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ARTICLE DE RECHERCHE

Unpacking complexities of mega-scale public sector information technology projects: An ecosystem perspective

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ABSTRACT

Mega-scale information technology (IT) projects in the public sector are significant undertakings operating within an ecosystem of stakeholders, resources, and constraints. The track record of these projects is abysmal. Employing an ecosystems lens, we study three failed mega-scale public sector IT projects: the U.S. Federal Bureau of Investigation's (FBI) Virtual Case File (VCF), the U.S. federal government's HealthCare.gov project, and Great Britain's National Programme for IT (NPfIT). A forensic analysis of these projects was conducted employing the Qualitative Media Analysis (QMA) methodology. The findings suggest several stakeholders in a public IT project assume roles analogous to different types of species in an ecosystem, with the public agency sponsoring the project as the keystone species. Specifically, the findings show that the public agency is susceptible to failure in hiring key personnel without proper knowledge and experience, and failure in responding to early signals alerting the impending implosion of the project ecosystem. In addition, flawed relationships between the public agency and contractors, and flawed relationship between the legislature and the public agency also contributed significantly to project failure.

Keywords: *Information technology, public sector, mega-scale projects, project failure, ecosystem.*

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RÉSUMÉ

Les projets de technologies de l'information (TI) à grande échelle dans le secteur public sont des entreprises importantes qui opèrent dans un écosystème d'intervenants, de ressources et de contraintes. En utilisant le concept d'écosystème, ce projet de recherche étudie trois projets TI à grande échelle dans le secteur public qui ont échoué : le U.S. Federal Bureau of Investigation's (FBI) Virtual Case File (VCF), le projet U.S. federal government's HealthCare.gov et le projet britannique National Programme for IT (NPfIT). Une analyse de ces projets a été réalisée à l'aide de la méthodologie Analyse Qualitative Média (QMA). Les résultats suggèrent que plusieurs parties prenantes dans un grand projet public TI assument des rôles analogues à différents types d'espèces dans un écosystème avec l'agence publique soutenant le projet dans en tant qu'espèce clé. Plus précisément, les résultats montrent que l'agence publique est susceptible de ne pas embaucher du personnel clé ayant les connaissances et l'expérience appropriées, et de ne pas réagir aux signaux précoces alertant sur l'imminence de l'implosion de l'écosystème du projet. De plus, les failles dans les relations entre l'organisme public et les entrepreneurs sous contrat et dans les relations entre la législature et l'organisme public contribuent également de façon importante à l'échec du projet.

Mots-clés : *Technologies de l'information, secteur public, projet à grande échelle, échec de projet, écosysteme.*

1. INTRODUCTION

Information technology (IT) project failures are commonplace in the public sector (Gauld, 2007; Purao & Desouza, 2010; Bozeman, 2002; Flyvbjerg, Bruzelius & Rothengatter, 2003). According to a report by The Standish Group, between 2003 and 2012, only 6% of federal IT projects in the US with over $10 million in labor costs were successful. Unfortunately, when IT projects fail in the public sector they fail spectacularly due to their mega-scale. These IT projects involve tens—if not hundreds—of millions of dollars, span multiple years, and encompass entire sectors of the economy, in addition to having national-level impacts.

A stinging example of a government IT failure was the eHealth project initiated by Ontario's Ministry of Health. The system was built to enable sharing of electronic health records such as lab tests, diagnostic imaging, and drugs and immunization records with other doctors. It was started despite the fact that similar efforts were underway in the provinces of Québec and British Columbia. In 2011, the auditor general of Québec declared that their efforts had failed. Ontario's estimated $1 billion investment in a health information network was "significantly underutilized" because its infrastructure, including an internal e-mail system, was markedly inferior to private sector alternatives. To date, the project is still not fully functional with an estimated cost of over $1 billion (Webster, 2012).

Another example is the following initiative from the Australian Public Transport of Victoria: the development of the Myki, a contactless smartcard ticketing system used on public transport projected to cost $999 million in 2005. In 2008, the cost-estimate had increased to $1.35 billion due to "reliability problems" (Own motion

investigation into ICT-enabled projects, 2011). The project fell four years behind schedule; inexperienced project managers and two different CEO turnovers occurred during the life of the project (Brouwer *et al.*, 2011).

Flyvbjerg *et al.* (2003) coined the term "megafailures paradox" to refer to the continued investment in mega-projects without first understanding why failures occur. While there is a growing literature that is examining mega-scale projects, many of these efforts focus on public infrastructure projects (Flyvbjerg *et al.*, 2003; Han *et al.*, 2009; Van Marrewijk, 2007; Yuttapongsontorn *et al.*, 2008). The literature on mega-scale IT projects in the public sector remains scant. This paper aims to fill the void.

Scholars have only recently started to acknowledge the fact that mega-scale IT projects operate within a very complex environment of stakeholders, organization norms and capabilities, resources, constraints, and external influences (Purao & Desouza, 2010; Becker *et al.*, 2011; Dille & Söderlund, 2011). For example, Dille and Söderlund (2011) introduced the term "inter-institutional project" to describe projects involving actors representing different institutional environments and discussed the critical need for researchers to differentiate such types of projects and develop theoretical and empirical understanding of the management of inter-institutional projects, by taking into consideration the complex interactions among institutional stakeholders. Hodgson and Cicmil (2008) argued that too often project managers are regarded as implementers that merely address issues of control and content which reduces their chances to act as social and political actors for the benefit of the project (p 5).

An ecosystem, a concept originated from ecology (Tansley, 1935; Van Dyne, 1969; Odum, 1953; Hollings, 1973), also describes a large number of entities operating at various scales and networks, including participating species and the interactions among them, natural resources, external influences, laws of physics, and so on. The fate of a natural ecosystem is determined by the intricate balance of these factors. Similarly, an IT project ecosystem is driven by a variety of factors. Under certain conditions, the ecosystem in which the IT project is originated and developed may be receptive. However, some of its configurations may also be hostile toward the project. For instance, when a large-scale IT project involves multiple institutions, the conflicting organizational norms regarding the timing of different project phases and activities leads to "temporal misfit" (Dille & Söderlund, 2011, 2013), which undermines project success. We argue that the ecosystem view provides a valuable perspective in the attempt to understand the multiplicity of forces, and the rich interactions among key players, that contribute to the demise of a mega-scale IT project.

We study three mega-scale IT projects conducted in the public sector: the U.S. Federal Bureau of Investigation's (FBI) Virtual Case File (VCF); the launch of the U.S. HealthCare.gov as the focal deliverable of President Obama's Affordable Care Act; and Great Britain's National Programme for IT (NPfIT), launched by the National Health Service. These three projects were focused on introducing technological solutions to support public policy outcomes. We chose these three projects as the technical solutions were rather similar in terms of complexity yet each project operated within different ecosystems—for example, supportive (FBI VCF) or hostile (HealthCare.gov and NPfIT) (see Section 2.2).

The overall goal of this research is to uncover the complexities of mega-scale public sector IT projects that led to the projects' failure employing an ecosystem

lens. This paper provides an analysis of these three cases between two contradictory ecosystems that operate in the same global context, for example, the U.S. (Healthcare.gov and FBI VCF), and between ecosystems within the same domain (i.e., healthcare) compared across global locations (U.S. and U.K.). Specifically, we conducted a qualitative forensic analysis of these three projects to dissect how and why these types of projects implode. Despite project differences, we presuppose that there are similar issues that contributed to their failure. Applying the ecosystem lens, we focused on the interactions among the species (stakeholders) involved in the project ecosystems. The contributions of this study include: identification of key species in a mega-scale public IT project ecosystem; identification of the failures of the public agency in performing the keystone species role of the project ecosystem; identification of flaws in the relationshps between the public agency and contractors, and flaws in the relationship between the legislature and the public agency. These failures and flaws are the consistent factors in explaining the tendency for mega-scale public IT projects to fail.

2. BACKGROUND

2.1. Mega-scale public sector IT projects

Over the last few years, IT projects in the public sector have increased in frequency, scale, scope, and complexity. The track record of these projects is abysmal. Notably, a study of 1471 large IT projects primarily consisting of US-based projects for public agencies revealed that one in six of those projects became a "black swan," or a statistical outlier due to expensive cost overruns (Flyvbjerg & Budzier, 2009). These increasing IT expenditures incite a pressing need to ask questions about how to avoid project failure. Bozeman and Bretschneider (1986) recognized that implementation of IT in the public sector would require a fundamentally different approach. They asserted that private sector principles could not be effectively translated to the public sector, that is, a new management framework would need to be designed for public sector IT projects. Scholars have also noted that IT projects in the public sector necessitate more attention to issues of openness, accountability, representativeness, and external and vertical linkages (Rocheleau & Wu, 2002; Cats-Barni & Thompson, 1995; Purao & Desouza, 2010; Becker *et al.*, 2011; Desouza, 2015).

Mega-scale IT projects have enormously dense patterns of interaction and these patterns often lack coherence and transparency (Grabher, 2002). For example, while Newell *et al.* (2008) note that large IT projects with complex objectives usually require work to be carried out in multiple subprojects (instead of one large project), subprojects tend to be less defined, and they are unlikely to be governed with pre-set goals. The subprojects are often haphazardly mashed together in hopes that a coherent product and innovative outcome will emerge. This aspect of mega-scale IT projects in the public sector makes these undertakings categorically different from private sector IT endeavors because numerous non-technical factors (i.e., political pressure, oversight by legislative committees, economic constraints and realities, internal cultural and cross-agency politics, etc.) have a direct impact on project outcomes. In short, projects in the public sector are heavily impacted by sociopolitical and economic conditions (Lamb *et al.*, 2013).

Dysfunctional internal dynamics are frequently observed in failed mega-scale public projects. Public employees enact various

behaviors, such as avoidance, normalization of bad behavior, dishonesty, etc. that contribute to project failure. These actions have been regularly seen in public agencies where employees are forced to live with and react to a set of constraints that they have little to no control over. For instance, Flyvbjerg (2009) identifies a pattern where officials avoid talking about project problems or even acknowledging failures after they have happened. Pinto (2006) argues that leaders who avoid red flags also normalize deviance, and bad behavior becomes ingrained in the organizational culture. Such normalization often happens as a kind of flawed or rationalized cost-benefit analysis. Crises and unforeseen events such as terrorism, market collapses, recessions, software issues, cost overruns, and missed deadlines are all problems that have to be addressed. Flyvbjerg (2005) notes the problematic practice of *strategic misrepresentation* where decision-makers or politicians underestimate the cost and overvalue the benefits of their projects to draw funding. Yourdon (2004) coined the term *death march projects* to describe undertakings that are typically set up to fail and operate under the hope or expectation that the project team will perform some type of miracle and find success. Pinto (2013) highlights *plan massaging* as a method of shortening a timeline after it has already been agreed upon. While these studies have addressed various aspects of individual managers' faults in mega-scale public IT project failures, to our knowledge, there is still a dearth of research that provides a holistic and theory-driven view of the tendency for public organizations to suffer such failures.

2.2. Ecosystem view of mega-scale IT projects

While an IT project has traditionally been viewed as an isolated, bounded, temporary organization, an emerging stream of research emphasizes the need to interpret project organization and outcome in the institutional environment (Kadefors, 1995; Engwall, 2003; Dille & Söderlund, 2011). Mega-scale public sector IT projects, in particular, are driven by a complex network of stakeholders and interactions and inter-relationships among these stakeholders (Dille & Söderlund, 2011). Many researchers have noted that such complex interactions among actors within and outside a social organization resemble the interactions among species in a natural ecosystem (e.g., Becker *et al.*, 2011).

Applying the ecosystem analogy in the specific context of business organizations, Moore (1996) coined the term business ecosystem to describe "an economic community supported by a foundation of interacting organizations and individuals—the organisms of the business world. This economic community produces goods and services of value to customers, who are themselves members of the ecosystem. The member organizations also include suppliers, lead producers, competitors, and other stakeholders. Over time, they co-evolve their capabilities and roles, and tend to align themselves with the directions set by one or more central companies" (p. 9). Koenig (2012) further developed a typology that classifies business ecosystems into four distinct types: supply systems, platforms, communities of destiny, and expanding communities. Supply systems, in particular, describes a business ecosystem that is "controlled by a principal who delegates to its constituents certain complementary contributions to achieve the strategic activity" (p. 215). When an organization delegates subtasks to contractors during a large scale IT project, the project ecosystem exemplifies a supply system. In analyzing industries such as mobile computing, researchers have found the ecosystem view to provide a more accurate representation of the competitive dynamics

Table 1. Summary of the ecosystem of the three cases.

Case	Country	Sector	Political climate	Duration of project	Managed by	Number of contractors	Overall budget
FBI VCF	U.S.A.	Defense	Supportive	5 years	One federal agency	Two primary contractors	$581 million
Healthcare.gov	U.S.A.	Health	Strong opposition	3 years	Two government agencies	One lead contractor and over 50 contractors and subcontractors	$133.6 million
NPfIT	U.K.	Health	Controversial	9 years	One government agency	Four contractors	£10 billion

compared to the traditional supply chain or value chain views (e.g., Rong & Shi, 2009). Other types of socioeconomic ecosystems have been proposed and all share one key defining feature: the presence of a network of interacting entities (Briscoe, 2010; Li *et al.*, 2012). For example, an organization could be viewed as a social ecosystem considering social interactions among the members, or a knowledge ecosystem where the knowledge transfer and exchange are the focus (Briscoe, 2010; Li *et al.*, 2012).

Prior research on IT project failures tends to focus on specific aspect(s) of IT projects (e.g., viewing IT projects as a type of organizational activity to be managed, and examining the role of project management practices in project outcomes), overlooking the complex interactions that exist in an IT project ecosystem. Therefore, in this study, we apply the ecosystems lens to understand the nature of public sector organizations that lead to their tendency to suffer mega-scale IT project failures. The ecosystem perspective provides an interesting perspective to study mega-scale public IT projects by permitting us to study species (stakeholders) that interact and are impacted by mega-scale projects.

We purposely chose to study three projects that operated in very different ecosystems. Specifically, we chose projects that had varied in the political climate, level of public scrutiny, scale, and operated in, and interacted with, stakeholders in different sectors (see Table 1).

2.2.1. Political climate

The VCF project was accelerated by the post-September 11th political climate. National security was championed by political leaders, the public sector, and citizens alike due to a heightened fear of terrorism. On the other hand, the HealthCare.gov project grew out of President Obama's election promises. The passage of the Affordable Care Act (ACA) led to political intractability and infighting in Washington D.C., eventually resulting in a government shutdown in late 2013. In contrast to the VCF, support for HealthCare.gov was decidedly lacking. The NPfIT came from a strong governmental will to modernize its health service, which was often handled locally with no possibilities to coordinate medical information efficiently through a system. The NPfIT was heavily discussed and portrayed as a controversy in the political debate as, for instance, the requirement analysis was poorly done (e.g., users were not involved enough in the requirement phase and it failed to address the confidentiality of patients' health information). The controversial political climate that the project faced was also due to a

recent history of failed projects (e.g., the 1992 and 1998 Information Management & Technology strategies) that aimed at improving health care services but failed to deliver their promises (Wainwright & Waring, 2000).

2.2.2. Public scrutiny

The FBI faced intense scrutiny from the public and government officials immediately following 9/11. It was a mix of this scrutiny and extreme patriotism that drove the project's acceleration (Verton, 2003). However, work on the VCF was done outside of the public eye and did not directly impact everyday citizens. The debates on the policy options and ramifications of overhauling the healthcare system was public. Political leaders, pundits, and even the citizenry were split on their views regarding the policy. Regardless, given the public nature of the debate, the time period immediately preceding the rollout of HealthCare.gov portal had focused the country's attention on the project. The NPfIT underwent scrutiny due to early signs of project complexity, confidentiality of information, lack of consultation of key stakeholders, etc., as it impacted the future of patients in the U.K. The media brought attention to these issues but also to the high cost of the project for taxpayers (Maughan, 2010).

2.2.3. Scale

The VCF project was conducted within one federal agency while the work on HealthCare.gov was managed chiefly by two government agencies. Additionally, the VCF project employed two primary contractors over the five-year life of the project, while the HealthCare.gov undertaking had over 50 contractors/subcontractors, major and minor consultants, and other public agencies to contend with over a brief three-year period. The NPfIT was then led by the Director General of National Health Service (NHS) IT who contracted four vendors (BT, Accenture, CSC, and Fujitsu) to work on the then five health authority regions in which the system was to be implemented. Those regions or clusters were: North East; North West and West Midlands, Eastern, London, and Southern (Campion-Awwad *et al.*, 2014). The difference in the range of stakeholders involved and the number of entities that had legitimate control over the project's fate makes for interesting comparisons from an ecosytems viewpoint.

2.2.4. Sectorial differences

These three projects operated in, and interacted with, stakeholders in different sectors. They are in the defense and healthcare sectors, which have large numbers of powerful external stakeholders vying for influence. These include major pharmaceutical companies, arms industries supporting the world's largest military, defense and engineering contractors, various lobbying groups, and numerous employees. The two healthcare projects Healthcare.gov and the NPfIT were from two different countries (the U.S.A. and the U.K.) with two different kinds of bureaucratic and political structures. Further, sectorial issues are compounded by the role of monopolies (or near monopolies) and their interests, especially monopolies related to large contracts. Sectoral differences also bring out nuances associated with power dynamics in networks, the appreciation (or lack thereof) for sector-level innovation, lobbying and political influence that impacts the level of control and power the public agency may (or may not) have to influence the trajectory of a project during all phases from the request for proposals to development, implementation, and ongoing maintenance.

3. METHODOLOGY

We employed a multiple case study approach to explain failures that occurred in the FBI VCF, the HealthCare.gov, and the NPfIT projects. This is the preferred strategy when "how" or "why" questions are being posed and when the focus of the research is on a real-life context (Yin, 1989). Multiple case studies also allow for comparative conclusions to be drawn.

Data captured for the case studies were gathered from a wide range of sources, that is, news outlets, journal publications, reports, case studies, records, and other publicly available documents. This approach is an effective means of analyzing data when dealing with sensitive issues or a hard-to-reach sample. Qualitative Media Analysis (QMA) was used as the method of analysis. QMA is an analytical tool that requires the researcher to study documents to uncover their relevance, significance, and meaning informed by the researchers' theoretical lens (Altheide, 1996). Additionally, QMA is a useful tool because it investigates documents, their narrative structure, context, bias, cultural focus, and thematic emphasis to arrive at multiple perspectives of a single occurrence.

Altheide (1996) categorizes successful document analysis into the following five stages: 1) document unit analysis, 2) protocol development and data collection, 3) data coding and organization, 4) data analysis, and 5) reports. First, a unit analysis and the appropriate content/documents to collect for the study should be identified. Identifying the appropriate content or documents is extremely important because it provides context and significance for how the data will help define the cases. Second, a protocol is to be developed to define the characteristics present in the data and determine testing procedures in a pilot round. A data collection sheet is included in the protocol because it outlines the variables to be considered in the study. Third, once data has been collected, it should be accurately coded. A midpoint analysis should be completed to determine if any alterations in the protocol are necessary. Fourth, data analysis of the contrasting and similar themes present in each case is needed. Once analysis has been completed, findings are drawn and concluded. Finally, as findings emerge, they should be integrated with the key concepts of the study and reported.

A protocol was developed to outline the variables to be included in the study. These variables were selected to capture the key dimensions of each project ecosystem and the symptoms of the project failure. The specific variables are *failure, stakeholders, disaster, media, political culture, internal constraints,* and *external constraints.* The data collection consisted of collecting media content on FBI VCF, HealthCare.gov, and the NPfIT. Internet searches were conducted to find troves of news stories, reports, journal articles, social media posts, etc. Approximately 420 pieces of data were found and applied to the study protocol for inclusion or for discard. The search included data from before the initiation of each project until their conclusions. A wide net was cast because the theoretical lens of this study values developments that occurred before, during, and after project failure, involving every stakeholder of the project ecosystem. Searches for media content included keywords such as: "failure," "contractors," "public opinion," "Congress," and "leadership," to find varied data on the topics. A total of 167 data sources were used: HealthCare.gov had 67, VCF had 26, and the NPfIT had 74. It should be noted that the richness in data varied due to the nature and publicness of each case. HealthCare.gov and NPfIT were very public projects resulting in a higher volume of media content.

The data were captured in three large, comprehensive spreadsheets that served as a

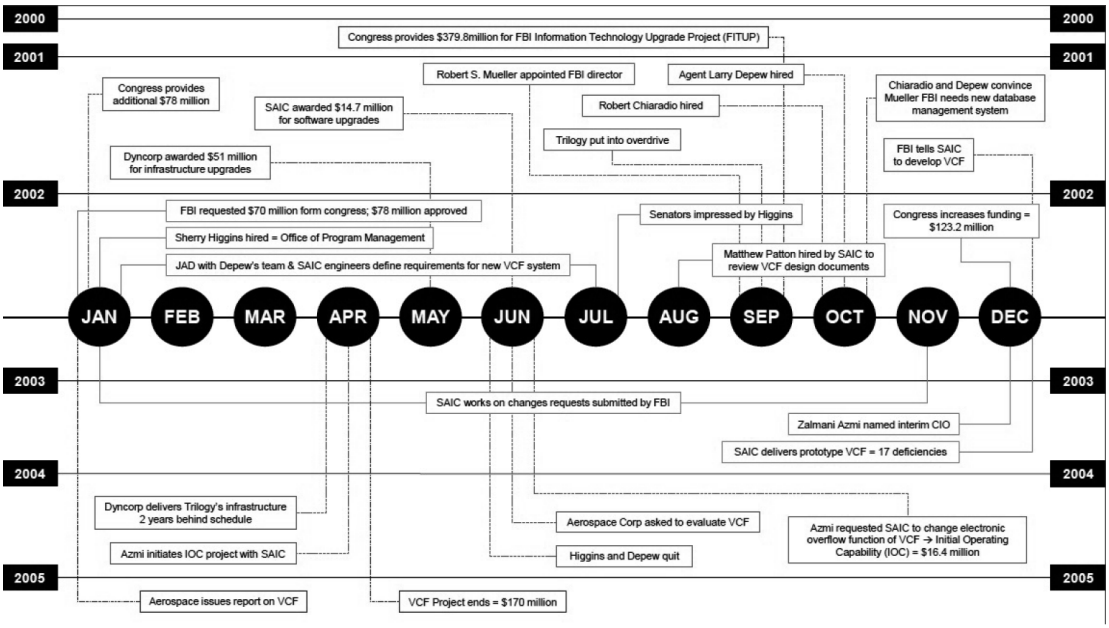
coding template. First, a detailed timeline of social, political, and financial events integral to the development of the studied projects was outlined and coded. This timeline organized overall key events that spanned topic areas and a variety of variables. In essence, it plotted the projects from their antecedents, actions, outcomes, and effects (see Figure 1 fo an illustration of the FBI VCF timeline). In addition, a list of each stakeholder's roles and responsibilities in the development of these projects was outlined and coded. This dataset provided clarity into the various stakeholders involved in each project and the roles they were supposed to play as outlined by contracts or formal agreements. Furthermore, the same list of stakeholders was used to build another dataset, which plotted stakeholder actions and interactions during the development of the projects on a timeline. This dataset included such information as correspondence, monies received, reports of work performed, etc.

The data were then triangulated for accuracy and reliability by locating corroborating information. This process ensured that information was accurate and matched the research protocol. Since media reports are often rife with opinion and conjecture, all factual information was corroborated to weed out invalid, incorrect, or unsubstantiated data. We purposely retained specific ideologies and viewpoints used in discussions of media overtones in order to reflect the inherent politicization of these projects.

Analysis included key events extracted from the spreadsheets to reveal similarities and dissimilarities between the cases. All three datasets were analyzed separately and together to locate trends and patterns. Analyzing the datasets together was useful because it provided a holistic view of the projects. For example, the contractor relationships looked very different for each project on the dataset describing roles and responsibilities. Yet when analyzed along with the first dataset detailing the social, political, and financial events in each project, they offered key insights into contractor relationships, trends, and outcomes.

The following examples illustrate the process of triangulation of the methodology to arrive at insights that are described in cases

Figure 1: Timeline of the FBI Virtual Case File.



that then help drew key findings for this paper. For instance, various data from the cases showed that underqualified individuals were assigned to the projects. More specifically, documents such as National Audit Report (2006, 2011) or academic papers (Hendy *et al.*, 2005) on the NPfIT project discussed the lack of experience of managers put in charge of such a mega-scale project. Documents on the FBI VCF showed evidence of how the FBI project managers lacked the right qualifications, both IT and business knowledge, but also experience with the public sector (Marchewka, 2010). Similarly, documents from the cases show that the funding of projects was not optimized. For the HealthCare.gov project, Congress approved an additional $27.7 million (Morgan & Hunter, 2013). For the FBI VCF, the FBI requested an additional $70 million from Congress to accelerate the Trilogy project and received $78 million (Marchewka, 2010); for the NPfIT, an additional £3.6 was added to the projected cost (Syal, 2013). These items of information taken together show trends in how the projects were conducted in similar or different ecosystems.

4. THE TALE OF THREE MEGA-SCALE HEALTH IT PROJECTS IN THE PUBLIC SECTOR

This section will describe three mega-scale public sector IT projects: the U.S. Federal Bureau of Investigation's (FBI) Virtual Case File (VCF); HealthCare.gov in the U.S. and National Health Service (NHS) in the U.K.

4.1. Virtual Case File

4.1.1. Context

Throughout the 1990s, the FBI developed information systems without an overarching organizational plan (Goldstein, 2005). By the year 2000, over 50 independent application systems were in place. This patchwork of systems, which were written in different programming languages and running on disparate platforms, failed to provide the most basic needs for an intelligence and security agency, namely, the sharing of relevant case data between FBI divisions and field offices (Marchewka, 2014). The FBI's Automated Case Support (ACS)—designed as a back-up for paper-based case management protocols—was so poorly designed that agents were required to navigate through 13 computer screens just to upload a single document in the system (US DOJ Officer of Inspector General, 2005). Data management challenges were frequently encountered. For instance, the FBI mishandled more than 3,000 documents associated with the trial of Timothy McVeigh for his role in the 1995 Oklahoma City Bombing (CBS News Staff, 2001). A 2005 report by the Office of the Inspector General delineated the shortcomings of the FBI's pre-9/11 systems (The Federal Bureau of Investigation's management, 2005):

- More than 13,000 of the FBI's computers were 4–8 years old and incapable of running modern software;
- Communication networks between and within FBI offices were up to 12 years old;
- Network speeds were equivalent to a 56k modem;
- Many networking components were no longer manufactured or supported;
- Agents were unable to reliably email each other, U.S. Attorneys' offices, or other federal agencies.

4.1.2. The Project

In September 2000, the U.S. Congress approved $379.8 million for a three-year FBI

Information Technology Upgrade Project (FITUP) under then-FBI Director Louis Freeh and CIO Bob E. Dies. The FITUP soon divided into three parts and was renamed Trilogy. During the summer of 2001, two different contractors, DynCorp and Science Applications International Corp (SAIC), were hired to work on Trilogy. The three-stage initiative would upgrade the FBI's inadequate IT capabilities: SAIC would develop software upgrades and DynCorp would be responsible for hardware (Office of Inspector General, 2005).

On September 4, 2001, Robert Mueller was appointed to the FBI Director role and took charge of Trilogy. The September 11th attacks occurred just days after the FBI's leadership change, shifting Trilogy into overdrive. Mueller gave orders for the project to be completed as soon as technically possible (Verton, 2003). He hired Robert Chiaradio, the agent in charge of the Tampa, Florida FBI field office, to assist with the project. Chiaradio concluded that the current plans for creating a web interface to support the antiquated ACS system would be insufficient. He needed an alternative solution that would allow agents to search across various investigations to find relationships to their own cases (Goldstein, 2005). In need of further assistance, Chiaradio hired Larry Depew, an agent who previously developed a database system to track Mafia activities in New Jersey (Marchewka, 2014). Over the next month, Chiaradio and Depew brainstormed new solutions to replace the antiquated ACS system. In December 2001, they convinced Mueller that the FBI needed an entirely new system that would include an improved user interface and database management system. Mueller instructed SAIC to stop their current work and instead begin work on the new system, referred to as the Virtual Case File (VCF) system (Marchewka, 2014). Under increasing pressure to deliver an improved case management system, Chiaradio and Depew began taking shortcuts in the planning and development stages. Joint Application Development (JAD) sessions were held with SAIC and other experts to define requirements for the new system. However, work processes were not halted until the JAD sessions were complete—resulting in numerous inefficiencies. Additionally, both the FBI and SAIC agreed to complete the VCF in 22 months. No backup plan was created in the case that the VCF was unsuccessful (Marchewka, 2014).

In January 2002, the FBI requested an additional $70 million from Congress to meet the accelerated deadline. Not only did Congress approve the funding, they provided $8 million more than was requested. Mueller and Chiaradio then hired C. Z. (Sherry) Higgins, an experienced IT professional with 29 years of experience, to create a new FBI unit: The Office of Program Management. This new department would serve as a central hub for expensive, complex, and risky projects (Marchewka, 2014). In her new role, Higgins named Depew—who had no formal IT experience—the official VCF project manager (Goldstein, 2005). Depew became the primary point of contact with the SAIC and served as a liaison between the FBI's investigative and administrative processes divisions.

In March 2002, just two months after hiring Higgins, Chiaradio left the FBI for a lucrative role at BearingPoint Inc., a global consulting firm (Verton, 2003). Depew continued to hold JAD sessions throughout the first half of 2002, resulting in a very detailed VCF requirements document. The VCF system would accept scanned documents and other electronic media, thereby simplifying evidence tracking, and allow individuals with proper clearance to access that evidence from any FBI office location (Goldstein, 2005). By summer 2002, SAIC had approximately 200 programmers on staff working on the VCF (Koman, 2006).

Everyone seemed pleased with the progress being made. In a July 2002 senate hearing, Higgins wowed the senators with a PowerPoint presentation outlining the VCF's capabilities (U.S. Senate Committee on the Judiciary, 2002).

Unfortunately, despite appearances, the VCF project was not on track. In August 2002 SAIC hired Matthew Patton to review design documents outlining the VCF's structure and user interface. Patton, who had previously spent four years helping develop a web-based database system used to plan the Department of Defense's $400 million budget, quickly realized that the VCF's 800-plus pages of requirements were too complicated for effective implementation. Patton asserted that SAIC was wasting time coding unnecessary applications and was making no attempts to control costs, for example, they were using 200 programmers where only a couple dozen were needed. Patton asserted that "[t]he [SAIC's] attitude was that it's other people's money, so they'll burn it every which way they want to" (Koman, 2006). Patton did not feel that his concerns were being taken seriously. Out of frustration, Patton posted a message on a public forum asserting that nobody at the FBI was taking security issues seriously. This post immediately got Higgins' attention. She labeled him a disgruntled employee and reported him to the FBI's security division. His clearance was revoked. Unable to continue work, he left his position three months later.

In December 2002, Higgins asked Congress for additional money, receiving $123.2 million and increasing the total cost of the Trilogy project to $581 million (Kerzner, 2014). In 2003, SAIC began taking change requests for software alterations from the FBI. Approximately 300 change requests were filed in 2003; SAIC implemented changes and delivered the final VCF product in December 2003. Zalmai Azmi, who was appointed interim CIO for the FBI just weeks earlier, quickly realized that the software was broken and unusable. He made the decision to reject the VCF based on 17 functional deficiencies. SAIC argued that many of the deficiencies were due to mid-project requirement changes.

In May 2004, Azmi asked SAIC if they would change an electronic function of the VCF into something he called the Initial Operating Capability (IOC) in six months for a fixed price of $16.4 million. Additionally, in June 2004, the FBI hired Aerospace Corporation to review the VCF and determine if system requirements were met. Aerospace found 59 issues and sub issues arising from the FBI's original 17 deficiencies; 19 were due to the FBI's requirement changes while the remaining 40 were SAIC problems (Marchewka, 2014). As a result, SAIC offered to fix all issues if given $56 million and an additional year to work on the project. Funding to fix these issues was never given, but the IOC was developed. However, before work on the IOC could be started, both Higgins and Depew left the FBI.

4.1.3. Outcome

Completed in March 2005, the IOC was partially successful. According to an internal FBI assessment, "Although the IOC application was an aid to task management, its use did not improve the productivity of most users" (Marchewka, 2014, p. 8). After the IOC launch, Mueller revealed to reporters that the FBI was looking into off-the-shelf software to meet their needs. In April 2005, the VCF project was officially abandoned (Kerzner, 2014). Commenting on the project, Senator Patrick Leahy asserted that the "[VCF project has been a] train wreck in slow motion, at a cost of $170 million to American taxpayers and an unknown cost

to public safety" (U.S. Senate Committee on Appropriations, 2005).

4.2. HealthCare.gov

4.2.1. Context

Healthcare reform in the U.S. is an oft-debated topic with wide-ranging implications. Throughout history, presidential calls for healthcare reform have been met with fierce opposition from the medical industry, for example, the American Medical Association has long opposed public insurance plans (Pear, 2009). In the late 1960s, rising healthcare costs for Medicare and Medicaid became a political issue that would persist for decades. Over the next five decades, other smaller yet significant healthcare projects would be passed, such as President Nixon's Health Maintenance Organization Act (HMO) in 1973, the Employee Retirement Income Security Act in 1974, COBRA (Consolidated Omnibus Budget Reconciliation Act), the Medicare Catastrophic Coverage Act in 1988 (later repealed in 1989), and the Children's Health Insurance Program (CHIP) in 1997. However, none of these programs provided affordable healthcare and insurance for the masses.

In 1993, President William J. Clinton began an effort to enact a law for universal health coverage using a "managed competition" approach where insurers would compete in tightly regulated markets. In the end, President Clinton's plan was unsuccessful because the health insurance industry lobbied against healthcare reform and the Republican opposition argued that reform would be too costly for many businesses (Nather, 2014). However, the CHIP was enacted shortly thereafter; to date, over seven million children have been insured under the law.

The argument that the federal government should support healthcare accessibility resurfaced in public discussions during the 2008 presidential election. After assuming office in 2008, President Barack H. Obama and members of Congress began negotiating the terms of healthcare reform. President Obama proposed a mandate that would require all Americans to enroll in an insurance plan of their choice. Despite heavy Republican opposition, the Patient Protection and Affordable Care Act (ACA) was passed by Congress in late 2009 and signed into law by President Obama in March 2010 (Dunham, 2010) (H.R. 3590). Enacted with the goal of reducing healthcare costs and increasing health insurance quality, the law expanded public and private insurance coverage for the uninsured by imposing mandates, subsidies, and insurance exchanges (Washington Post, 2013). The ACA is the most significant regulatory overhaul of the U.S. healthcare systems since the passage of Medicare[1] and Medicaid[2] in 1965.

4.2.2. The Project

After the ACA's passage, planning, and construction of HealthCare.gov was quickly initiated and the launch date was set for October 1, 2013, in time for the December 23, 2013 deadline for individuals to sign up for coverage that would begin in January

[1] Medicare is a national social insurance program, administered by the U.S. federal government since 1966, that guarantees access to health insurance for Americans aged 65 and older who have worked and paid into the system, and younger people with disabilities as well as people with end stage renal disease (Medicare.gov, 2012) and persons with amyotrophic lateral sclerosis.

[2] Medicaid in the United States is a social health care program for families and individuals with low income and resources.

2014. Envisioned as the official marketplace for health insurance, HealthCare.gov would be a federally operated exchange for citizens to shop for coverage. The Department of Health and Human Services (HHS) and the Centers for Medicare and Medicaid Services (CMS) were responsible for implementing key aspects of the law. This included the development and certification of the insurance exchanges, determination of consumer eligibility for federal subsidies, and construction of the HealthCare.gov website (GAO-13-614, 2014). The website's functionality would include digital identity authentication, income verification, and other forms of data verification to determine insurance plan eligibility (CMS, 2014). The goal was to ambitiously roll out HealthCare.gov in a "big bang" release involving the deployment of all technology components at once instead of incrementally (Thibodeau, 2013).

Development of the HealthCare.gov website occurred between 2010 and 2013. Under the direction of the White House Office of Health Reform, CMS and HHS contributed to the implementation of the ACA in various ways. CMS was primarily responsible for the day-to-day development of HealthCare.gov and served as the lead systems integrator (LSI) for the various aspects of the project. HHS's Office of Health Reform was tasked with ensuring that the project adhered to the ACA's rules and regulations.

Contractors and subcontractors were also hired for specific tasks throughout the project (Depilles, 2013). In May 2010, the Canadian-based contractor CGI Federal won a bid as lead contractor on the project for $93.7 million. Over 55 other contractors and subcontractors were hired during the course of the project. Work was routinely divided into smaller projects and given to a contactor to complete. For example, Quality Software Services, Inc. (QSSI), a subcontractor of CGI Federal, developed the Data Services Hub and the Enterprise Identity Management System (EIDM) used for HealthCare.gov (Yang, 2013). The contractors also developed other pieces of technology such as the user interface, email notifications, registration confirmations, account activation links, and the landing page for the website (Allison, 2013). Moreover, various federal agencies, such as the Internal Revenue Service and Social Security Administration, were engaged as well for purposes such as income and identity verification.

In May 2011, David Cutler, a Harvard professor and former advisor on President Obama's 2008 Presidential campaign, sent a memo to White House officials arguing that an outside entity should be contracted to oversee integration of the various components of HealthCare.gov (Washington Post, 2013). However, Cutler's recommendation went unheard—CMS would remain the LSI (CBS News Staff, 2013). During the next 18 months, CMS worked with individual contractors as they completed their assigned tasks. As the 2012 presidential election drew near, stakes became incredibly high. President Obama was vying for reelection and Republican opposition was actively lobbying against the ACA, despite the fact that it had already been signed into law. The White House, concerned that controversial plans or information might be leaked to the media and used against President Obama, instructed HHS employees not to share "concepts of operation" or other diagrams delineating the internal operations of HealthCare.gov (Washington Post, 2013). Furthermore, important insurance coverage standards and rules were not released until after the election (Washington Post, 2013).

As the October 1 launch of HealthCare.gov neared, concerns began to arise that the project would not be completed as scheduled. In March 2013, HHS announced that it would delay the rollout of small business health exchanges by one year. A

few weeks later, Henry Chao, deputy CIO at CMS, said that he was "pretty nervous" about the exchanges being ready by the October 1 deadline at an insurance industry meeting (Morgan & Hunter, 2013). Shortly thereafter, more troubling news arose when CGI Federal announced that they would soon exceed their contract's ceiling of $93.7 million. Additional funds not included in the original contract were needed to avert a cost overrun and improve system functionality. As a result, Congress approved an additional $27.7 million in April 2013 (Morgan & Hunter, 2013).

In June 2013, the Government Accountability Office (GAO) released a report on HealthCare.gov contending that while "missed interim deadlines may not affect implementation, additional missed deadlines closer to the start of enrollment could do so" (GAO-13-601, 2013, p. 1). The GAO's warning heightened pressure on CMS, HHS, and contractors to succeed. In July 2013, Serco was awarded a contract—worth up to $1.25 billion—to handle paper applications for exchange-based health plans. Shortly after the contract was awarded, Britain's Serious Fraud Office (SFO) began a criminal investigation into Serco for fraud, resulting in more bad press for HealthCare.gov (Murray, 2013).

In August 2013, CGI Federal sent a memo to the CMS stating that only 55% of work was completed (Washington Post, 2013). Several weeks later, Congress approved an additional $58 million in funding for CGI Federal to ensure HealthCare.gov would meet the October 1 deadline. The additional funds were justified as the need to add new elements to the system and increase capacity, but the GAO (2014) later found that the additional funds were really to continue the original development work. As the launch date neared, it became clear that there would not be sufficient time to properly test all of HealthCare.gov's components. According to a September 2013 report, the top risk to the project was "not enough time in schedule to conduct adequate performance testing" (Johns & Wolf, 2013). Increasing pressures resulted in the approval of an additional $18.2 million in funding for CGI Federal just weeks before launch (Morgan & Hunter, 2013).

On October 1, 2013, the day HealthCare.gov launched, the site crashed almost immediately. Issues were initially blamed on higher-than-anticipated volumes of web traffic. However, other problems were soon uncovered, such as missing drop-down tools, confusing instructions, and the transmission of unnecessary data (Aigner-Treworgy, 2013). During the first week, the site attracted 250,000 users simultaneously; administration estimates were for 50–60,000 simultaneous users. It has been estimated that only 1% of 3.7 million interested persons were able to enroll on the site during its first week (Smith *et al.*, 2013). For the 1% that could access the site, they experienced errors in price quotes, incorrect data transmitted to insurers, two days of data hub outages during October, and verification issues that prohibited enrollment.

4.2.3. Outcome

Following the failed deployment of HealthCare.gov, the White House contracted with Quality Software Services, Inc. (QSSI) to coordinate efforts to fix the website (Eilperin, 2014). In an interview with Gerald Seib at the Wall Street Journal's CEO Council, President Obama acknowledged that his administration underestimated the complexities of building such a website and also discussed the inefficiency of government procurement methods (Wall Street Journal, 2013). President Obama vowed to fix the site by late November and announced that a "tech surge" approach would be used, that is, experts from the public and

private sector would be brought in to work on the site until it was fixed (Mazmanian, 2014). The tech surge was largely effective; HealthCare.gov's system uptime was improved from an embarrassing low of 42% on November 1 to 95% by early December (Auerbach, 2013). However, enrollment was lower than anticipated. While projections anticipated 800,000 enrollees by December, only 364,000 individuals had signed up (Brennan, 2013). As a result, open enrollment, which was originally set to close on December 23, 2013, was extended until March 31, 2014. Nearly 8 million individuals had enrolled by the March deadline (Galewitz, 2014).

4.3. National Health Service (NHS)

4.3.1. Context

In the 1990s, Great Britain wanted to modernize its health service. In 1992 a strategy was put in place to enhance the national health service including the development of electronic health records. The strategy was called the NHS Information Management and Technology (IM&T) strategy (Wainwright & Waring, 2000; Campion-Awwad *et al.*, 2014). However, "despite several technological advances and the introduction of key infrastructure, the strategy lacked overall objectives, specific targets and sufficient programme evaluation" (Brown, 2001 as cited in Campion-Awwad *et al.*, 2014). The 1992 IM&T strategy failed and was followed by the 1998 IM&T strategy. The 1998 IM&T strategy also failed. The reasons of the latter failure were identified by Brown (2001, as cited in Campion-Awwad *et al.*, 2014) as "the lack of identifiable performance targets, lack of clear business case and lack of clarity about plans to evaluate the success or failure of the strategy."

In the late 1990s, following these missed opportunities, and after many discussions at the government level, a private meeting was held at 10 Downing Street on February 18, 2002 chaired by Prime Minister Tony Blair and that included Microsoft CEO Bill Gates (Campion-Awwad *et al.*, 2014). During this meeting, attendees agreed that a centralized IT approach to Great Britain's National Health Service (NHS) was the best solution to enable information and information systems to be better integrated and linked with each other across Great Britain (Collins, 2003). Following this meeting, Great Britain's National Programme for IT (NPfIT) was launched by the NHS in June 2002 making it the largest public sector IT project yet in the U.K., given its scope (the five health authorities mentioned above) and its budgeted overall cost of £6 billion. The NPfIT was intended to create an online portal that would allow citizens to access personal health information such as test results, x-rays, and summary care records (Syal, 2013). The platform was supposed to automate all patients' health information and enable patients and doctors to book appointments, fill out electronic prescriptions, and otherwise share information.

4.3.2. The Project

The NPfIT started in June 2002 as a mega-scale, complex Health IT project that was supposed to develop a unique integrated system connecting patients through a digital medical record with physicians, healthcare facilities, pharmacies, and laboratories so that medical practitioners would have access to any patient's health information anytime anywhere. The NPfIT project was, due to its public nature, in the public eye and part of the political debate in the U.K. during the duration of the project until it started being dismantled in 2011. The press coverage continued for a few years after it was officially stopped to report on the failure

(Syal, 2013; Justinia, 2016), lessons learned (Charette, 2012), the Fujitsu battle (Smith, 2014), among others. The NPfIT had many stakeholders from patients and doctors to politicians.

The NPfIT consisted of more than 300 hospitals and health institutions across England. The project was divided into five strategic health authority regions to facilitate the implementation: North East, North West and West Midlands, Eastern, London, and Southern clusters (Campion-Awwad *et al.*, 2014).

Early on, questions surrounding the complexity of the project, concerns regarding the confidentiality of patients' health information, the lack of consultation with key stakeholders, and the need for a thorough procurement phase were brought up by the media (ComputerWeekly.com, 2007; 2008). The U.K. National Audit Office (2008) also reported on the fact that this mega-scale public health IT project was more than an IT project. It stressed that organizational and cultural changes bound to accompany this mega-scale project should be taken into account for the project to be successful. Campion-Awwad *et al.* (2014) discussed the fact that healthcare professionals were not included adequately in the development of the project. The procurement phase lacked clear conversations with healthcare professionals—future users of the systems. The public officials and technology professionals failed to understand the needs of the health profession regarding implementing a digital national health system. Future key users of the NPfIT such as doctors, nurses, clinicians, etc., were barely consulted about their needs and their ideas on how to develop the system. Instead, the government and the technology companies under contract took decisions based on what features they thought should be part of the system. As a result, the system was highly complex and not user-friendly, making it difficult for healthcare professionals to adapt and to use. It became clear early on that users did not feel committed to the NPfIT (Smith, 2011). Hendy, Reeves, Fulop, Hutchings, and Masseria (2005) stated that the sociocultural challenges in the implementation of the NPfIT were as difficult as the technical and logistical ones. The project experienced several types of problems and concerns that led to conflicts, delays, changes in leadership, changes in suppliers, privacy concerns, etc. For instance, there were procurement concerns due to haste that engendered overriding concerns, such as values and communication (Campion-Awwad *et al.*, 2014). Further, concerns started arising from patients on a national scale that questioned the mandatory nature of the NPfIT (Cross, 2006) and the confidentiality of their health information. Many started to use their right to opt out of the system and have their records shared among health practitioners. One of the reasons was the lack of information that patients received on the sharing on how and which information would be shared. Cross (2006) stressed that one campaign was devoted to reassuring patients on the security of their health information especially on the fact that such a centralized system with only one access point to the patient's record was highly secured and any unauthorized access would be detected right away. These concerns became serious and generated conflicts.

When the NPfIT was launched, vendors were contracted to implement the project in the various regions. Four technology companies (BT, Accenture, CSC, and Fujitsu) were contracted to cover the five health authority regions, which made interoperability challenging (Campion-Awwad *et al.*, 2014, pp. 20–21). They were hired based on their qualifications to implement the system quickly and not work on detailed specifications with the idea that details would be handled as needed and not planned in

advance (Smith, 2011). Richard Granger was appointed Director General of the project in September 2002. He had extensive consulting experience in public sector IT projects and his previous position was at Deloitte (Campion-Awwad *et al.*, 2014). He made it a point to go through the procurement process as fast as possible. He managed to set up all the contracts in about a year, which is unusual for a public project of such a scale (Smith, 2011). His implementation agenda was proven to be unrealistic (Campion-Awwad *et al.*, 2014). Handling the procurement phase at this pace meant that the requirements of the project were not well understood and vendor choices not always thought through. A few months into the NPfIT, conflicts arose between NHS and some vendors. Soon after, some vendors started leaving the project. For example, just over a year into the contract (in 2004), British Telecom left, and Accenture/iSoft left in 2006 (Sessions, 2008). Further, from early on, there were issues between the NHS and Fujitsu. In 2002, Fujitsu won the contract to digitize medical records. Disagreement appeared between the NHS and Fujitsu soon afterwards about changes including a new system for electronically displaying and storing X-rays (Smith, 2011). After years of disputes, the contract was fully terminated in 2008. However, the disputes between the government and Fujitsu did not end in 2008 but continued until 2014 when Fujitsu eventually won the battle in court arbitration and was awarded about £400 million in compensation in addition to what was already paid in the past (Smith, 2011).

Hendy *et al.* (2005) studied the implementation of the NPfIT early on and recommended that the NPfIT address four key issues: 1) lack of trust of the stakeholders in the success of the project; 2) the methodology for implementation; 3) the timetable for implementation, which seemed unrealistic; and 4) the need for better explanations of the benefits of the project to the staff going through the changes mentioned above, as it was observed that rushing through the procurement phase led to an unrealistic timetable that in turn started creating doubts about the success of the project. Also, key stakeholders were not consulted on what their needs were when it came to digitizing medical records. This generated a lack of commitment to the project by the medical profession and additionally many patients started worrying about security and privacy issues and decided to use their right to opt out of the program. Campion-Awwad, Hayton, Smith, and Vuaran (2014) identified three main themes that can explain what went wrong with the project: 1) haste, 2) design, and 3) culture and skills (p. 3). Not taking the time to think the project through generated an unrealistic timetable, failure to test the system, etc. The design of the project made it difficult to recognize the limitations of the project or confidentiality issues inherent to a healthcare IT project. Culture and skills means for instance that there was no clear leadership, little or no concern for privacy issues, etc.

4.3.3. Outcome

The NPfIT began dismantling in 2011 into separate component parts and eventually officially ended in 2013. The projected cost was £6.4 billion; however, that cost increased greatly due to poor planning. With approximately £10 billion already spent on the abandoned project, it created one of the costliest project failures in the history of ITs (Syal, 2013). Taxpayers continued to pay transition and exit costs during 2013 and 2014.

More than a decade later, only one small section of the intended use of the NPfIT fully functions: the Summary Care Records (SCR). An SCR is an electronic record that centralizes key patients' health information. Currently, more than 94% of

the population of England holds an SCR that can be accessed by medical professionals twenty-four hours a day, seven days a week. Further, since April 2015, all GPs should offer their patients online access to summary information of their GP records. Other aspects of digitizing healthcare have been redirected to local solutions. Further, in April 2016, the NHS director of digital technology Beverley Bryant confirmed that contracts signed during the NPfIT and still ongoing will be funded up to 2020 to enable a better transition (McBeth, 2016).

5. FINDINGS

We make use of the rich amount of information collected on the three projects and perform a comprehensive case analysis with a bottom-up approach. When the ecosystem view is employed, researchers aim to identify key actors and examine their interactions before drawing useful conclusions (Karhu *et al.*, 2009; Briscoe, 2010; Purao & Desouza, 2010; Becker *et al.*, 2011). Taking the same approach, our first step for each project was to identify and examine a list of stakeholders and their interactions within the ecosystem. After a thoroughly analysis of each project ecosystem was conducted indepdendently, we extracted common issues that cut across the three mega-scale IT projects and the ecosystems in which they operated.

5.1. Species influencing the success of each project ecosystem

In all three cases, several stakeholders (species) levied significant influence on the project outcome. Ecologists have assigned roles to different species in an ecosystem, e.g., the keystone species—the species that is the most critical in maintaining the biodiversity and the survival of the entire ecosystem (Mills *et al.,* 1993). We found these roles are analogous to the roles of stakeholders in the project ecosystem. We will next discuss the role of each species and its interactions with other species in the ecosystem.

5.1.1. The Keystone Species: Public Agency

First and foremost, the public agency is the "keystone species" of each project ecosystem—the effective management of which determines the direction of the entire ecosystem (Purao & Desouza, 2010). The literature on digital business ecosystems suggests that in an ecosystem involving multiple stakeholders, it is common for one or more companies to act as the keystone species of the ecosystem and take responsibility for setting the vision and direction for all stakeholders to follow (Moore, 1993). In the three cases, the public agencies assumed the role of keystone species and failed in this regard. Each project was initiated and accelerated hastily due to a number of political, social, and economic concerns. Developers of HealthCare.gov worked feverishly to get the project underway and developed. The project was born out of a very divisive political fight about healthcare reform that was still ongoing and snagged with various legal challenges, political criticisms, and media attention. They had only three years to interpret the law, gain compliance from insurers, states, agencies, and other stakeholders, delegate work to contractors, and develop the website with the knowledge that pushing the deadline back was not an option.

The FBI's intentions of improving their systems were accelerated after September 11. Due to public fear for national security, the FBI pressed on with contractors and work plans that they knew were not working—all to maintain the image of being

productive. The hasty beginnings also led to flawed implementation strategies. Implementation strategies reflect an overall agency plan on how to design, develop, and execute a project. None of the projects had a strong implementation strategy, which was the reason for so much risk and waste. For instance, the NPfIT procurement phase was rushed through, which led to a misunderstanding of the requirements of the different stakeholders. In addition to the initial setup of the ecosystem, as the keystone species the public agencies also carry the duty of monitoring the state of the ecosystem, especially, performance of other species such as the ecosystem engineers (contractors). As illustrated in the next section, the agencies in these cases often failed to monitor and respond to underperforming contractors.

5.1.2. Ecosystem Engineers: Contractors

Contracting is the most important way that the government outsources work (Dille & Söderlund, 2013). The contractors are the "ecosystems engineers" of each project ecosystem that are responsible for building the ecosystem environment (Purao & Desouza, 2010). For the three projects, contractor relations contributed greatly to project failure. In the case of the ACA, the project was deeply fragmented. For instance, Northrop Grumman, Deloitte LLP, SAIC Inc., Rand Corporation, General Dynamics, Booz Allen Hamilton, MITRE Corporation, Vangent, and PriceWaterhouseCoopers all won contracts with the government to develop pieces of HealthCare.gov. The fragmented nature of development was not entirely the contractors' fault. Employees at CMS decided to take on roles such as lead integrator of software, a role traditionally contracted to an experienced business. Efforts were made haphazardly by many contractors and without sufficient guidance or access from CMS and HHS. These efforts were detrimental to the working relationships between the contractors and agencies as well as to the outcome of HealthCare.gov. CMS' relation with their contractors was inconsistent throughout. Some contractors received contracts to build significant portions of the website, but lacked access to critical information because public agency leadership failed to provide it.

In order to implement NPfIT the British Labor Department for Health signed contracts with four main vendors: British Telecom, Fujitsu, CSC and Accenture. The vendors were divided by clusters and by projects and were in charge of projects that were spread out on one or more clusters. For instance, British Telecom was in charge of the implementation for London cluster services (Campion-Awwad *et al.*, 2014). The vendors were chosen because of their ability to expedite the procurement process at the request of the head of the program (Smith, 2011), which soon caused problems: the requirements were not well-defined and the choices based on those requirements were not fully thought through. The haste in the procurement phase did not allow for proper communication and consultation with the hospitals, clinicians and patients who were to eventually become the end users of the NPfIT (Campion-Awwad *et al.*, 2014).

In order to implement the VCF, the bureau chose two different contractors: DynCorp and the Science Applications International Corp (SAIC). The task orders were awarded under the Millennia contract, an IT services vehicle overseen by the General Services Administration (GSA), and set on a three-year time frame (Emery, 2001). In the wake of the September 11 attacks, FBI director Mueller instructed the project to be put into overdrive and completed "as soon as technically possible" (Marchewka, 2014). This resulted in the project being placed on an accelerated 22-month timeframe. SAIC agreed to deliver the system

by December 2003 and DynCorp agreed to deliver hardware by July 2002. However, DynCorp didn't deliver until April 2004 due to difficulties migrating email networks off legacy systems. SAIC delivered an initial VCF system on time, but it was riddled with deficiencies. SAIC's inability to correct such errors, combined with a recommendation to the project leaders from an independent reviewer (Aerospace Corp.) to pursue a commercial off-the-shelf solution, led to official project termination in April 2006.

In all three cases, as the ecosystem engineers, the contractors struggled to achieve an accurate estimation of the amount of "engineering" they will need to perform for the ecosystem. Underestimation of the work required lead directly to the contractors' inability to deliver their components of the system on time, on budget, and on scope.

5.1.3. Specialist: Politicians and Legislatures

Politicians are officials elected to represent their constituents. They include the president, the prime minister, governors, and members of federal and state legislatures. Their role in all three projects was specific and significant, representing a specialist species—a species occupying a unique ecological niche in the ecosystem. Politicians, especially through the power of the legislatures, leveraged their influence and political capital on other stakeholders in the development of each project. For the ACA and HealthCare.gov, initiating the project was a monumental and highly divisive political process. The president set the healthcare reform agenda and guided the development of the ACA while members of Congress actively debated for or against the new law. For the VCF, the decision to initiate the Trilogy Project was largely an internal decision. Politicians did not truly enter the fray until after 9/11 and passage of the PATRIOT Act, when significant efforts were underway to secure the country's safety. By that time, the FBI had already developed its project but the VCF was given more "teeth" by its political supporters. For the British government, the decision to initiate the NPfIT came from a need to reform an outdated healthcare system with the promise to make it one of the most sophisticated paperless systems in the world.

Politicians also helped to create political overtones that drove each case's narrative. For the ACA, two factions of Congress emerged during the developmental stages of HealthCare.gov: one faction was adamantly opposed to the ACA and sought to have it defunded, and another wanted to see the ACA move forward. The rhetoric surrounding the law shaped much of the narrative of the ACA and HealthCare.gov. This narrative was largely one of mistrust and too much government power (Le, 2013). For the NPfIT, many politicians viewed the decision as rushed and as a campaigning tool for the next elections for Tony Blair (Campion-Awwad *et al.*, 2014). The meeting held at 10 Downing Street on February 18, 2002 chaired by Prime Minister Tony Blair and that led to the decision to launch the NPfIT is reported to have lasted 90 minutes and not to have addressed past issues encountered in public health IT projects (for instance the 1992 and 1998 IM&T failed strategies) at their core but rather to choose to impose an unwelcome change to the health system (Campion-Awwad *et al.*, 2014). Conversely, for the VCF, the tone was considerably more supportive and patriotic. Congressional voices like then-Senator Joe Biden (D-DE) offered context for the law the day before it passed, stating in an October 25, 2011 press release that "[t]he anti-terrorism bill allows law enforcement to keep up with the modern technology these terrorists are using." The tenor of discussion left no room for alternatives, and

the FBI's Virtual Case Files project found itself positioned in the early stages of an overhaul with a congress that could not support its mission more strongly.

In each case, the politicians and legislatures focused primarily on one dimension of their role of specialists: the *policy* dimension, i.e., setting the rules for governance and interactions among species in the ecosystem. However, they overlooked or ignored the other crucial dimension of their speciality: the *monitoring* and *evaluating* dimension. Once the initial setup of the ecosystem is completed, they failed to monitor how those logical ideas, regardless of political support, were being implemented throught the various administrative actions around the IT projects.

5.1.4. Specialist: Media Outlets

Media outlets occupy another unique niche in the project ecosystem. They are not immediately responsible for the success of the ecosystem, yet they perform the crucial task of monitoring and broadcasting the system's health. Through the published news reports and stories, the media had direct influences on the way members of these projects chose to act. Throughout the development and implementation of the ACA, the media published a breadth of stories. Some were rigorous and provided non-partisan factual information, while others reported biased information driven by political agendas. For instance, in February 2014, the nonpartisan Congressional Budget Office (CBO) released a report on the ACA entitled "Labor Market Effects of the Affordable Care Act" where they projected that there would be a reduction of hours worked by individuals resulting in the decline of full-time-equivalent workers of about 2.0 million in 2017, rising to about 2.5 million in 2024 (Congressional Budget Office, 2014). Most media outlets initially misreported the story by zeroing in on the part about the reduction in the workforce, but failing to mention that the CBO's projected findings were tied to the *chosen* number of hours worked, rather than a representation of actual job losses. While some outlets corrected their misreported stories to state the true nature of the CBO's report after they realized their inaccurate reporting, others maintained the same misrepresentative claim (Gold, 2014). For NPfIT, the media started reporting more on the project when problems started arising a few months into the project, informing that vendors started to leave or that confidentiality concerns were brought to attention (Campion-Awwad *et al.*, 2014). For the VCF, the FBI's image was tarnished prior to the initiation of the Trilogy project. The September 11 attacks directed a flurry of media attention at the bureau. The FBI's inability to effectively share basic information became more and more of a problem. Criticism continued throughout the implementation of the Trilogy project. The media was once again critical when the VCF was abandoned in 2005. An article in The Washington Post asserted that the VCF's failure "stemmed from failures of almost every kind, including poor conception and muddled execution of the steps needed to make the system work, according to outside reviews and interviews with people involved in the project" (Eggen & Witte, 2006).

5.1.5. Natives: Citizens

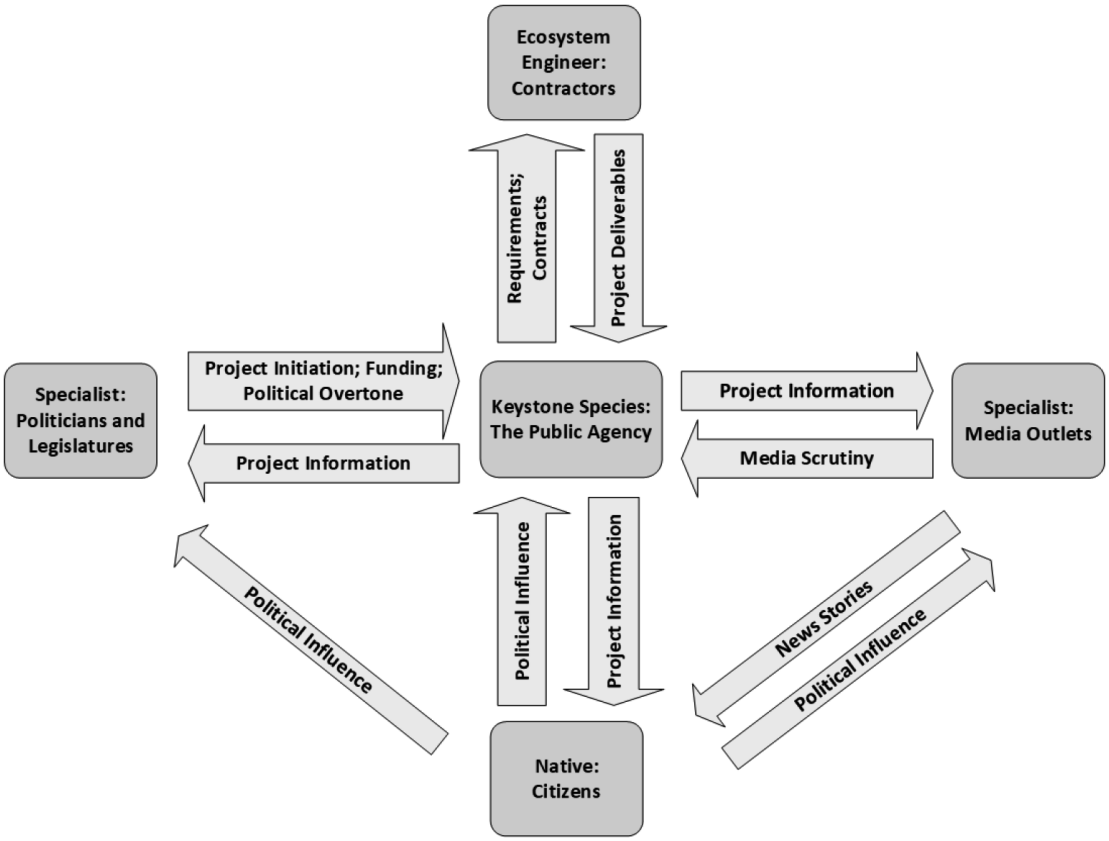
Citizens are the highly influential voting populace that elect politicians, view the media, advocate through their actions, and pay taxes, who ultimately fund the public sector IT projects. As the permanent residents of the geographic region these public IT projects aim to serve, citizens are the native species of the ecosystem.

Public sentiment can change the direction of the project at any time. First, as project stakeholders, citizens were activists or supporters. In the case of the ACA, activists in favor of and opposition to the bill included nonprofits, think tanks, political action groups, lobbyists, wealthy citizens with high political influence, and insurers. Activists not in favor of the ACA, for example, Charles and David Koch—known popularly as the Koch brothers—spent a significant amount of their money and political capital to repeal and defund the law (Schouten, 2013). For the VCF, citizens were vocal about wanting more security post 9/11, but few mentioned the VCF directly.

Second, citizens as taxpayers had an expectation that their tax dollars were being used efficiently and effectively. Citizens are "the public" that stakeholders such as politicians and the media work so hard to persuade. Efforts through the news, social media, and commercials were all made to sway public opinion. For the NPfIT as the project escalated, the media started writing about the concerns emerging from the management of the NPfIT. Citizens became aware of the problems and of the monetary impact of the project escalation.

The following diagram (see Figure 2 below) illustrates the interactions and inter-relationships among the species of the project ecosystems, with the keystone species (public agency) at the center stage. Each arrow in the diagram represents the resources and information one stakeholder provides to another, and/or the influence it has on the other stakeholder. These flows of

Figure 2: Species and Interactions within a Mega-scale Public Sector IT Project Ecosystem.



resources and information capture the most crucial interactions among these species.

5.2. Major failures in the project ecosystem

Building on the analysis of the events that unfolded and stakeholders' actions taken during each project ecosystem's failure, we extracted several major issues common to the three projects that contributed to the failure. The first few issues revolve around the public agencies' failure as keystone species for the project ecosystems.

5.2.1. Failures in the public agency's performance of the role of keystone species

Failure in hiring key personnel with proper knowledge and experience

From the perspective of knowledge management, a large IT project embodies a network of individuals that transfer and exchange explicit and tacit knowledge for the benefit of the organization (Briscoe, 2010; Li *et al.*, 2012). Effective flow of knowledge within the ecosystem requires highly qualified individuals occupying certain positions to serve as key nodes in the network (Briscoe, 2010). The three cases demonstrated that the failure of the projects could be partially attributed to dysfunction in the knowledge ecosystem. The cases exemplified several instances where the expertise of underqualified individuals was scaled up to fit the size and scope of the project. For instance, HealthCare.gov had leaders and managers that were highly regarded in matters of health reform and public administration but not the required technological knowledge.

In these projects, leaders did not seek out advice from the experts within the IT departments of their own organizations when making technology decisions, even when they weren't equipped to make such decisions. The decision to serve as the lead systems integrator for the entire HealthCare.gov website was a poor choice made by CMS and HHS. After the project collapsed, the tech surge was proof positive that, internally, neither agency had the expertise to adequately manage the project. For the FBI, once the VCF was a known failure, there were reports of the FBI's continued mid-stream project modifications and continued acceptance of missed deadlines and cost overruns. For the NPfIT, the haste with which the implementers wanted to conduct the project led to rushed decisions without sufficient consultation of experts and stakeholders.

Failure in responding to early signals alerting the impending implosion of the project ecosystem

Detecting early warning signals of an impending collapse of a natural ecosystem has been a persistent yet elusive goal for scientists (Carpenter *et al.*, 2011). There are usually indications of impending failures that can be detected before the failure occurs (Purao *et al.*, 2012) that should enable the organization to intervene to prevent or minimize the damage. Bartis and Mitev (2008) showed that different stakeholders have different interpretations of a system during the implementation phases which leads to different problems because success or failure of the project is understood differently by the stakeholders. In the case of the three projects, the projects were in crisis well before they failed. Unfortunately, the projects had no contingency plans. The implosion occurred when there were little to no appropriate actions to remedy the failures. Hensgen *et al.* (2003) note the importance of staying alert to crisis signs and signals in a project in order to allow for "self-correction" (p. 193). They identify two types of signals that would alert managers to crisis: *mechanical alarms*, which are

technological triggers, and *human technology*, which are organizational personnel that alert organizations to problems.

In the case of HealthCare.gov, human technology would be the signalers of crisis. The teams assigned to HealthCare.gov were wrapped up in projects they were ill equipped to handle. Arguably, the teams had a fear of signaling the crisis flag due to external constraints. The short window of time, many moving parts, and extreme political pressure on HHS and CMS were palpable. Some individuals involved could see what was coming, but there was no time to stop it unless the website launch was pushed back. In the case of NPfIT, human technology would also raise the alarm to problems. In 2008, the National Audit Office alerted that for the project to succeed, NHS needed, in addition to the technology in place, to change its organizational culture. This suggested approach, which was more socio-technical, was not adopted. Another signal occurred when in 2004, conflicts between two of the contractors, Fujitsu and British Telecom, could not be resolved and they both left the NPfIT project just after over a year into the project. The VCF project team continually allowed the contractor to push back due dates. There were instances of the project development team holding up progress. There is no evidence of anyone acting rationally enough to create a human technology alert sufficiently loud to substantively help the project. However, just having a human technology signaler wouldn't have been enough. There were ample warnings from the state of the software for each project that should have let leaders know that the projects were heading toward failure.

5.2.2. Flawed relationships among species in the project ecosystem

The interactions and inter-relationships among stakeholders are a defining characteristic of an ecosystem. Dysfunctional relationships among key species or stakeholders in any ecosystem could trigger the collapse of the system.

Severely flawed relationships between the public agency and contractors

Considering public agencies' dependence on contractors to carry out the actual development tasks, the relationships with the contractors are arguably one of the most critical in the ecosystem (Dille & Söderlund, 2013). In the three cases, the relationships with contractors were severely flawed in unique ways. For example, the relationship between HealthCare.gov contractors can be best described as fragmented contractor management. Due to the infighting within CMS and HHS, there were various controls driving contractor relationships and decision-making, making contractor guidance inconsistent. For the NPfIT, two contractors left the project a year or so after the project started. The relationships were not managed properly until it was too late. The FBI was still brainstorming ideas throughout the project and the VCF contractors were given too much latitude to perform unnecessary work and miss deadlines. The FBI was locked into a contract that greatly benefitted their contractors when holdups happened. For instance, the FBI's contracts also stipulated that if the project time frame was lengthened or the contractor incurred unforeseen or additional costs, the FBI would pay those costs too (Goldstein, 2005).

Flawed relationship between the legislature and the public agency

By providing funding to the public agency for a public IT project, the legislature serves as the direct source of resources for the ecosystem. It is known to ecologists that a natural ecosystem starved of resources can fail; on the other hand, an overabundance of

certain resources can also lead to a disaster. What we have observed in these projects exhibits the same relationship: both the severe overfunding and underfunding of a large public IT project can contribute to its problems.

HealthCare.gov had significant money issues, as the ACA was underfunded for political reasons. The Congressional Budget Office projected it would cost between $5 billion and $10 billion to implement the law. HHS only received $1 billion for general implementation work. The NPfIT was initially granted the £6.4 projected cost and ended up costing £10 by the time it was abandoned. For the FBI, Congress approved $379.8 million to be spent over three years and then approved an additional $201.2 million as the project stretched to five years, increasing the project cost to $581 million (Kerzner, 2014). The overfunding and the underfunding reflect the strong hold that legislature can place on a project. In the three situations, the effects were damning and contributed to failure.

6. DISCUSSION

6.1. Limitations

As with any research that builds on analysis of specific cases, the generalizability of the findings is limited, considering the unique settings of the three projects investigated. The three projects are components of a nationwide IT initiative in an English-speaking country. Additional insights are needed regarding the success or failure of mega-scale IT projects in other areas of public interest (e.g., public education, national security, etc.), at different governmental levels, under different political and cultural contexts.

The methodology also limits our ability to assess the strength of relationships among specific research constructs or make any causal inferences. Statistical analysis of a larger sample of similar projects would be required for such purposes. Additionally, the present study only utilized information publicly available on the three projects. While the public sources provided sufficient data for our analysis of the three failed projects, first-hand data (e.g., interviews with key managers) would undoubtedly enrich our understandings of the internal struggles during project implosion.

6.2. Concluding remarks and suggestions for further research

The three mega-scale public sector IT projects studied in this research proved themselves to be complex ecosystems. These three projects operated in different ecosystems, for example, supportive vs. hostile ecosystems. This key distinction could imply that these projects should have seen different outcomes based on the ecosystem attributes, for example, it could be argued that a project conducted in a supportive ecosystem would see a more successful outcome. Yet, as we show in this paper, they all suffered from similar issues that led to project failure. One similarity shared by the three projects is that the issues were on the extremes. For instance, whether too much funding or too little, too much scrutiny/support or too little. These, being extremes, challenged and put the ecosystem out of balance, which in turn impacted the IT project.

Our findings further demonstrated that these projects shared significant characteristics with natural ecosystems with flawed interactions among species. When mega-scale IT projects are being developed, a variety of stakeholders engage with one another, such as contractors, lawmakers, the

public, the media, and public employees, to create the project outcome. When failure occurs, it is an outward manifestation of the inability of the public agency to perform its role as keystone species for the ecosystem, and flawed relationships between the public agency with other species in the ecosystem. Our study also contributes to the project management literature by providing further evidence supporting the notion that environmental factors exert critical influence on large-scale inter-institutional IT projects (Kadefors, 1995; Engwall, 2003; Dille & Söderlund, 2011).

Our study suggests several directions for future research. There exists an almost infinite number of natural ecosystems vastly different from each other. Likewise, large-scale IT projects vary on many dimensions, such as those discussed in the introduction. Further, projects could be originated by different levels of government, and require different levels of technological intensity. Additional studies of cases under different settings—of both failed projects and successful ones—will help build knowledge around different types of IT project ecosystems that vary in their ability to react to crises. The exploratory explanations for public IT project failures we proposed should be further developed into research models with testable hypotheses and operationalization of constructs, and verified empirically.

In our application of the ecosystem view, we generally take a holistic view of the public agencies while focusing on their interactions with stakeholders external to the agencies. Within a public agency, a multitude of self-interested actors form a network of interactions, creating complex dynamics that impact the outcome of the project (Dille & Söderlund, 2011; Janssen *et al.*, 2015). Our discovery includes useful observations and suggestions regarding internal project management practices, for example, the importance of filling key positions with personnel with sufficient technical expertise. However, as dynamics change and the level of technology intensifies, further research is needed. In particular, insights into the internal dynamics of the project team within a public agency will lead to practical guidelines for managing a large public IT project, and insights into better theorization, policy guidelines, frameworks, and cases to be used for educational purposes.

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