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LESSONS LEARNED FROM A BUSINESS OWNER'S RISK ASSESSMENT OF CAPITALIZED INTERNAL SOFTWARE DEVELOPMENT PROJECTS

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ABSTRACT

This study shows how a projectized U.S. Telecom company achieved cost savings by leveraging their capital expenditures (CapEx) process for treating capitalized internal software development (CISD) projects. The company provided data access to 200 completed CISD projects to conduct this study. Twelve independent variables selected based on risk factors from the business owner's perspective and prior studies. Capitalized Labor, Vendors and Work In Progress Days were significant predictors of project delays while nine remaining variables were not. This study indicates that factors important to business owners can be used as a standardized risk instrument in assessing software development risk.

Keywords: business owner; software development; capitalization; critical success factors; financial risk; capitalized labor

INTRODUCTION

The U.S. telecommunications industry will have reached a market size of $1.3 trillion dollars (Marketwired, 2016). Given a market size on pace to pass a trillion dollars in the next two years, it can be easily substantiated that competition in the U.S. Telecom industry is very intense. This intensity translates into U.S. Telecom companies scouring their cost structures for any cost savings that can be passed on to pricing, products and service differentiation segments of their business models (Hill & Jones, 2009; Porter, 1985). This strategic action of passing cost savings to other segments of their business model is common practice among U.S. Telecom companies as one of the ways to remain competitive (Goldman, Knable Gotts, & Piaskoski, 2003; Kaplan & Norton, 2008; Porter, 1985).

This study shows how a projectized U.S. Telecom company in 2005, achieved cost

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savings by leveraging their capital expenditures (CapEx) process related to the treatment of capitalized internal software development (CISD) projects. This study looks at how this company treated CapEx within CISD projects as a framework for risk assessment. In simple terms, CapEx are expenses that originates within an organization's business model and are capitalized or the expenses are depreciated (Yang, 2014). There are three significant characteristics of CapEx related to CISD projects that this study will discuss in detail.

1. Capitalization, whereby a fraction of the cost is expensed against revenue periodically.
2. Convergence between the functions of project management and financial risk assessment performed by the project manager (PM) and the business owner respectively.
3. The key critical success factors (CSFs) and the control and monitoring of financial and business risks as a risk assessment measure.

CISD projects are projects that result in development of software for the sole use by the organization, not intended for resale. There are small numbers of cases whereby internal software is used as a platform for the deployment of other software intended for resale. However internal software developed as a standalone doesn't generate revenue for the organization.

The need for CISD projects in U.S. Telecom companies are critical to their ability to render quality telecommunication services to customers (Bohlin, Caves, & Eisenach, 2014; Kim, Lee, Ahn, Ahn, & Ku, 2008). In addition to the delivery of quality to customers, CISD projects are a vital part of the network infrastructure expansion and delivery of new features which fosters competition (Aroudaki, 2012; Dobardziev, 2005; Harno, 2009; Malisuwan, Tiamnara, & Suriyakrai, 2015). Along with aforementioned benefits of quality and services, is the responsibility to monitor and ensure transparency between CISD projects cost and the impact of financial and business risks. As it pertains to the U.S. Telecom company is this study, the responsibility for transparency of CISD projects cost and the monitoring of financial and business risks are shared between the PMs and the business owner.

The role of PMs in this study were to plan, identify and mitigate, if necessary, the risks to the CISD projects within the four project constraints of time, cost, performance, and scope (Heagney, 2012). In event of risk occurrence, it is reported to the business owner in a timely manner so that decisions can be made concerning the financial impact to the company's balance sheet (Lanza, 2002). Business owners, as defined in Procaccino (2002) are considered to be senior executive management whose functions range from providing political support for CISD projects, to the assessment of business risk on the company's financial risk and conversely as well (Abascal, Eduardo, 2012; Li, Hsiaob, & Li, 2015).

In the case of the publicly traded U.S. Telecom company in this study, origins of financial risk reside in the capital structure mix of debt and equity. In terms of debt, the issuance to raise funds for projects and the measure of that debt to the company's assets value, represents financial risk (Abascal, Eduardo, 2012; Li et al., 2015). The impact of capital structure on the volatility of future earnings is directly related to business risk (Abascal, Eduardo, 2012; Li et al., 2015). The volatility of future earnings is attributed in part, to U.S. Financial Markets' reaction to telecom companies who announce future increases in CapEx spending; this signals future revenue growth and increased earnings per share (EPS) to market investors (A. Jones, & Hammad, 2017; A. H. Jones, 2011; B. Smith, 2007; C. Jiang, Chen, & Huang, 2006).

For business owners it is very important to monitor the use of capital raised— especially from the issuance of debt. The aim of business owners are to reduce the business risk by ensuring CISD projects create assets that facilitate revenue and support functions of the organization (Hill & Jones, 2009; Porter, 1985). Business risk is premised on the fact that it affects financial risk (Abascal, Eduardo, 2012; Li et al., 2015). This study is premised on this fact as well; whereby the business risk is represented by the CISD projects undertaken. The financial risk represents the uncertainty of CISD projects cost, which initially resides on the balance sheet as CapEx, but could potentially become operating expenses due to project failure.

Contrary to the PM's role in managing CISD projects, the business owner must deal with a legal dimension of CISD projects that transcends the organization into the area of U.S. Financial Markets' integrity. For the business owner there are legal consequences, criminal in nature, for capitalizing operating expenses, post Sarbanes Oxley (SOX) Act of 2002, in the U.S. (Volz & Tazian, 2006; Wilmer, Cutler, & Pickering, 2003). As a result of this legal dimension, the business

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owner's role in managing CISD projects requires extensive and burdensome monitoring and control of capitalizable cost. The burdensome aspect is due to the mix of capitalized and non-capitalized project activities typically embedded in the application stage of CISD projects (Financial Accounting Standards Board, 1998).

The cost of the capitalized activities are recorded to a construction in progress (CIP) account located on the balance sheet as assets that are not yet placed in service or begun depreciation. The CIP account is a holding account for all CapEx to include CISD project cost related to capitalized activities. Once a CISD project is deployed or the test and transitioning phase is completed, the cost that reflects capitalized activities are moved out of the CIP account into other assets categories on the balance sheet signaling that the asset is in service and capitalization begins. Capitalization of a CISD project means that capitalized cost can begin depreciation and that all phases identified in the application stage are completed (Financial Accounting Standards Board, 1998). A key point that will be elaborated on later in this study is the difference in the meaning of deployment of CISD projects for PMs and the business owner.

Prior to the wave of corporate malfeasance cases in the U.S. between 2001 and 2009, and the adverse affects on U.S. Financial Markets, capitalization of CISD projects did not require extensive monitoring and control (Nixon, 2015). However, one case marked a shift in U.S. government regulations requiring extensive monitoring and control of capitalization was WorldCom. In WorldCom's case, the company was capitalizing operating expenses to show favorable earnings per share (EPS) which led to the inflation of its stock price (Wilmer et al., 2003).

To better understand the financial benefit of capitalization afforded publicly traded telecom companies with CISD projects, lets hypothetically assume the following example:

1. A PM has been awarded a CISD project with a budget of $3 Million.
2. $500,000 out of the $3 Million budgeted represents capitalized cost incurred over 90 days during the application phase of this project.
3. The PM notifies the business owner that the application phase of the project is completed.
4. The PM's company is publicly traded with 500,000 shares of common stock

outstanding at the end of the 90-day period.

5. The business owner uses a three year (36 months) depreciation schedule for all CISD project cost..
6. The company recognized $2 Million in revenue at the end of the 90-day period.
7. The cost of services (COS) and all other operating expenses are $600,000 and $200,000 respectively.

Given the information in this hypothetical example, **Ref Table I** shows two basic 90-Day Income Statements. The two income statements show two scenarios that highlight the effect on earnings per share (EPS) if the business owner capitalize the $500,000 in cost during the application phase (Scenario 1) versus not capitalizing it (Scenario 2).

In Scenario 1, the company benefits from a significantly higher EPS of $2.32 by capitalizing the CISD project cost of $500,000 incurred during the application phase[1]. Scenario 2 shows an EPS of $1.40 which represents the total CISD project cost incurred during the application stage of $500,000 included with All Other Expenses[2].

The drawback to the benefit of capitalization afforded CISD project cost as shown in the hypothetical example in Table 1, is the risk due to project delays and the repercussions thereof. Business owners faced with delayed CISD projects must make the decision whether to expense the entire CISD project cost in the application phase or continue to hold the cost in the CIP account as an asset not yet in service[3]. However at some point, the CISD project cost must be transitioned out of the CIP account and into a depreciation expense account or an operating expense account that reflects the entire CISD project cost incurred. In either scenario, the business owner must make a decision which ultimately impacts EPS positively or negatively.

The goal of the business owner is to have the CISD project completed successfully without delay and receive the benefit of a capitalization. However, if the CISD project is delayed, this puts the business owner in a difficult position of deciding to keep the

[1]The CISD Project Depreciation is: ($500,000/36 months) x 3 months = $41,667.
[2] All other expenses in Scenario 2: $500,000 + $200,000 = $700,000.
[3] CISD project cost in the CIP account represents cost of assets not yet in service or depreciation has not started.

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capitalizable cost in the CIP account and risk the possibility of the following outcomes should the CISD project fail:

1. Reporting operating expenses as assets (H. J. Smith & Keil, 2003).
2. Capitalizing operating expenses, as in the case with WorldCom (Wilmer et al., 2003)[4].

The business owner's standard operating procedure in this study was to assess the cause of delay before making the decision to report the entire CISD project cost against the company's revenue. The process of assessing the impact of this business risk on the company's financial risk hinged on CISD project information provided at the onset for capitalization approval, and the PM's ongoing project status reports (Keil, Smith, L. Iacovou, & L. Thompson, 2014; Lanza, 2002). It is from this assessment by the business owner, and lessons learned from the outcomes of prior closed CISD projects, this study presents the first of two questions.

1. Can the business owner's risk assessment of CISD project costs be used to mitigate project failures?

In the next part of this study critical success factors are discussed as contributors to lessons learned from the outcomes of prior closed CISD projects. The critical success factors are discussed primarily from the PM's perspective in prior studies (Boghossian, 2002; J. J. Jiang, Klein, & Ellis, 2002; Lagerstrom, von Wurtemberg, Holm, & Luczak, 2012; Procaccino, 2002; Purna Sudhakar, 2012). The critical success factors mentioned in prior studies are used in conjunction with a clear depiction of the capitalization process executed by the U.S. Telecom company in this study. An alignment is performed between the key critical success factors from prior studies, and key inputs in the capitalization process executed by the U.S. Telecom company in this study. These key inputs from the capitalization process that align with the key critical success factors highlight the convergence between the roles of the PM and the business owner mentioned earlier. It is from this alignment between the key inputs in the capitalization process and the key critical success factors from prior studies that the second question originates.

[4] In accordance to FASB's SOP 98-1, capitalization of internal software activities is based two determinations: 1. Do the activities create a new asset. 2. Do the activities add new functionality to an existing system.

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2. Can project managers' (PMs') critical success factors be used as a risk assessment of CISD projects to mitigate financial risk?

LITERATURE REVIEW

There is a common trait within the American corporate culture about risky projects that confuses risks accountability and defeatism (Boehm & DeMarco, 1997). Procaccino (2002) calls this confusion an emotional stigma, however in the forward written by Tom DeMarco it states,

"To do real risk management, you have to develop a deep understanding of the factors that have undone those who have gone before you." (p7)

This forward sets the overarching theme in this study. This section discusses the intertwined concepts of risk assessment and critical success factors for software development projects. Furthermore, three questions are addressed as the basis of inquiry concerning critical success factors as a risk assessment scale to mitigate financial risk in CISD projects.

1. How should critical success factors be understood in terms of probability and uncertainty?
2. What does CISD project success mean? And to who?
3. How organizational culture effect lessons does learned?

In the process of presenting CSFs as a risk assessment scale, the divergence in meaning of uncertainty and project success between business owners and PMs are presented. In the summary, the organization's cultural impact on lessons learned, the roles of organizational process assets (OPA) and enterprise environmental factors (EEF) are discussed as a prelude to twelve variables selected as the risk assessment scale for prediction of ongoing CISD projects' outcomes.

Probability versus Uncertainty

We start with a comparison and contrast between Boehm (1991), Boehm & DeMarco (1997) and Barki, Rivard, & Talbot, (1993). In Boehm (1991) a risk exposure (RE) formula for software risk management is introduced. It is premised on first-hand observations of successful PMs in several

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organizations[5] ,"...that the successful project managers were good risk managers." (Boehm, 1991, p. 33). In Boehm & DeMarco (1997) and Boehm (1991) the risk exposure formula is presented as:

$$RE = Prob(UO) * Loss(UO)$$

Where:

Prob(UO) is the probability of an unsatisfactory outcome.

Loss(UO) is the loss to parties affected if the outcome is unsatisfactory.

In contrast to Boehm's risk exposure formula, Barki et al. (1993) presented a software development risk formula:

Software development risk = project uncertainty * magnitude of potential loss due to project failure.

Barki et al. (1993) differs from Boehm (1991) on two key aspects that aligned with the business owners' perspective on the CISD projects in this study. The first aspect shows Boehm (1991) software development risk formula factors in probability as oppose to uncertainty. For the current business owners of today, uncertainty is more apparent in their assessment of software development risk because it reflects the state in which their business risk impacts their financial risk. This state is shown for business owners in the prevailing question that constantly arise, "If the project is delayed, do I continue to allow the expenses to sit on my balance sheet?" This question is not one of probability but of uncertainty.

Second, both risk formulas factor in a different number of potentially unsatisfactory outcomes. Barki et al. (1993) claims project failure as the only unsatisfactory outcome whereas, Boehm (1991) claims multiple unsatisfactory outcomes. This contrast plays a significant role in determining the statistical procedure in this study. This study follows Barki et al. (1993) claim that project failure is the only unsatisfactory outcome. By aligning with this claim, the statistical procedure best suited for treating the dataset in this study is Multiple Discriminant Analysis (MDA).

[5] The majority of the observations were conducted by Dr. Barry Boehm between 1973 and 1989 while as a chief scientist of the Defense Systems Group at TRW Inc.

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More details on MDA are discussed in the next section.

This study does not negate Boehm (1991) RE formula which factors in probability instead of uncertainty. In fact, the probability factor in the RE formula plays a significant role in this study as well, but only after the risk assessment scale is developed. The probability factor is utilized to interpret the significance of the prediction when the risk assessment scale is applied to open or ongoing CISD projects.

Critical Success Factors as risk assessment factors

Barki et al. (1993) formula is based on a comprehensive research synthesis of information systems uncertainty. As a result of the research synthesis thirty-five risk variables were selected to develop as scale to measure uncertainty in system development projects. Out of those thirty-five variables selected four aligned with business owners' perspectives related to CISD projects.

1. Need for new hardware.
2. Need for new software.
3. Number of hardware suppliers.
4. Number of software suppliers.

For the business owners' of CISD projects, project failure does not mean all expenses accrued are now fully expensed. It is common practice that the cost of equipment and labor pertaining to software code, designs, database development, and enhancements that were a part of the failed projects, are reused on other CISD projects (Barns & Bollinger, 1991; Eiband, Eveleigh, Holzer, & Sarkani, 2013; Frakes & Fox, 1996).

The four variables identified in Barki et al. (1993) scale are synonymous with the items that are capitalized under the application stage of the Statement of Position 98 - 1 Accounting for the Costs of Computer Software (SOP 98-1) document for internal software development (Financial Accounting Standards Board, 1998). The failure for business owners are seen in terms of the financial impact to the financial statements due to business risk. Therefore, for business owners it goes back to the prevailing question, "If the project is delayed, do I continue to allow the expenses to sit on my balance sheet?" For business owners of CISD projects that are delayed, this state of uncertainty constitutes failure.

Jiang, Klein & Ellis (2002) extended the work of Barki et al. (1993) by developing an instrument to measure software development risk and examine the relationship between this risk and project success. The findings showed that there was a negative correlation of -.22 between software development risk and process success using a confirmatory factor analysis (CFA) model. Jiang et al. (2002) equates this low negative finding to diametrically arranged adjectives between the software development risks and project success dimensions. There are two major conclusions to Jiang et al. (2002) which reaffirms Boehm (1991) notion that successful project managers are good risk managers and highlights the convergence of roles between PMs and business owners previously mentioned.

1. Software development risk variables are determinants of project success.
2. Project managers' understand the success of projects different than executives or business owners. The demographics included in the study showed only 14 executives out of 152 technology professionals surveyed. Jiang et al. (2002) concedes to this as a limitation when stating:

Examination of other interest groups may indicate the presence of other risk categories that would provide a more comprehensive picture of the development process, including the group interaction items dropped during analysis. (p.26)

Boghossian (2002) focused solely on critical success factors as predictors of successful software development projects. As a result of the findings based on ten companies selected, and eleven experts interviewed in Boghossian (2002), fifteen critical success factors were identified. Out of the fifteen CSFs introduced in Boghossian (2002) one, executive management support through the Product Development Life Cycle (PDLC), was highlighted as the key critical success factor.

Procaccino (2002) echoed the same findings as Boghossian (2002). Procaccino (2002) identified project sponsor's engagement throughout the project as one of four components that had the largest impact on project success. In addition to reaffirming Boghossian (2002) findings, Procaccino (2002) makes mention of the contrast between project managers and business owners while referring to business owners as senior executive management. Lagerstrom, von Wurtemberg, Holm, & Luczak, (2012) provides a clear depiction of this contrast between project managers and business owners which will be discussed later in this section.

Sudhakar (2012), unlike Boghossian (2002) and Procaccino (2002), pivots away from

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project sponsor's involvement as a key critical success factor, to factors related to managerial competencies within an organization's cost structure. Sudhakar (2012) is a research synthesis of scholarly articles between January 2011 and April 2011 that identified thirty-five critical success factors of software development projects. The thirty-five critical success factors were grouped into seven categories.

1. Communication
2. Technical
3. Team
4. Organizational
5. Environmental
6. Product
7. Project Management

As previously mentioned, CISD projects are projects that result in development of software for the sole use by the organization. In light of what CISD projects are, the critical success factors within the organizational category focused on success in other areas within an organization's cost structure as heralds to software development success. In fact one of the organizational factors of reducing the cost basis was ranked as ninth and it highlights the cost savings characteristic of CISD projects mentioned earlier. The low rank of 9th in terms of frequency of appearance in prior studies could be attributed to the demographics of the sample surveyed. The reduction of an organization's cost basis is achieved by capitalizing key costs of software projects. As previously shown in Scenario 1 of Table I, capitalization causes just a fraction of CISD projects' expenses to appear on an organization's Income Statement.

Sudhakar (2012) identified organizational factor successes as positive impacts on profit margins and budget to performance on major jobs. One of the reasons that organizational factors weigh heavy on software development project success is because these factors unify the revenue and support units within the cost structure (Jones & Alshammari, 2017). An example of this unification between the organizational factors and software development project success is an ERP implementation that brings together an organization's customers, supply chain partners, human resources, and financial accounting (Drummond, Pamella; Araujo, Fernando;Borges, 2013; Mathrani & Viehland, 2010). In fact, a huge percentage of randomly selected CISD projects for this study were directly related to an ERP implementation.

Lagerstrom et al. (2012) builds on Sudhakar (2012) factor of reducing the cost basis with thirty-one CSFs that focused on the use of function points in software development to assess cost. Duration and consultants were the two critical success factors in Lagerstrom et al. (2012) that directly related to the ultimate question that business owners of CISD projects must face, "If the project is delayed, do I continue to allow the expenses to sit on my balance sheet?" It is clear from this question that business owners' identify duration as an important determinant of success or failure of CISD projects.

Consultants as a critical success factor, is shown in the findings of Lagerstrom (2012) to have similar significant effect on the project cost as duration, but its association to duration was not highlighted given that project cost was the dependent variable in the study. However, the findings also showed that for every additional consultant increase, project cost also increased 1,000, 000 SEK[6]. This finding reflects a behavior by project managers of crashing CISD projects due in part to the addition of excessive functionality and capabilities (Amrit, van Hillegersberg, & van Diest, 2013; Buschmann, 2010; Shmueli, Pliskin, & Fink, 2015; Shmueli & Ronen, 2017). Crashing delayed CISD projects is the common solution for project managers—which translates into adding more consultants leading to increase cost. The indirect effects of crashing delayed CISD projects and increase cost brings two questions to the forefront in this study.

What does project success mean? And to who?

Heagney (2012) and Pinto and Slevin (1988) defined a project successful if it is completed on time, within budget, within scope, and the customer is satisfied with the end results. This definition of project success is at a very fundamental level of project management. However, in today's world of project management this definition becomes complex when multiple stakeholders are considered. Projects that have multiple stakeholders may interpret project success different than other stakeholders (J. J. Jiang et al., 2002; Lagerstrom et al., 2012; Suttrfield, Friday-Stroud, & Shivers-Blackwell, 2006). Procaccino (2002) premised Jiang et al. (2002) limitation of a single stakeholder as one of three factors leading to a working definition of project

[6] SEK represent the currency in Sweden. Swedish Krona

success. In Procaccino (2002) the following three factors are mentioned as a working definition of project success, which expands beyond the project manager's interpretation of success:

1. The perspective of one or more project stakeholders, influenced by culture, practices and system-related goals of the organization being asked to define success.
2. The development process and/or the resulting software.
3. The non-technical and/or technical focus.

Sudhakar (2012) defines project success in terms project management and product success. This coincides with Procaccino (2002) development process and the resulting software product factors that influence project success. In terms of the primary stakeholders in CISD projects, business owners and project managers, there is consensus on the four fundamental project management constraints being a part of this definition of project success (Heagney, 2012). Time and cost would be categorized as project management success factors, while scope and performance as product centric success factors.

In the case of Suttrfield, Friday-Stroud, & Shivers-Blackwell (2006) success of projects can be derailed due to various stakeholders' agendas. The acknowledgement of various stakeholders' agendas increases the occurrence of bad outcomes when confining the definition of project success to a single stakeholder. Suttrfield, Friday-Stroud, & Shivers-Blackwell (2006) adds credence to the first factor in Procaccino (2002) and the limitation mentioned in Jiang et al. (2002).

Procaccino (2002) categorizes technical issues as issues related to the application development stage of the SOP 98-1 document. The capitalizable phases listed under the application stage on the SOP 98-1 are coding, software design, hardware, testing and transitioning. As for the non-technical issues, Procaccino (2002) focused solely on project managers' issues related to managerial competencies needed for the project and the team. No other stakeholders are mentioned regarding non-technical issues, albeit one of the success factors in defining project success is, "The perspective of one or more project stakeholders…" (Procaccino, 2002, p. 5).

This study acknowledges multiple perspectives of project success from multiple project stakeholders (Heagney, 2012; J. J.

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Jiang et al., 2002; Procaccino, 2002; Purna Sudhakar, 2012; Suttrfield et al., 2006). However, the risk assessment scale constructed from twelve variables in this study originates from the business owner perspective of success as mentioned earlier. The goal of the business owner is to have the CISD project completed without delay and receive financial benefit of capitalization. The financial benefit of capitalization implies that every non-technical issue in a project is not the responsibility of the project manager solely.

Responsibility of CISD projects beyond the project manager is inferred from the content of the SOP-98-1 document (Financial Accounting Standards Board, 1998). The SOP 98-1 was written by The American Institute of Certified Public Accountants (AICPA) and cleared the Financial Accounting Standards Board (FASB) concerning accounting treatment of costs of computer software developed obtained for internal use. This means that every activity that occurs within a CISD project, led or managed by the project manager, results in the recording of an accounting transaction. This study expands on Procaccino (2002) non-technical issues to include issues that represent capitalization activities that results in accounting transactions. These activities are further represented by variables within this study that reflects organizational culture and the external effect of government regulations concerning projects that have capitalized cost

The organizational culture effects on lessons learned.

Project management procedures, processes or practices within all organizations are not the same. In fact, at the granular levels within organizations interrelationships among business units reflect tactical strategies that are often different (Hill & Jones, 2009; Jones & Alshammari, 2017; Porter, 1985). Therefore, at higher levels it is commonplace to view differences in strategies among organizations in the same industry, as a reflection of how each organization utilize its organizational process assets (OPAs) and how the executive leadership responds to enterprise internal and external environmental factors (Barnard, 1938; Drucker, 2008; PMI, 2018).

As previously mentioned, the U.S. Telecommunication company discussed in this paper was a projectized company (PMI, 2018). Influenced by the SOX Act of 2002, this company's procedures required the creation of a project for every activity performed albeit support or operations

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related. Projects were created for payroll, supplies, equipment, company events, CISD activities, and products and services development. At the start of the process to facilitate CISD project creation, a project request application is submitted and followed by a weekly scheduled meeting to review the application for capitalization approval or rejection by a representative from the organization's fixed assets department. Based on this project request application and prior studies, the framework for assessing the business and financial risk due to failure of ongoing and future CISD projects originates.

The Project Management Institute (PMI) identifies organizational process assets (OPAs) as, "…the plans, processes, policies, procedures, and knowledge bases specific to and used by the performing organization." (PMI, 2018, p.39). PMI further defines enterprise environmental factors (EEFs) as internal and/or external conditions, not under the control of the project team, that influence, constrain, or direct the project (PMI, 2018). OPAs and EEFs are significant to this study because they represent the basis of how 12 factors were selected for the assessment and impact of success or failure of ongoing and future CISD projects. The basis for using the project request form to extract factors is due to its representation of OPAs in the organization. Furthermore, the project request form highlights the organization's culture of how CISD projects are processed internally.

Organizational culture is a critical component in the implementation of lessons learned—especially lessons from project risk management and continuous improvement processes (Drummond, Pamella; Araujo, Fernando;Borges, 2013; Kwak & Stoddard, 2004; Mark Marlin, 2008). Sudhakar (2012) and Procaccino (2002) identified OPAs as organizational factors and development processes respectfully and considered them critical success factors in their studies. OPAs are the basis upon which lessons learned are created and are the origin of the twelve factors selected in this study (PMI, 2018). The primary stakeholder who required the information that represented these twelve factors in Table II on the project request form was the controller of the organization—the business owner[7].

[7]The U.S. Telecommunication company used in this study was Nextel Communications (1993 - 2005), and the Nextel Controller who granted full access to Nextel's CISD projects was Mr. William "Bill" G. Arendt.

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METHODOLOGY

Based on the content in the database provided by this U.S telecommunications company, a total of 291 completed CISD projects were released for study. The outcomes for these projects were categorized as delayed or success. A project with an outcome of success meant that it was completed on time whereby the actual deployment date was less than or equal to the baseline finish date. Delayed projects were defined as projects completed, but not within the time stipulated on the project request application. CISD projects that were categorized as delayed were projects whereby the actual deployment date was greater than the baseline finish date.

Since the project outcome had only 2 possibilities, reflecting a dichotomous characteristic, it was identified as the dependent factor. As a result of the dichotomous characteristic of the dependent factor, Multiple Discriminant Analysis or MDA was the statistical procedure selected to examine the predictors or factors. The database contained a wide range of possible data elements that could be selected as factors in this study. However, the criteria for selection of factors were based on the previously developed software risk instruments in Barki et al. (1993) and J. J. Jiang et al. (2002), critical success factors in Boghossian (2002), Lagerstrom et al. (2012), Procaccino (2002) and Purna Sudhakar (2012) that aligned with the SOP 98-1 document, and the common risk management system implementation recommendations in (Lanza, 2002).

At this point, it is important to mention that knowledge of the organization's culture was needed to understand how and why these factors were selected. The organizational culture effects on lessons learned further reinforces the theory that software development risk is relative to the structure of the organization that develops internal software. The clearest depiction of this organization's culture as it pertained to CISD projects was their use of a project request application. For final passage as factors selected for MDA inclusion, all twelve factors had to be represented directly or indirectly on the project request application.

The first set of factors selected were cost estimates submitted by project managers seeking capitalization approval at a weekly asset review meeting. These cost estimates are similar to budget numbers and are displayed in terms of the accounting treatment suggested for internal products and services. The accounting treatment suggested was either capital or operating

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expenses (Capex or Opex). The project cost estimates are categorized into three groups, hardware, software and labor. Therefore, six of the factors selected were Capex Hardware, Capex Software, Capex Labor, Opex Hardware, Opex Software and Opex Labor.

The next set of factors were selected from the preliminary stage of the SOP 98-1 document. These factors are also called pre-concept phases because they represented cost associated with project planning prior to the execution of software development and obtaining capitalization approval. These factors are discovery analysis and requirements gathering. Discovery analysis represents all cost associated with feasibility studies and business case development. This cost is usually based on labor hours. Requirements gathering represents all cost associated with gathering system requirements, development of a detail project plan, vendor selection and analysis necessary to ensure requirements are mapped to corporate goals. Similar to the discovery analysis phase, the requirements gathering costs are usually based on labor hours as well.

The number of extended days and Work In Progress or WIP days are key variables for the business owner. These variables are key when examining the CIP account for the purpose of determining which projects will be expensed. As mentioned earlier, the WIP days are the number of days the business owner expects the capitalized costs of software development projects to remain in the CIP account. The extended days represent the number of days beyond the baseline finish or planned launch date. Project managers may sometimes push their baseline finish dates further in the future due to any number of reasons. Typically projects that were originally delayed but later extended are done at the discretion of the project manager and are categorized in this study as delayed CISD projects.

The final group of factors were selected based on previous research in this area of software development risk whereby risk instruments were developed. In Jiang et al. (2002) an exploratory factor analysis was conducted, which produced six risk dimensions. The six dimensions were technological acquisition, project size, role definition, user experience, and user support and team expertise. From this group of dimensions, technological acquisition was quantified by the number of vendors and purchase order lines from the database of completed projects. The number of vendors is self-explanatory. However, the number of purchase order lines gives a clear count of

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goods and services purchased for any given CISD project. **Ref Table II** summarizes the twelve factors with their definitions, the stakeholder requesting the status of that factor, and the literature supporting MDA inclusion.

DATA COLLECTION AND ANALYSIS

A random sample of two hundred closed projects, one hundred from each group of project outcome success and delayed, were selected from the database. MDA, using the case step-wise method, was conducted to determine whether the twelve factors of Capex Hardware, Capex Software, Capex Labor, Opex Hardware, Opex Software, Opex Labor, Discovery Analysis, Requirements Gathering, WIP Days, Extended Days, Number of Venders and Number of Purchase Order Lines) could predict CISD project delays. Three of the factors combined for an overall Wilks' lambda that was significant, $\lambda = .89$, χ^2 (3, N = 200) = 22.8, $p < .01$, indicating that overall, these three predictors differentiated among the two project outcomes. The remaining nine factors were not significant.

Ref Table III shows the relative importance of each independent factor discriminating between the groups. This table includes the discriminant weights, loadings for the function (Standardized Canonical Discriminant Function Coefficients), and the Univariate F ratio. As mentioned early, the independent weights were analyzed by the step-wise method, and Cap Labor, Vendor and WIP Days were the significant factors for inclusion into the function. Weights and loadings are key indicators of discriminant power. The positive and negative signs do not affect their rankings. The signs indicate a positive or negative relationship with the dependent factor.

Researchers have a tendency to place more emphasis on the loadings more so than the weights (Hair, R. Tatham, & Black, 1995/2004, p.272). Therefore, as a generally accepted practice, variables indicating a loading of ± .30 or higher are regarded as important (Hair, R. Tatham, & Black, 1995/2004, p.293-294). The loadings of Cap Labor, Vendor, WIP Days, Opex Labor, Number of PO Lines and Requirements Gathering all exceed ± .30. Therefore these six factors are distinguished between the two project outcomes of success and delayed, and can be used to produce an accurate probability of delayed ongoing and future CISD projects.

Given that the two groups of delayed and success projects have an equal size of 100 randomly selected cases each, the cutting score would be the average of the two centroids. The cutting score is the score against which each project's Discriminant Z score is compared to determine predicted group membership (Hair, R. Tatham, & Black, 1995/2004, p.241). Therefore based on the Functions at Group Centroids in

Ref Table IV, the cutting score is zero. This means that if a CISD project has a Discriminant Z score greater than zero; it will be classified as a delayed project. Likewise, a score less than zero will classify a software project as a success.

This can be further seen in the two Canonical Discriminant Function graphs in **Ref Figures I and II.** The Project Outcome Delayed Graph shows the majority of the 100 delayed projects randomly selected, were located to the right of zero or the cutting score. Whereas on the Project Outcome Success Graph, the majority of the 100 success project randomly selected fell to the left of the cutting score of zero.

The Classification Results in **Ref Table V** show that we were able to classify correctly 66% of the CISD projects in our sample.

a. Cross validation is done only for those cases in the analysis validation, each case is classified by the functions derived from other than that
b. 64.5% of original grouped cases correctly
c. 63.5% of cross-validated grouped cases correctly

The Symmetric Measures as in **Ref Table VI** show that we took into account chance agreement; the kappa coefficient was computed at a value of .29, a moderate value. Finally, to assess how well the classification procedure would predict in a new sample, we estimated the percent of project outcomes accurately classified by using the leave-one-out technique and correctly classified 64% of the projects.

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

DISCUSSION AND CONCLUSION

Several constructs can be extracted about the business owners' perspectives on risk assessment of CISD projects. The first construct is that their goal shapes their understanding of a successful CISD project. As previously mentioned, the goal of the business owner is to have the CISD project completed successfully without delay and receive the financial benefit from

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capitalization. Second, delayed CISD projects have negative impacts beyond the organizations' business risk—the financial risks are impacted as well. Third, uncertainty constitutes failure. Finally, OPAs and lesson learned are the driving force behind opportunities to improve overall organizational processes.

In regards to the first fact that the business owner's goal shapes their understanding of a successful CISD project, this is reflected in the difference between the date capitalization can begin and the launch date of CISD projects. For the business owner, the deployment date is the date the project is completed which is not the date the project is completed in its entirety or the launch date. Capitalization begins when the test and transitioning activities are completed which is the deployment date (Financial Accounting Standards Board, 1998). Hence, the deployment date is the date the assets can be deployed into service. This shows that projects have multiple stakeholders with different interpretations projects success (J. J. Jiang et al., 2002; Lagerstrom et al., 2012; Suttrfield et al., 2006).

Due in part to the U.S. legal ramifications surrounding capitalization if done illegally, the business owner sees uncertainty resulting from CISD project delay as a project failure with a negative financial impact similar to Scenario 2 of Table I. The reason why uncertainty constitutes failure of CISD projects is due to the "*risk exposure mitigation*" mindset, once project delay becomes the reality, by the business owner. Given (Barki et al., 1993) risk exposure formula which predicates on the uncertainty factor being greater than zero, the remaining concern for the business owner is the magnitude of potential loss once uncertainty becomes a reality. Thus the risk exposure mitigation mindset of the business owner reflects the mitigation of the magnitude of potential loss.

From a proactive perspective, mitigation of project failure is also tied to Boehm (1991) risk exposure formula which factors in probability. With a constructed CISD project risk assessment scale based on closed projects, it can be applied to ongoing CISD projects early on in the project life cycle. The CISD project risk assessment scale in this study represents a framework augmented by the contributions of OPAs and lessons learned. The CISD project risk assessment scale is also comprised of critical success factors that are linked to the organization's methodology of project management by way of the project request application. This establishes that the project manager's critical success factors can be used in a risk assessment of CISD projects to mitigate financial risk.

The CISD project risk assessment scale in this study was initially constructed from twelve predictor factors with the final scale indicating three factors of statistical significance. Of the three variables, cap labor was significant and selected based on the capitalization risk the business owners must consider. The number of vendors were significant and extracted from two prior study risk assessment instruments (Barki et al., 1993; Purna Sudhakar, 2012). WIP days was the other significant predictor and it was selected because it was considered a key indicator in determining how long capitalized cost was expected to remain in the CIP accounts. Nine variables out of twelve were not significant. However, Opex Labor, the number of PO Lines and Requirements Gathering should also be considered when predicting a delayed project due to their significant loadings. These statistical results, $\lambda = .89$, χ^2 $(3, N = 200) = 22.8$, $p < .01$, establishes that the business owner’s risk assessment of CISD project costs can be used to mitigate project failures. In addition, the CISD project risk assessment scale was able to classify correctly 66% of the CISD projects in our sample. This finding translates into a probability of 66%, given the cap labor, number of vendors, and WIP days, that a project outcome of delayed or success can be correctly predicted.

In conclusion, this study indicates the other factors can be used to assess software risk and originate from stakeholders other than project managers. This study also provides project managers with other quantifiable factors to consider when assessing software development risk. Furthermore, the concept of standardizing an instrument or model to assess software development risk can be obtained but the affects of the risk factors lose their predictability if they are not assessed in relation to the structure and culture of the organization. However, contrary to this finding that strength of predictability is based on how close the risk assessment scale is integrated with the structure and culture of the organization, also provides support for a limitation as well.

An important limitation of this study is premised on the achievement of both cost savings and cost advantage. As previously implied, cost savings achievement is real evidence of cost advantage achievement. Accordingly, strategies aimed at an organization's cost structure or value chain are subject to volatility or reconfiguration (Porter, 1985). Consequently, this changes how OPAs are utilized and in turn, it affects the predictability of existing CSFs. Therefore, the CISD project risk assessment scale must be utilized frequently to capture the effects of any change albeit in the cost structure, value chain, organizational structure or culture.

Given the statistical results, two points can be taken from this study. First, by using the required information for determining software capitalization, software development risks from the business owners' perspective can be used to predict delays to an acceptable degree of accuracy. Second, the degree of predictability of a software development risk assessment model must account for the uniqueness of how organizations are structured and their culture. Thus, the discriminating factors in this study may not have the same prediction power for other telecommunications company. Therefore, as an organization's structure or culture change, the risk factors related to software development, whether from a project manager or business owner changes as well. A lot goes into the structure and practices of an organization that may skew results if a standardized risk assessment instrument is used as oppose to a model constructed with the knowledge of how an organization develops capitalized internal software.

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LIST OF FIGURES

Table I- Two 90-Day Income Statements

Income Statement

90-Days (Quarterly)

	Scenario 1	Scenario 2
Revenue	$ 2,000,000	$ 200,000
COS	(600,000)	(600,000)
Gross Profit	$ 1,400,000	$ 1,400,000
Operating Expenses		

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	CISD Project Depreciation	41,667	-
	All Other Expenses	200,000	700,000
Total Operating Expenses		$ 241,667	$ 700,000
Net Revenue		$ 1,158,333	$ 700,000
Outstanding Shares (Common Stock)		500,000	500,000
EPS		$ 2.32	$ 1.40

Table II- List of Independent Factors

Independent Factors	Definition	Stakeholder	Literature
Cap Labor	Cost estimate of capitalized labor.	Business Owner	Lagerstrom et al., 2012; Purna Sudhakar, 2012
Vendors	Number of vendors providing service to software project.	PM risk instrument.	Barki et al., 1993; Purna Sudhakar, 2012
WIP Days	The numbers of days between the baselines start and finish dates.	Business Owner	Barki et al., 1993; Lagerstrom et al., 2012; Lanza, 2002; Purna Sudhakar, 2012

Independent Factors	Definition	Stakeholder	Literature
Cap Labor	Cost estimate of capitalized labor.	Business Owner	Lagerstrom et al., 2012; Purna Sudhakar, 2012
Opex Labor	Cost estimate of expensed labor.	Business Owner	Lagerstrom et al., 2012; Purna Sudhakar, 2012
Purchase Order Lines	The number of purchased items represented on the purchase order.	PM risk instrument	Barki et al., 1993; Lagerstrom et al., 2012; Purna Sudhakar, 2012
Requirements Gathering	Cost associated with pre-concept phase of project.	Business Owner	Boghossian, 2002; Financial Accounting Standards Board, 1998; Procaccino, 2002; Shmueli et al., 2015
Extended Days	The number of days between the original and modified baseline finish date.	Business Owner	Lagerstrom et al., 2012
Cap Software	Cost estimate of capitalized prepackaged software.	Business Owner	Barki et al., 1993; J. J. Jiang et al., 2002; Purna Sudhakar, 2012

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Independent Factors	Definition	Stakeholder	Literature
Cap Labor	Cost estimate of capitalized labor.	Business Owner	Lagerstrom et al., 2012; Purna Sudhakar, 2012
Discovery Analysis	Cost associated with pre-concept phase of project.	Business Owner	Boghossian, 2002; Financial Accounting Standards Board, 1998; Procaccino, 2002
Cap Hardware	Cost estimate of capitalized hardware.	Business Owner	Barki et al., 1993; J. J. Jiang et al., 2002; Purna Sudhakar, 2012
Opex Hardware	Cost estimate of expensed hardware below the company defined limit for capitalization.	Business Owner	Barki et al., 1993; J. J. Jiang et al., 2002; Purna Sudhakar, 2012
Opex Software	Cost estimate of expensed prepackaged software too low to capitalize.	Business Owner	Barki et al., 1993; J. J. Jiang et al., 2002; Purna Sudhakar, 2012

Table III. Summary of Interpretive Measures for Project Outcome Discriminant Analysis

Independent Factors	Standardized Weights	Discriminant Loadings		Univariate F Ratio	
	Value	Value	Rank	Value	Rank
Vendor	.596	.600	1	8.781	1
Cap Labor	.545	.570	2	7.928	2
WIP Days	-.700	-.474	3	5.470	4
Opex Labor	NI	.457	4	6.950	3
Purchase Order Lines	NI	.431	5	3.666	6
Requirements Gathering	NI	.365	6	5.208	5
Extended Days	NI	-.245	7	2.136	7
Cap Software	NI	-.148	8	.686	11
Discovery Analysis	NI	-.124	9	1.255	10
Cap Hardware	NI	-.113	10	.248	12
Opex Hardware	NI	.051	11	1.941	8
Opex Software	NI	.019	12	1.630	9

NI: Not Included in the case step-wise solution.

Table IV- Functions at Group

Project Outcome	Function
	1
Delayed	.349

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Success	-.349

Unstandardized canonical functions evaluated at group

Table V- Classification Results

Project Outcome				Predicted Membership		Total
				Delayed	Success	
Original		Count	Delayed	61	39	100
			Success	32	68	100
		%	Delayed	61%	39%	100
			Success	32%	68%	100
Cross-validated		Count	Delayed	59	41	100
		%	Success	32	68	100
			Delayed	59%	41%	100
			Success	32%	68%	100

Table VI- Symmetric Measures

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Measure of Agreement	Kappa	.290	.068	4.111	.000
N of Valid Cases		200			

Appendix

Table VII. Eigenvalues

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	.123[a]	100.0	100.0	0.331

a. First 1 canonical discriminant functions were used in the analysis.

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Table VIII. Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	Df	Sig.
1	.890	22.831	3	.000

Table IX. Standardized Canonical Discriminant Function Coefficients

	Function
	1
Cap Labor	.545
Vendors	.596
WIP Days	-.700

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Figures I & II- Project Outcomes Delayed and Success Graphs

Figure I

Project Outcome Delayed Graph

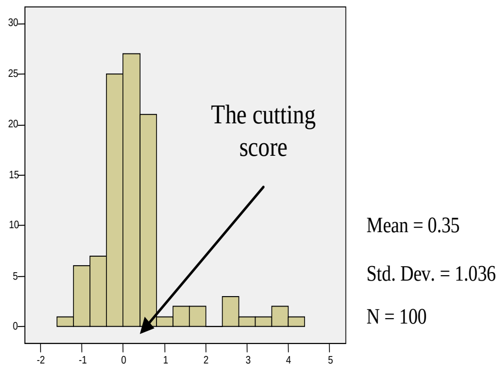

Figure II

Project Outcome Success Graph