p.588). The researcher’s chosen grounded theory analysis method has been used in prior exploratory studies comparing different groups (Henninger et al, 2015). The intercoder reliability strategy employed was to engage a doctoral peer to review a sample of two interview transcripts and categorize/code the data. The data categorization and coding were checked for consistency with the researcher’s codes and variations. The internal validity review confirmed there was consistency between the researchers’ and peer reviewer’s coding results.

## Discussion

Information technology is often the impetus for mission driven modernization programs and enhancements to federal government services. This study seeks to present critical success factors for implementing a crowdsourcing initiative for IT innovation in the federal government. According to Lui (2017) there are limited studies on crowdsourcing at the organizational strategy level (p. 657). The research results presented the participants perception that a crowdsourcing strategy can improve the value of IT problem-solving and solutions for federal agencies. There was positive executive and senior leader feedback on crowdsourcing for IT innovation. Both participant groups, those initiated to crowdsourcing and the less experienced uninitiated, perceived a value to using crowdsourcing for IT innovation. Those interviewed supported crowdsourcing as a path for IT innovation in the federal government. The participants perceived any crowdsourcing to be preferred to an insulated approach to IT innovation. From this research crowdsourcing for IT innovation offers the federal government an opportunity to 1) harness collective solutions 2) solve complex problems cost effectively 3) enroll the diverse wisdom of the crowd 4) narrow uncertainty relative to the unknown and 5) capitalize on public-private synergies to gain more value for citizens.

To enable successful IT crowdsourcing initiatives in federal agencies and to foster innovation, collectively the participants identified fifteen (15) critical success factors (Appendix A). The initial critical success factors were condensed into eight (8) critical success factors that occurred repeatedly in the interviews and to group similar factors. The eight (8) factors are identified in Table 3. These critical success factors were identified by federal government executives as being most important for crowdsourcing success for IT innovation.

In Table 3 the importance of the critical success factors is distinguished between the initiated and uninitiated study participants. The table presents the frequency of occurrence of the success factor in the data. Both groups noted an executive sponsor is imperative to champion the effort and obtain senior level buy-in. Government organizations’ can be tough to navigate because of bureaucracy and scale, therefore having someone at the top to be the voice for making crowdsourcing a priority can be the difference between success and failure. Six (6) participants commented that an executive sponsor and management buy-in was essential for crowdsourcing to be a success.



**Table 3: Crowdsourcing for Innovation Critical Success Factors**

Critical Success Factor	Initiated Participants	Uninitiated Participants
Executive Sponsor	2	3
Clear Problem Definition	1	1
Business case and strategy	3	1
Capable Crowd	2	1
Marketing and Communication Campaign	2	1
Incentives and Recognition	1	4
Culture	5	2
Context	1	2

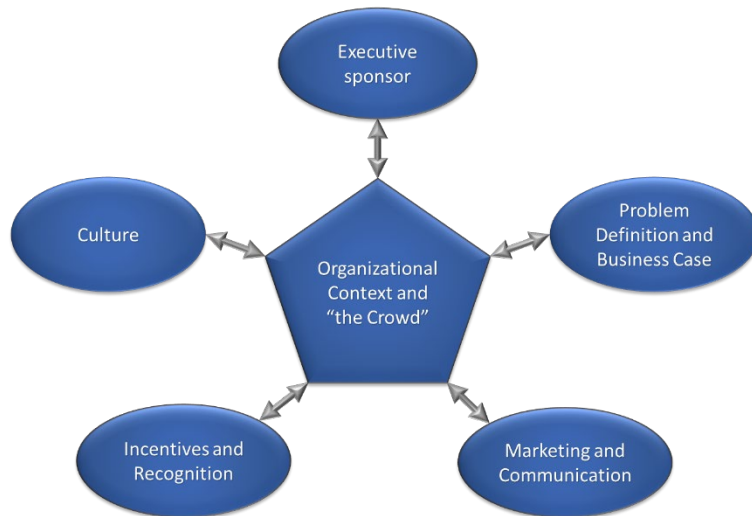
Clarifying the problem scope and definition and a developing a business case was foundational to a successful crowdsourcing project according to six (6) participants. Participants emphasized the importance of the understanding the problem context to be addressed with crowdsourcing and who is curating the crowdsourcing effort. Participants thought a business case, determining the boundaries for operational and innovation needs, and a crowdsourcing strategy were important for achieving innovative results from IT crowdsourcing. Six (6) participant organizations had a crowdsourcing strategy although only three (3) of the organizations had a formal documented strategy.

In comparing the critical success factors identified by the initiated versus uninitiated participant there were differences. Interestingly, the initiated participants’ found culture to be the most significant success factor whereas the uninitiated group leaned toward incentives and recognition being the principal success factor. As noted previously, both groups stated having an executive sponsor as important. Although the context or organizational environment was a lower priority success factor, both groups discussed this success factor. In the federal government, the agency’s mission and environment could play a key role in ascertaining whether crowdsourcing for IT innovation aligns with the strategy and risk posture. Also noteworthy is metrics scored lowest among both groups. The differences in the critical success factors may be attributable to the initiated group’s real-world experiences with IT crowdsourcing initiatives that have achieved innovative outcomes.

Being cognizant of crowdsourcing critical success factors can give the government organization experimenting with this IT innovation method the insight to design an initiative that fits the organization’s goals and has a higher likelihood of positive outcomes. For crowdsourcing to be effective as an IT innovation approach, crowdsourcing should fit with the agency’s culture and innovation strategy. Federal agencies with a highly secure, closed environment are unlikely candidates for crowdsourcing to thrive as an innovation mechanism.

The framework proposed in this study is a tool to aid the government practitioner’s in making better decisions about what problems are fit for IT crowdsourcing and how to structure a IT innovation project for the federal government. Critical success factors can facilitate the development of standardized crowdsourcing processes and procedures for the federal government. The critical success factors, incorporated in the organizational strategy, may increase the likelihood of a successful and repeatable crowdsourcing project endeavor. For example, a critical success factor identified in the study interviews is penetration to a large, capable crowd. Challenge.gov, a crowdsourcing portal has been able to reach large expert audiences and has repeated innovative outcomes. NASA for example has used Challenge.gov and partnerships with InnoCentive for IT innovation project such as developing a new algorithm to improve the Robonaut’s tool (<https://www.innocentive.com/nasa-partners-with-innocentive-to-crowdsource-innovation-initiatives>).

The factors summarized in the following diagram (Figure 4) form a proposed framework of critical success factors for IT innovation crowdsourcing in the federal government.



**Figure 4: Government Crowdsourcing Critical Success Framework**

Six (6) factors were deemed as essential for favorable crowdsourcing outcomes pertaining to IT innovation in the federal government. Factor 1 concerns an executive champion to sponsor crowdsourcing efforts. Factors 2 relates to defining the problem and strategy. Factors 3 focuses on the who and how of engaging and motivating the right crowd to solve the problem. Naturally, the right crowd is vital to effective IT problem solving. The context factor is subjective and incorporates many dimensions about the agency's leadership and mission as well as the agency's environmental fit for IT innovation crowdsourcing. Factor 4 is about the culture's openness and willingness to experiment and innovate while still meeting operational needs. Balancing the government mission and infusing creative solutions can be a dilemma considering budget and acquisition cycles and the expectation of project investment results within a fiscal year timeframe. Finally, Factors 5 and 6, respectively are marketing and communication and reward incentives. The critical success factors in this study are from the lived experiences of federal government executives, with a track record of delivering success projects in the federal government, and who are accountable for driving innovation in their organizations. Most crowdsourcing studies focus on private industry success factors rather than the unique characteristics of the federal government space.

Crowdsourcing has the potential to transform IT innovation in federal agencies. The IT innovation opportunity extends from traditional information technology software and hardware to algorithms advancing big data and automation applications. However, there are unique aspects of the federal government environment to be addressed for crowdsourcing to be successful for IT innovation. A clear problem scope and definition is key to employing crowdsourcing and achieving positive outcomes according to the study interviews. As more federal agencies successfully implement crowdsourcing for IT innovation, a standardized repeatable method is needed to tap into the full potential of crowdsourcing.

Comparison to private industry critical success factors is a limitation in this study. Only two (2) private sector firms were interviewed and more subjects are needed for a detailed analysis. Future studies should expand the research to include more comparisons with private industry. A repeatable crowdsourcing

process design for IT innovation in federal government would be a future research topic as well as a useful tool to aid in managers adopting crowdsourcing. Another area for further research is to explore and test the effect of moderating variables on IT innovation adoption the government domain.

This study contributes to the limited academic research on crowdsourcing as a strategy for IT innovation in the federal government. Increased empirical data on adopting crowdsourcing methods for IT innovation in government will contribute to the crowdsourcing body of knowledge. This study supports federal government practitioners to understand factors important for a successful IT innovation crowdsourcing endeavor. Awareness of the critical success factors allows federal government practitioners to design crowdsourcing projects best suited to federal government innovation objectives. There is a need for more IT innovation in the federal government and crowdsourcing offers an avenue to up the game.

## Conclusion

This paper explored crowdsourcing for information technology (IT) innovation in the federal government. Crowdsourcing for IT problem-solving and innovation is gaining momentum in federal agencies. Crowdsourcing can accelerate the government innovation cycle with limited investment, and help address the Executive Order for the United States to take a leadership role in digital technology and the drive for better customer experience and creative solutions to complex public problems. Federal government senior leaders and managers should be aware of the crowdsourcing alternative and initiate pilot projects to test strategies for operationalizing crowdsourcing for IT innovation. The critical success factors from this research can assist government executives and leaders to structure an enterprise or divisional crowdsourcing program as an IT innovation strategy and assist in implementing crowdsourcing initiatives that get organizational buy-in and yield positive outcomes. In addition, government practitioners should consider the viability of internal crowdsourcing to motivate employees to participate in bringing new, creative ideas to the organization. (Wagenknecht, Levina & Weinhardt, 2017). This research proposes a framework to support government practitioners in making the decision to use crowdsourcing for IT innovation. More executive sponsorship of crowdsourcing for IT innovation has the potential to exponentially expand new ideas and foster an innovation culture in the federal government.

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## Appendices

### APPENDIX A: Critical Success Factors

- Problem scope and definition;
- Business case;
- Communicate benefits;
- Penetration to capable, large crowd;
- Broad collaboration;
- Collaboration platform;
- Crowdsourcing as a strategy;
- Executive sponsor and managers on board;
- Recognition;
- Catalyst and context;
- Culture facilitates experimentation and openness;
- Agency capability to handle process and documentation requirements;
- Determine space for operational and innovation needs;
- Metrics; and
- Marketing campaign