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Two Project on Information Systems Capabilities and Organizational Performance

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TWO PROJECTS ON INFORMATION SYSTEMS CAPABILITIES AND ORGANIZATIONAL PERFORMANCE

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in

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By
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DISSERTATION APPROVAL FORM

DISSERTATION APPROVAL FORM

This dissertation is approved as a credible and independent investigation by a candidate for the Doctor of Philosophy degree and is acceptable for meeting the dissertation requirements for this degree. Acceptance of this dissertation does not imply that the conclusions reached by the candidate are necessarily the conclusions of the major department or university.

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ABSTRACT

Information systems (IS), as a multi-disciplinary research area, emphasizes the complementary relationship between people, organizations, and technology and has evolved dramatically over the years. IS and the underlying Information Technology (IT) application and research play a crucial role in transforming the business world and research within the management domain. Consistent with this evolution and transformation, I develop a two-project dissertation on Information systems capabilities and organizational outcomes.

Project 1 examines the role of hospital operational effectiveness on the link between information systems capabilities and hospital performance. This project examines the cross-lagged effects on a sample of 217 hospitals measured over three years, to ascertain the effect of Hospital IS capability variants on Hospital performance in terms of quality of care and profitability, as mediated by hospital operational effectiveness. Hospital operational effectiveness was studied as process efficiency and service efficiency. The results of our study provide evidence for a considerable causal impact of hospital IS capabilities on hospital performance as mediated by hospital operational effectiveness.

Project 2 investigates the impact of CEO's communication styles on organizational performance using text-mining approach on CEOs tweets from social media. The contribution of our study is three-folded: 1) From a methodological standpoint, we present a model to establish a relationship between CEO communication styles on social media and firm performance. Additionally, we apply text mining to identify communication styles of CEOs. 2) From a performance management, we evaluate organizational performance in three types: Operational, Financial, and Reputational. 3) From a management practice and policy perspective, our study results will help organizations evaluate the CEO candidates from a communication style standpoint.

DECLARATION

I hereby certify that this dissertation constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions or writings of another.

I declare that the dissertation describes original work that has not previously been presented for the award of any other degree of any institution.

Signed,

Giridhar Reddy Bojja

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PROJECT 1

Hospital Operational Effectiveness on the link between IS-Capabilities and Hospital Performance: Insights from a cross lagged mediation model

CHAPTER 1

INTRODUCTION

The advancement of healthcare is influenced by information technology (IT). Today, healthcare organizations implement IT in the different aspects of the operations. Most hospitals have IT systems that offer numerous benefits, such as but not limited to better patient care, lessen medical errors, lower healthcare costs, and overall, more accessible healthcare. As healthcare evolves, Information technology becomes inevitable. Healthcare is one of the industry's most affected by IT because of its rapid changes. Customers' expectations for customized services, particularly in healthcare, have risen due to advances in IT technologies and improving living standards (Aceto et al., 2020; Kim et al., 2017). Such changes significantly impact the hospitals' operational effectiveness and organizational performance towards the delivery of services. This raises an interesting question; how does IT enhance operational effectiveness?

In this research, we want to investigate the impact of HIT capabilities on hospital operational effectiveness. Internal drivers such as but not limited to communication between provider and patients, standards in treatment procedures, and data-driven decisions of the organizations primarily guide operational effectiveness goals. Operational effectiveness is a crucial goal of the company and IT governance since it aims to make the most productive use of resources in business operations while also improving efficiency, quality, productivity, and competitiveness. Numerous widely accepted organizational management theories see a firm’s ability to efficiently employ resources as a source of competitive advantage, mainly when operational effectiveness requires capabilities that allow an organization to respond to changing consumer needs or environmental factors quickly. These factors contribute to establishing quality control, and process improvement functions, all of which depend on successful implementation of IT. Companies are becoming more aware of the need to personalize services and process efficiency to fulfill the changing demands of increasingly sophisticated consumers and competitive pressures resulting from greater competition in the healthcare sector.

Everything in healthcare is a process. Healthcare processes are the actions that providers or systems take, both implicitly or explicitly, sequentially or in simultaneously, to carry out activities that are intended to promote or maintain health of patients. Processes can be made more reliable by gaining a deeper understanding of them and reducing unexpected or unnecessary variance (Balestracci, 2009). In terms of healthcare, this can enhance the efficiency, quality, and patients' expectations of the care they receive. As a result, quality healthcare satisfies the demands of patients by fostering overall health, enhancing satisfaction, and reducing errors (Siriwardena & Gillam, 2013). On other hand, In the healthcare industry, high-quality service delivery is critical to success (Meesala & Paul, 2018). It is essential to understand patients' impressions on hospital services and their expectations of hospital care (Upadhyai et al., 2019). When these expectations are met, it boosts the patient satisfaction which is very vital for any healthcare organization. Therefore, tracking, monitoring and enhancing process efficiency and service efficiency in healthcare operational environments are more important than ever. In this context, key aspects of hospital operational effectiveness focus on improving the service encounter and patient-orientation by paying closer attention to process efficiency and service efficiency which are vital elements to achieve overall hospital performance. Thus, we believe IT capabilities can potentially impact hospital operational effectiveness.

With massive and growing IT spending, evaluating and managing whether IT investment leads to enhanced organizational performance is critical. Despite the fact that several studies have looked into the effects of health information systems on hospital outcomes, the inconsistent, variable, and mixed evidence suggests that more research is needed. To exemplify, Studies by (Bharadwaj, 2000; Devece, Palacios, et al., 2017; Devece, Palacios-Marqués, et al., 2017; Santhanam & Hartono, 2003) reported a positive relationship between health information technology and firm performance. Various studies such as (Chae et al., 2014; DesRoches et al., 2010; Zhou et al., 2009) have shown no impact of IT on hospital outcomes. As a result, the conclusions of these studies on how IT may affect organizational performance are uneven. Therefore, a paramount concern emerges in observing and optimizing the HIT adoption to positively capture and influence the relationship between hospital IT investments and performance. Thus, identifying the intermediate business processes that affect the performance is essential and contributes to the IS literature immensely. The study by (T. Wang

et al., 2018) investigated the association between health information technology expenses, Bed utilization rate, and EHR adoption level as intermediate business processes, hospital performance. Their findings reveal a positive association between HIT and hospital performance with intermediate business processes. (Aydiner et al., 2019) find the decision-making performance and business process performance plays a significant positive role in the relationship between IT capabilities and performance. (Angst et al., 2012) show that Clinical IT and administrative IT capabilities significantly affect the hospital outcomes mediated by technical protocols of the care. (Felipe et al., 2020) show that IS capabilities positively affect organizational performance by mediating organizational agility. Their study to investigate the relationship between IT capabilities and provider performance. (Thambusamy & Palvia, 2020) shows that service innovation and quality play an essential role in the relationship between IT capabilities and provider performance. One paper that is closely related to ours is (Thambusamy & Palvia, 2020), in which they considered service efficiency from the perspective of IS/IT executives in the healthcare organization. In contrast, our focus remains on the patient's perspective, and we operationalize service efficiency from patient survey responses. Thus, our research is unique from (Thambusamy & Palvia, 2020). According to (Devaraj & Kohli, 2003), the actual use of such systems is crucial, and it is the missing link between Information systems capabilities and performance. We believe that hospital operational effectiveness is the critical concept that indicates IS's practical usage and its impact on organizational performance.

In determining the practice and deployment of IT, time is a critical contextual aspect. It takes time for an organization to realize commercial benefits from its IT investment since it takes time to establish a company's ability to assimilate, combine, and deploy IT resources, and then to profit on that investment. IT application success requires not just the deployment of technology but also the ability to handle large organizational changes and social planning. As a result, a temporal lag between a firm's IT spendings and the point of maximum benefit on firm performance is expected. Because of the time required to introduce and implement necessary complementary organizational changes, researchers have proposed that time lags could be related to an IT learning effect (Campbell, 2012; Schryen, 2013). Whether there is a time lag effect of hospital IT investments, capability, and efforts on the firm performance, has been researched in generic organizational terms. Despite substantial HIT spending in recent times, the impact of HIT initiatives has been controversial and vigorously debated in both

practice and research (Mettler, 2016). Since the immediate effects are minor, institutions may likely doubt the benefits of the same. However, studying the effects over a period of time has shown results. Most of the previous studies on this topic examined a temporal aspect of the problem. They relied on simple longitudinal research designs (Mou & Cohen, 2018), which are not necessarily sufficient to establish causality (Frees, 2004). This represents a considerable gap in IS research on this topic and must be fulfilled through the suitable application of an empirical research design.

This study aims to investigate the relationship between the Hospital IS capability and Hospital operational effectiveness which in turn affects Hospital performance. The Hospital IS capability is studied in terms of the HIS categorized as Clinical, Administrative, and Strategic aspects, whereas its effect on Hospital performance as mediated by Hospital operational effectiveness is studied in terms of 'Quality of Care' and Profitability aspects as two distinctly recognized financial and non-financial aspects of hospital outcomes. The Hospital's operational effectiveness is studied in terms of service efficiency and process efficiency.

CHAPTER 2

BACKGROUND AND THEORETICAL FOUNDATION

Information Systems Capabilities

IS capabilities are derived from a resource-based paradigm to comprehend better how IT capabilities may act as a potential key differentiator for organizations (Mithas et al., 2011). In this study, we will use (Bharadwaj, 2000) definition of IS capabilities: "A firm's IT capability is described here as its ability to mobilize and deploy IT-based resources in combination or copresent with other resources and capabilities, expanding the traditional notion of organizational capabilities to include a firm's IT function."

Information is lifesaving. In the healthcare industry, this is especially true. Access to patient and population health data allows health care leaders, clinicians, and nurses to make critical care decisions that can make all the difference in the life of the patients. Getting health

data into the hands of the relevant people as quickly as possible is dependent on health information systems that effectively and seamlessly integrate health care and information technology. The health information systems capabilities enable healthcare firms to gather, organize, monitor, and improve patient treatment procedures and other sensitive information (Fichman et al., 2011). Based on Austin and Boxerman's approach, Heath information systems capabilities are categorized into three types in this study (Carlson, 2010). The three variants include Clinical IS capability (CISC), pertaining to the clinical information systems capabilities, such as cardiology information systems capability, clinical decision support capability etc.; Administrative information systems capabilities (ADISC) such as those pertaining to operational and Human resources support and Strategic information systems capabilities (STISC) including capabilities such as case mix management, outcomes and quality management capabilities.

Clinical Information Systems capabilities

Clinical Information systems capability is a broad term that encompasses capabilities directly linked to the patient's diagnosis, medication, treatment, and outcome assessment. Clinical IS capabilities are primarily intended to enhance patient-centered care by providing instant access to patient data such as clinical documentation, medication management, health records, radiographs, and treatment plans, both directly or through network systems (Islam et al., 2018). Clinical information systems include electronic health records, computerized practitioner orders, patient portals, speech recognition, telemedicine, and radiology, to name just a few examples. They might be narrowly focused on a particular context of clinical information, or they might be broad and essentially cover all aspects of patient care. For example, patients access their information online through a patient portal in most healthcare organizations, especially those with deployed EHR systems. A patient portal is a secure website where patients may contact their doctors, seek prescription refills, make appointments, review test results, and pay bills (Emont, 2011).

Administrative Information Systems capabilities

A healthcare organization's human resources and general operations are aided by an administrative information system (ADIS), which primarily comprises administrative or

financial components. For example, an administrative information system might capture information for managing employees, resources, equipment, suppliers, or infrastructure. These systems could manage people and material resources and provide accounting and billing systems for staff and patients. It is the primary driver of identifying and developing the IS capabilities most closely linked to the organization's needs and wants.

Strategic Information Systems capabilities

Strategic information management capabilities are concerned with the comprehensive information processing in the hospital. It is entirely dependent on the organization's business plan and strategic goals, which must be translated into an appropriate information strategy. STISC outlines the information management strategy and provides instructions for creating and implementing the HIS by outlining the system's intended outcomes.

Hospital Operational Effectiveness

Hospital operational effectiveness refers to the hospitals' ability to establish processes based on the core information system capabilities that enhance service efficiency and process efficiency. The operational effectiveness allows hospitals to execute their activities better and achieve a competitive advantage. The apparent increase in competition in the healthcare industry has also increased the awareness to modify hospital services and hospital performance to be in line with emergent trends between patients and competitive demands. Hence, tracking, monitoring, and enhancing service efficiency and process efficiency in the processes and become more critical in the hospital operational effectiveness.

Service Efficiency

Service efficiency entails socio-psychological interactions between the patient and the caregiver, encompassing communication, understanding, empathy, and responsiveness. Information economics theory says that quality attributes can only be judged after a real experience with the service. Things like cleanliness and physical appearance can judge hospital service efficiency. However, most of the criteria are based on personal experience or trust. For example, if a patient goes to a hospital's waiting room, they can see how clean it is. The cleanliness of a hospital can be judged without having to stay there. However, patients need to

judge the quality of services like doctor communication and pain management. Suppose the patient does not have long-term experience with the service. In that case, they cannot judge aspects such as doctors' and nurses' competence and skill level (Dagger et al., 2007). Most conceptualizations share a multidimensional understanding of service efficiency. The study by (Dagger et al., 2007) shows that service efficiency is affected by technology and process factors. Service efficiency that alludes to what is done throughout the service, its instrumental execution, or what they obtain due to encounters with a healthcare worker is technical service efficiency (Woodall, 2001). (McDougall & Snetsinger, 1990) say that because of the complexity and intangibility of hospital services, and that patients do not see or understand the backstage processes, it is hard to get an accurate picture of how good hospital services are at their technical level. Functional quality refers to the sociological and interpersonal aspects that are provided in the service (Woodall, 2001). These include communicativeness, expressions of compassion and empathy, and responsiveness (lo Storto & Goncharuk, 2017). In-hospital services require technical and functional quality components, and there is a direct causative link (Isaac et al., 2010). However, it is crucial to consider which criteria people use to assess service efficiency. Patients are unlikely to possess the skills necessary to assess the level of technical quality, which encompasses a wide range of factors connected to hospital services. However, they are adequately qualified to assess functional quality, which comprises aspects of the hospital service experience. Technical quality, which includes credibility features, and functional quality, dependent on service encounter factors, makes measuring service efficiency from the consumer's standpoint difficult. In this study, we are incorporating the HCAHPS survey data, which focuses on the functional quality element, primarily comprised of patient experiences while utilizing health services.

Process Efficiency

The use of efficiency-based standards of care is referred to as "process-based measurements." Process efficiency is achieved when a clinician makes the best judgment about treatment and effectively implements the plan. The outcome of IT-enabled capabilities might take some time to reflect on the overall organizational performance as the investments in IT are made at the application level. So, it is necessary to track the impact of IT capabilities on hospital processes that are linked to providing best practices in patient care. Laws by federal

governments and HHS entail specific guidelines for care providers to incorporate evidence-based best practices for healthcare delivery. These best practices improve the treatment quality. Technological advancements in healthcare can now improve the quality and efficacy of care providers. For example, the government of the United States has provided a stimulus cheque of $19 billion to incorporate electronic health records (A. Sharma et al., 2018). These initiatives are intended to improve the rate of adoption of IT capabilities and processes such as CPOE, EHR, automated medicine distribution, and clinical data repositories, resulting in significant behavioral changes to standardize care practices. The purpose is to maximize treatment quality by providing rapid access to patient records, minimizing clinical errors and avoiding unwanted testing. Similarly, since 2015, the federal government has begun to reduce Medicare reimbursements to hospitals that do not meet the "meaningful use" criteria for EHR implementation outlined in the "meaningful use" guidelines (DesRoches et al., 2013). These initiatives and technological advancements in healthcare can now improve the quality and efficacy of care providers.

Hospital Performance

According to researchers and business executives, IT capabilities are crucial for increasing organizational productivity and effectiveness. Investment in future IT initiatives can be made more sustainable if they result in measurable performance benefits. However, as the need for IT investment grows, the expected reward is likely to be questioned. Although recent research has largely shown the evidence of IT capabilities on hospital outcomes, not all studies have shown a clear benefit from IT capabilities. Therefore, the viable benefits of using IT capabilities in healthcare remain widely debated. The business value of health information technology can be accessed through two viable measures, namely, quality of care and profitability.

The influence of individual health services on the patient's health state is ultimately used to assess health care quality. Improving quality entails selecting and implementing health services that, when correctly implemented, result in the most significant improvement in patients' health. One of the most important contributions of IT is to improve the quality of care by providing rich information on the patient and their health condition. Recent advancements in IT have been shown to provide alternative diagnostics and treatment options so physicians

can pick better services faster and avoid making mistakes that can cause adverse effects on patient health. However, the previous research on HIT and quality of care has shown varied outcomes. (Chaudhry et al., 2006) A systematic literature review of 257 papers on HIT and quality of care revealed that only 20% of the studies had shown significant impact. Similarly, a study by (Encinosa & Bae, 2011) found no link between HIT and care outcomes. A study by (Agha, 2014) revealed that health information technology had very little impact on readmission, morality, and adverse drug events. In another study, HIT was revealed to have no effect on mortality and readmissions (Spetz et al., 2014). In contrast, studies have shown the significant impact of HIT on the quality of care. A study by (McCullough et al., 2010) has shown that IT capabilities significantly impact quality. (Restuccia et al., 2012) revealed that HIT implementation has shown positive mortality and patient satisfaction results. The study by (Bojja & Liu, 2020) has shown that IT investments affect the quality of care.

The increasing interest in information technology spending in healthcare raises questions about financial and productivity payoffs. The advantages of implementing information technology have been extensively researched, yet the financial outcomes of IT have remained elusive (T. Wang et al., 2018). The study conducted by (Melville et al., 2004) revealed that implementation of IT had shown positive effects on profitability and cost reduction. Similarly, a study by (Kohli et al., 2012) They have shown that IT capabilities do produce profits in healthcare. A study by (T. Wang & Biedermann, 2010) revealed that information technology contributes to profitability by eliminating paper-based documentation. (Mello et al., 2010) study shows that HIT implementation reduces medical errors, thus lowering care costs. However, many studies have shown little or no evidence of financial performance. To name a few, a study by (Kazley & Ozcan, 2007) revealed that HIT implementation had no association with operating expenses. Similarly, studies by (Ginn et al., 2011) have not indicated any effect between IT capabilities and profits. A study by (Kohli & Tan, 2016) showed no association between EHR implementations and return on investment.

Relationship between IS capabilities and Service efficiency

By relying on technology rather than human effort, information technology eliminates or reduces the amount of wasted effort. Care providers should have more time for value-added

activities such as explaining treatment procedures, diagnosing, understanding, responding to patients' needs, and responding to questions about treatment alternatives, thereby increasing the richness of service efficiency while coordinating practitioners and hospitals at the service level (Angst et al., 2012). For example, clinical information systems capabilities increase patient engagement as service users. It enables patients to access their health records, promoting learning more about their illnesses and motivating them to take an active role in shared decision-making. Cardiology information systems can help cardiologists examine a severely ill patient by allowing them to assess their complete medical history as well as all visuals from multiple modalities, which helps to provide necessary recovery information for the patients, provide help as soon as they want, which ultimately helps in providing improved patient care. Administrative information, such as scheduling systems, enables hospital staff to monitor and control cardiac rehabilitation in a timely fashion by increasing the chances that staff will be effectively prepared to handle patient needs and comply with providing superior service, such as explaining medication prior to offering it to patients and explaining discharge instructions. Thus, improving patient satisfaction levels. From previous studies, patients with high satisfaction rates will again visit the same hospital in the future and refer it to their friends and family, thus improving business and generating revenue for hospitals. According to (Plugge et al., 2013), delivering exceptional service efficiency consistently throughout time has been a reoccurring issue caused by a dearth of IT providers' competencies and the way they are managed. Strategic information capabilities profoundly influence service efficiency since they provide direct inputs into service development.

Relationship between Operational effectiveness and Hospital performance

Quality of care is a vital component of a well-functioning healthcare system. Doctors are now expected to help their patients' overcome diseases and offer advice on how to live a healthy lifestyle. Physicians also play a vital role in spreading public awareness about the importance of regular medical checkups and examinations (Morrow et al., 2010). In order to improve the quality of care, patients' perceptions of various aspects of received treatment must be evaluated on a routine basis. Patient experiences can be used to improve service efficiency, and patient satisfaction is a crucial metric in assessing care outcomes (Sajid & Baig, 2007). The assessment of factors that contribute to service efficiency can also help healthcare leaders

improve existing services (Badri et al., 2005). In addition, process efficiency is vital in streamlining the treatment procedures by following best practices. These best practices mean changing physicians' behaviors toward patients and their care. Improved treatment procedures with standard protocols will improve the care process, which is essential to achieving better care quality (Bardhan & Thouin, 2013). Evidently, enhancing service efficiency and process efficiency will help build a robust health system that is important for achieving overall quality of care.

Hospital operational effectiveness facilitates the collection of all responsibilities and processes conducted by care providers within an organization to develop services that bring value to patients. Operating in a competitive environment in which healthcare organizations work and the burgeoning demand for high-quality services and structured procedures to meet patients' needs. For these reasons, healthcare organizations strive to strengthen their services, products, and performance to raise patient retention and revenues (Gomes et al., 2010). Operational effectiveness will assist healthcare organizations in evaluating and re-designing current processes to improve contemporary critical measures such as revenues (Hughes, 2008). Process efficiency detects inefficiencies, eliminates redundancies, and needs a rethinking of the present workflow of care operations—this results in a change in how the healthcare system operates by lowering operational costs and increasing profitability (Institute of Medicine (US) Committee on Quality of Health Care in America, 2001). Maintaining high service efficiency will encourage patients to return to the same provider for subsequent medical visits, increasing revenues (Prakash, 2010).

Importance of Time Lags

It is broadly agreed that a mismeasurement of IS capability impact can be traced back to ineffective methodologies as delayed effects must be considered but are overlooked (Oz, 2005; Schryen, 2010, 2013). The study by, (Brynjolfsson & Yang, 1996; Devaraj & Kohli, 2000; I.-L. Wu & Chang, 2011) even concludes that adaptation and learning lags have not been adequately included in IT-Performance studies and that this critical methodology is a shortcoming in 'IT productivity paradox.' which needs to be addressed. A few studies, such as (Angst et al., 2012; Campbell, 2012; Das et al., 2011; McCullough et al., 2010) address this argument, and their findings reveal that time lag exists and that an organization's spending on

IS can take a few years to yield results. Thus, it is essential to account for the time lags by applying an empirical research design to study the IS-productivity problem.

CHAPTER 3

HYPOTHESIS BUILDING AND FRAMEWORK

Based on the research purpose and the empirical framework, as described above, the study addresses the problem of inconsistent and varying evidence *on the relationship between Hospital IT, Hospital operational effectiveness and hospital performance* (Bardhan & Thouin, 2013; Henry et al., 2016; T. Wang et al., 2018). Hospital IT(IS) capability has been identified in this study, as the more appropriate measurement construct than HIT itself as accounting for the greater fit and viability of the same in research and practice (Mettler, 2016).

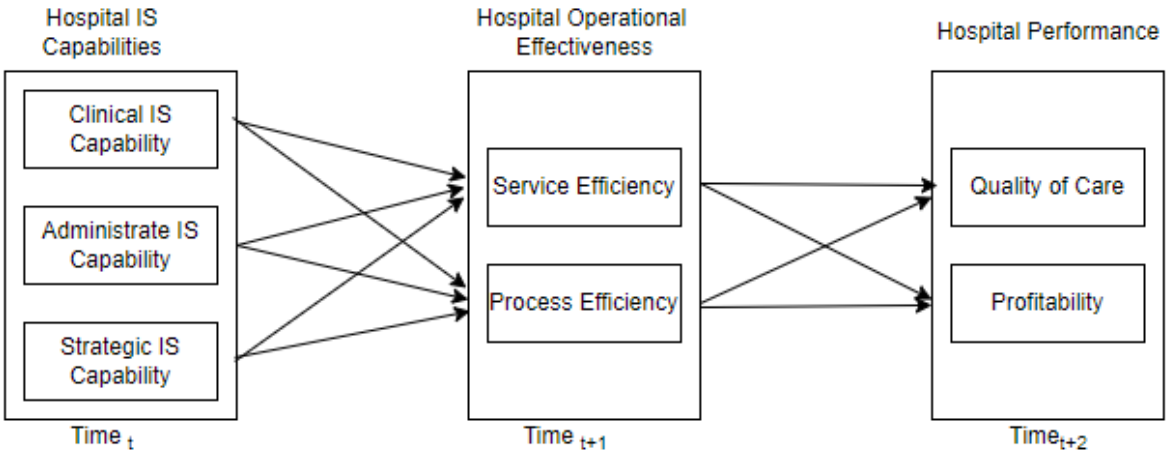


Figure 1. Research Framework

Based on the purpose, and variables, a broad conceptual framework is presented in Figure 1.

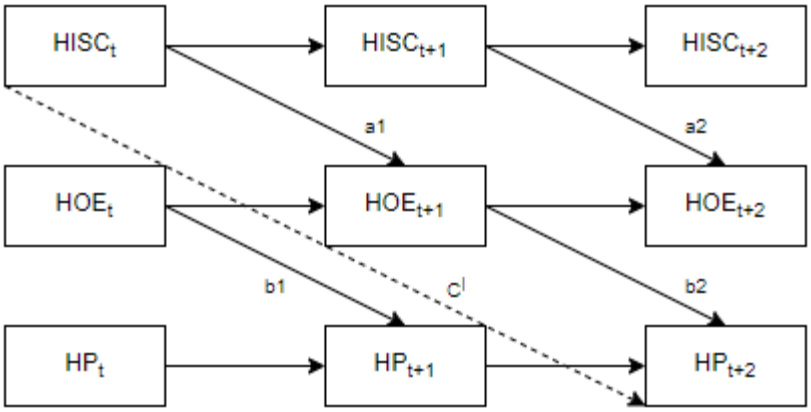


Figure 2. CLPM model

Fig 2. Shows CLPM model adopted for the study

The problem statement has also suggested examination of the problem from a temporal perspective, in order to account for greater causality in the research framework. Thus, cross lagged panel model has been adopted to account for the lagged time effects of Hospital IS capability (HISC) on Hospital performance (HP) as mediated via Hospital Operational Effectiveness (HOE) (Campbell, 2012; Frees, 2004; Mou & Cohen, 2018).

Quite importantly, the problem statement establishes the need for studying Hospital Information systems as meaningful functional applications of Hospital IT such that they can account for the differences in hospital characteristics, environment and resources. For this purpose, the Hospital IS capability as the chief independent construct in terms of Clinical IS capability, Administrative IS capability and Strategic IS capability (L. Sharma et al., 2016; Zhang et al., 2013) is studied. Overarchingly however, all these variable relationships are examined in cross-lagged temporal terms, as per the framework described above (W. Wu et al., 2018), thus, the following hypotheses as presented below.

Cross Lagged Mediation Effects

The development and application of Hospital IS capability and its components can take a lag time, which can be assumed to be a minimum of one year, to take effect in terms of hospital

competencies and success of critical intermediate operational processes (Campbell, 2012). This effect is likely to be strong at the beginning period of the acquisition of the respective Hospital IS capability. Since, Hospital operational effectiveness represents the intermediate competencies and processes, these competencies are likely to ultimately affect the hospital outcome performance, though over a time lag, since the competencies can be expected to take a cumulative buildup effect only over a period of time. This lag time is assumed to be one year as mentioned above, based on the fact that Hospital budgets and planning as well as accountability and return on efforts are usually accounted for on an annual basis (Campbell, 2012; Henry et al., 2016).

Based on the cross lagged effects, the *a1* x *b2* paths indicate the presence of a mediation effect in the above model variants (W. Wu et al., 2018). Notably there is a significant direct mediation effect of HOE from HISC to HP if c' path is significant; and an indirect mediation effect measured as *a1* x *b2* if at least a1 path is significant. Full mediation happens when the c' path is non-significant, and at least a1 is significant. Partial mediation occurs when a1 and c' path are both significant (Baron & Kenny, 1986). Thus, we hypothesize the following (hypothesis set 1.1): *Hospital operational effectiveness variants mediates the impact of HIS capabilities and Hospital performance variants over time.*

Table 1. Hypothesis 1.1

1.1	***Hospital operational effectiveness variants mediates the impact of HIS capabilities and Hospital performance variants over time***
1.1.1	There is a significant cross-lagged mediation effect of HOE variants at t+1 on QOCP at t+2
1.1.1.1	There is a significant cross-lagged mediation effect of HPE at t+1 on QOCP at t+2 with CISC at t
1.1.1.2	There is a significant cross-lagged mediation effect of HPE at t+1 on QOCP at t+2 with ADISC at t
1.1.1.3	There is a significant cross-lagged mediation effect of HPE at t+1 on QOCP at t+2 with STISC at t
1.1.1.4	There is a significant cross-lagged mediation effect of HSE at t+1 on QOCP at t+2 with CISC at t
1.1.1.5	There is a significant cross-lagged mediation effect of HSE at t+1 on QOCP at t+2 with ADISC at t
1.1.1.6	There is a significant cross-lagged mediation effect of HSE at t+1 on QOCP at t+2 with STISC at t
1.1.2	There is a significant cross-lagged mediation effect of HOE variants at t+1 on PP at t+2
1.1.2.1	There is a significant cross-lagged mediation effect of HPE at t+1 on PP at t+2 with CISC at t
1.1.2.2	There is a significant cross-lagged mediation effect of HPE at t+1 on PP at t+2 with ADISC at t
1.1.2.3	There is a significant cross-lagged mediation effect of HPE at t+1 on PP at t+2 with STISC at t

1.1.2.4	There is a significant cross-lagged mediation effect of HSE at t+1 on PP at t+2 with CISC at t
1.1.2.5	There is a significant cross-lagged mediation effect of HSE at t+1 on PP at t+2 with ADISC at t
1.1.2.6	There is a significant cross-lagged mediation effect of HSE at t+1 on PP at t+2 with STISC at t

While the Hypotheses sets 1.1 sought to examine the presence of the indirect - mediation and cross-lagged effects, there are likely to be direct effect paths of Hospital IS capabilities such as acquisition of improved or more advanced cardiology information systems, which may cause subtle direct change in the quality of care of the patients, without necessarily affecting any intermediate processes or developing any persistent intervening competencies (Campbell, 2012). Importantly, two of the most important outcome constructs of hospital performance are 'Quality of Care' and 'Profitability', which are examined as two distinct variants of the same (Bardhan & Thouin, 2013; L. Sharma et al., 2016; T. Wang et al., 2018). However, these direct effects are likely to take longer than mediated effects, in absence of any tangible intermediate process support (Frees, 2004; Henry et al., 2016). Thus, we hypothesize the following (hypothesis set 1.2): *There is a significant two lag direct effect of HISC variants on HP variants over time.*

Table 2. Hypothesis 1.2

1.2	There is a significant two lag direct effect of HISC variants on HP variants over time.
1.2.1	There is a significant effect of HISC variants at t on QOCP at t+2
1.2.1.1	There is a significant effect of CISC at t on QOCP at t+2
1.2.1.2	There is a significant effect of ADISC at t on QOCP at t+2
1.2.1.3	There is a significant effect of STISC at t on QOCP at t+2
1.2.1.4	There is a significant effect of CISC at t on QOCP at t+2
1.2.1.5	There is a significant effect of ADISC at t on QOCP at t+2
1.2.1.6	There is a significant effect of STISC at t on QOCP at t+2
1.2.2	There is a significant effect of HISC variants at t on PP at t+2
1.2.2.1	There is a significant effect of CISC at t on PP at t+2
1.2.2.2	There is a significant effect of ADISC at t on PP at t+2
1.2.2.3	There is a significant effect of STISC at t on PP at t+2
1.2.2.4	There is a significant effect of CISC at t on PP at t+2
1.2.2.5	There is a significant effect of ADISC at t on PP at t+2

1.2.2.6	There is a significant effect of STISC at t on PP at t+2

Methodology

Sample and Data Collection

The data for study was collected from three sources. We obtained IS capability data from the HIMSS Analytics Database, which is also known as the Dorenfest Integrated Healthcare Delivery Systems database (HIMSS, 2014). It provides detailed data on investments and usage of HIT and Hospital information systems, among various hospitals in the U.S. The data on profitability such as net patient revenue, and adjusted discharges were also obtained from this source. Further, we obtained data on 'quality of care' i.e. Mortality, Readmissions, and Patient Satisfaction from Center of Medicare and Medicaid Services (CMS) (CMS, 2014). The data on the mediating variable namely Hospital Operational Effectiveness (HOE) components including process efficiency and service efficiency indicators were obtained from the Hospital Consumer Assessment of Health Providers and Systems (HCAHPS) survey (HCAHPS, 2014) which is also available in CMS.

For the study purpose, we collected data of 3 years i.e. 2012-2014 for a three wave CLPM study. The data from a large panel of hospitals from both the databases was combined using common identifier fields i.e. 'Medicare Number' and 'HA Entity Id'. The initial data collected was for more than 2500 hospitals, however, upon matching, alignment and elimination of clusters of missing data finally 217 hospitals' reported data across different measured items was used in this study, which is close to a medium sample size for such cross lagged mediation studies (Wu et al., 2018). Therefore, the sample used in this study contains data from 217 hospitals, which was extracted, aligned standardized aggregated. We are using balanced panel data set for this study, as only those hospitals which reported all data were finally retained in the sample.

Measurement of Variables

Information Systems capabilities

In order to operationalize the constructs, From the HIMSS survey, we identified 26 IT application capabilities. We used principal component analysis as an exploratory approach with varmax rotation to identify 3 functional areas of IT capabilities factors namely, Clinical, Administrative and Strategic. In the process, several measured variables were eliminated and those found suitable based on factor analyses were retained in the model for further analysis. Once we have final set of factors, we perform a cumulative average for each HIS capabilities. For each type of IS application, a hospital indicates whether or not the specific IS capability is functional or not. Functionality of IT capability is coded as 1, while a score of 0 is attributed if it is not functional. Thus, each HIS has maximum score of 1. If some of them are not functional, then we take a ratio of functional capabilities by total number of functional capabilities and non-functional capabilities. For example, a hospital is using Closed loop medication administration, Laboratory information systems, and Telemedicine while not using Speech recognition software, would receive a score of 0.75 for Clinical IS capability (i,e. (1+1+1+0)/4)). The results of factor analysis are presented in the table below. In order to show level of variance and reliability of the measures, we presented average variance extracted and composite reliability of the HIS capabilities which can be find in the table 3 below. The results indicate, as shown in the table 3, The Average Variance Extracted (AVE) and Composite Reliability (CR) are above the recommended values 0.50 and 0.70 respectively (Fornell & Larcker, 1981), thus validity and reliability of the constructs is achieved.

Table 3. Factor Analysis – Information Systems Capability

Information Systems capability	**Factor**
Clinical Information Systems (CISC)	
Cardiology Information Systems	0.75
Clinical Data Repository	0.78
Telemedicine	0.82
IS Interfacing Medical Devices	0.79
Computerized Practitioner Order Entry	0.74
Patient Portal	0.68
Closed-loop medication	0.59
Electronic medical records	0.71
Average Variance Extracted	0.54

Composite Reliability	0.903
Administrative Information Systems (ADISC)	
Staff Scheduling	0.68
Benefits Administration	0.74
Personal Management	0.79
Payroll	0.89
Average Variance Extracted	0.607
Composite Reliability	0.859
Strategic Information Systems (STISC)	
Decision Support Systems and Analytics	0.68
Outcomes and Quality Management	0.74
Executive Portal	0.79
Participation in an Information Exchange Initiative	0.89
Average Variance Extracted	0.633
Composite Reliability	0.872

Hospital Operational Effectiveness

To measure Process Efficiency (HPE), we obtained data on evidence-based based practices for treating four types of health conditions: Acute myocardial infarction, Pneumonia, Surgical infection prevention and Hearth failure from HCACPS survey. We performed principal component analysis as an exploratory approach with varmax rotation to derive at the factors. Factor analysis of the 12 measures yielded a single factor solution, so we compiled a composite measure of the process efficiency. In order to show level of variance and reliability of the measure, we presented Average variance extracted and composite reliability of the Process efficiency which can be see in the table below. The results indicate, as shown in the table 4, The Average Variance Extracted (AVE) and Composite Reliability (CR) are above the recommended values 0.50 and 0.70 respectively (Fornell & Larcker, 1981), thus validity and reliability of the construct is achieved.

Table 4. Factor Analysis – Process Efficiency

Process Efficiency (HPE)	**Factor**
Patients given ACE inhibitor for Left Ventricular Systolic Dysfunction	0.72
Patients given ACE inhibitor for Left Ventricular Systolic Dysfunction	0.68
Patients given Beta Blocker at arrival	0.56
Patients given ACE inhibitor for Left Ventricular Systolic Dysfunction (LVSD)	0.75
Patients given assessment of Left Ventricular Function (LVF)	0.84
Patients assessed and given pneumococcal vaccination	0.71
Patients given initial antibiotic(s) within 4 h after arrival	0.64

Patients given oxygenation assessment - Patients given the initial antibiotic(s)	0.84
Patients having a blood culture performed prior to first	0.80
Surgery patients received preventative antibiotic(s) 1 h before incision	0.55
Average Variance Extracted	0.512
Composite Reliability	0.912

To measure *Service Efficiency(HSE)*, we obtained patient experience data on the quality of service. These include aspects such as communication with patients, responsiveness to patient needs, and hospital environment from HCACPS survey. We used Principal component analysis as an exploratory approach with varmax rotation to perform factor analysis. Factor analysis of the 9 measures yielded a single factor solution, so we compiled a composite measure of the service efficiency. The results of factor analysis are shown in the table below. The results indicate, as shown in the table 5, The Average Variance Extracted (AVE) and Composite Reliability (CR) are above the recommended values 0.50 and 0.70 respectively (Fornell & Larcker, 1981), thus validity and reliability of the construct is achieved.

Table 5. Factor Analysis – Service Efficiency

Service Efficiency (HSE)	**Factor**
Clean rooms and bathrooms	0.75
Quiet in the room at night	0.78
Communication with doctors	0.82
Communication about medicines.	0.79
Receiving help as soon as they wanted.	0.74
Discharge information.	0.68
Pain management/control	0.59
Responsiveness of hospital staff.	0.71
Average Variance Extracted	0.750
Composite Reliability	0.960

Hospital Performance (HP): Hospital performance (HP) is studied in terms of quality of care (QOCP) and profitability performance (PP).

Quality of Care (QOCP): We considered mortality and readmissions rates as the potential measures which represents overall quality of care. QOCP is a composite construct and

is measured in terms of Readmission rates and Mortality rates which are inverse measures. To measure QOCP, we identified 4 measured items as shown in the table 6 below.

Table 6. Quality of Care

	Quality of care
1	Readmission rate of heart failure patients
2	Readmission rate of pneumonia patients
3	Mortality rate of heart failure patients
4	Mortality rate of pneumonia patients

Profitability Performance (PP): PP is the financial performance outcome measure of a hospital. It has been defined as the net inpatient revenue scaled by adjusted discharges (Bai & Anderson, 2016).

Table 7. Profitability

Profitability
Net inpatient revenue scaled by adjusted discharges (Bai & Anderson, 2016).. PP=(Net inpatient revenue/adjusted discharges)

CHAPTER 4

RESULTS AND DISCUSSION

The overarching purpose of this quantitative cross-lagged panel model study was to examine the effect of Hospital IS capabilities on hospital operational effectiveness, in turn affecting hospital outcomes. This study examined these impacts with a strong literary basis (Bardhan & Thouin, 2013; Campbell, 2012; Mou & Cohen, 2018) for the possible mediating effects of intermediary operational processes and associated efficiencies in the relationship between the various IS induced capabilities and hospital performance. The preceding evidence for the effect of hospital IS and associated capabilities was inconclusive and especially unclear on the time lag effects or persistence of the relationship (Mettler, 2016; Mou & Cohen, 2018). Thus, this research aimed to establish a degree of causality between the variables. Therefore, a cross-lagged panel model was adopted to test and validate the hypotheses and address the

research objectives, as laid down in the Introduction section. The data were thus collected, prepared, and analyzed under the model and the descriptive, and inferential results are presented below, followed by hypotheses validation.

Descriptive Statistics

An examination of the descriptive statistics of the study variables data shows that the mean levels of all the three HISC variants have increased over the sample period (2012-2014), across hospitals. However, the sample dispersion has decreased, in general. This implies that the usage, consistency, and coherence of IT in hospitals and the resultant IS capabilities have steadily increased over the sample period. At the same time, the Hospital process efficiency (HPE) increased slightly from 2012 to 2013, but a greater extent from 2013 to 2014, as opposed to Hospital service efficiency (HSE), which increased consistently. The increase in HPE and HSE signifies a general improvement in the hospital's operational effectiveness. The quality-of-care performance (QOCP) consistent with being defined as an inverse measure in the study, decreased over the sample period. The Profitability Performance (PP) also showed a marked increase in mean levels over the sample period. However, while the dispersion from mean levels for the QOCP decreased, that for the PP slightly increased across hospitals over the said period. Further, the data for independent construct (HISC), along with the mediating construct (HOE) and thereby their sub-constructs, are negatively skewed. This implies that most of the hospitals' IS capability and operational effectiveness values lie on the medium to the higher side of their frequency distributions. Among the HISC variants data, the left skew is greatest in the administrative variant, whereas among the mediating (HOE) constructs' data, process efficiency (HPE) is more left-skewed than Service efficiency variant (HSE). This may be attributed to an unusually greater focus on administrative than clinical or strategic IS capability utilization and process efficiency improvement in Hospitals. On the outcome front, the profitability performance data shows a high right skew, indicating lower profitability performance across most hospitals during the sample period.

Table 8. Descriptive Statistics

	Mean	Std. Deviation	Kurtosis	Skewness	Minimum	Maximum	Count
$CISC_t$	0.643	0.257	0.286	-0.784	0.000	1.000	217
$ADISC_t$	0.767	0.232	0.559	-0.910	0.000	1.000	217
$STISC_t$	0.629	0.264	-0.538	-0.270	0.000	1.000	217
HPE_t	0.948	0.026	0.539	-1.027	0.864	0.991	217
HSE_t	0.710	0.037	1.610	-0.891	0.573	0.782	217
$QOCP_t$	0.163	0.010	-0.060	0.105	0.138	0.189	217
PP_t	883908.084	432222.740	6.207	1.915	205411.960	3052426.681	217
$CISC_{t+1}$	0.766	0.203	1.097	-0.847	0.000	1.000	217
$ADISC_{t+1}$	0.854	0.171	0.852	-1.009	0.250	1.000	217
$STISC_{t+1}$	0.700	0.249	-0.194	-0.585	0.000	1.000	217
HPE_{t+1}	0.958	0.025	0.718	-1.081	0.872	0.998	217
HSE_{t+1}	0.720	0.037	1.610	-0.891	0.583	0.792	217
$QOCP_{t+1}$	0.161	0.010	-0.060	0.105	0.136	0.187	217
PP_{t+1}	907886.657	440056.764	3.470	1.487	227091.108	2882234.270	217
$CISC_{t+2}$	0.835	0.171	-0.322	-0.641	0.250	1.000	217
$ADISC_{t+2}$	0.897	0.143	1.254	-1.185	0.250	1.000	217
$STISC_{t+2}$	0.753	0.233	-0.060	-0.689	0.000	1.000	217
HPE_{t+2}	0.970	0.020	0.852	-1.068	0.902	1.000	217
HSE_{t+2}	0.732	0.036	1.291	-0.788	0.603	0.799	217
$QOCP_{t+2}$	0.159	0.010	-0.137	0.093	0.133	0.184	217
PP_{t+2}	968595.743	480504.093	5.528	1.921	274767.220	3189477.876	217

Table 8. Descriptive Statistics

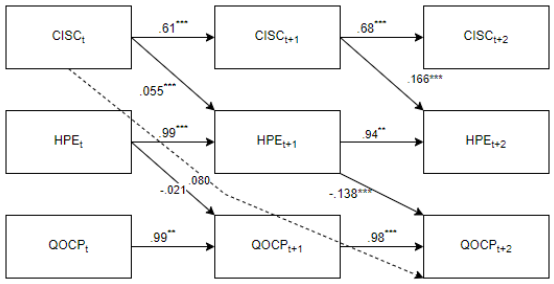
The correlation matrix (Appendix A, Figure A.1) depicts the correlations between each of the model sub-variables for each of the waves from t to t+2 (2012-2014). Several bi-variate associations emerge. All Independent variable variants have overall low to moderate, yet significant correlation among themselves, for the three waves (2012-2014) respectively, except that between CISC and ADISC in wave t+2. This indicates that different variants of HISC are distinct but related enough to qualify as its sub-constructs. The mediator variables do not show a significant correlation among themselves in the three waves, which may be attributed to their distinct dimensions. The outcome variables had no significant correlations between them, except in the first wave, wherein a negative correlation was observed between QOCP and PP (r= -.151, p<.05). This is consistent with the inverse nature of the quality-of-care construct, as defined in the study. Further, no significant contemporaneous correlations were detected between independent and mediator variables in wave t, except between CISC and HPE and

STISC and HPE in both waves t+1 and t+2, wherein small and significant correlations were detected.

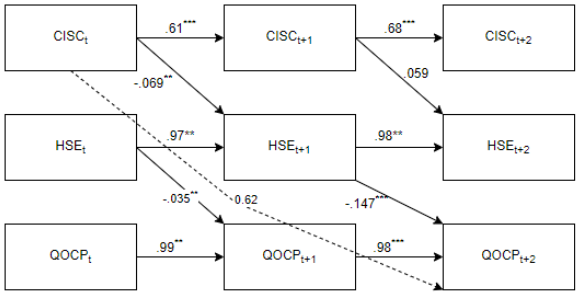
Mediator (HOE) variables have overall significant contemporaneous correlations with dependent variables in the model, except those between HSE and PP, in all three waves. There are no significant cross-lagged correlations between HISC (independent variable) variants to the HOE (mediator) variants from wave t to wave t+1. From wave t+1 to wave t+2, both CISC (clinical) (and STISC (strategic) aspects of the independent variable have a significant correlation with hospital process efficiency (HPE-first mediator variant). From waves t to t+1 overall the mediator variables have a small, but significant correlation with the outcome variables, except between HSE_t and PP_{t+1}. From waves t+1 to t+2, the mediator variables similarly have a small but significant correlation with outcome variables, except between HSE_{t+1} and PP_{t+2}. Thus, there are significant though small correlations between mediator and outcome variables, except between Hospital service efficiency and profitability in both wave transitions.

Inferential Results

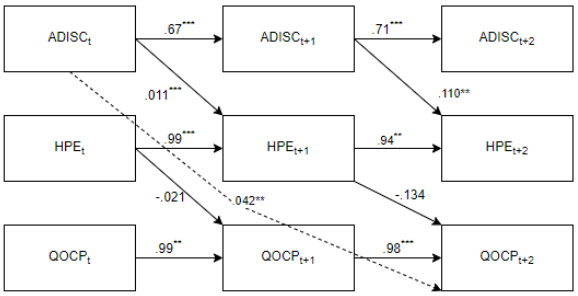
Mediation analysis was the focal aspect of the study. The cross-lagged panel model was run. The inferential results for validating the hypothesized time-lagged relationships between the Hospital IS capabilities, as mediated through Hospital Effectiveness variables, were generated. The analysis was performed through twelve cross-lagged path model iterations. These iterations were based on the different combinations of the variables under the independent (HISC), mediator (HOE), and the hospital performance vectors, for the three waves (t through t+2). The inferential results are thus, presented below, for each of the iterations, towards the validation of the hypotheses of the study. The Tables and Figures under each model variant typically present the values for the *a1, b2,* and the *c'* paths as per the primary conceptual model from (W. Wu et al., 2018). The model variants and mediation results have been grouped primarily by the HISC (independent vector) variants into three blocks of four paths each. Further, the autoregressive effect path results are presented.



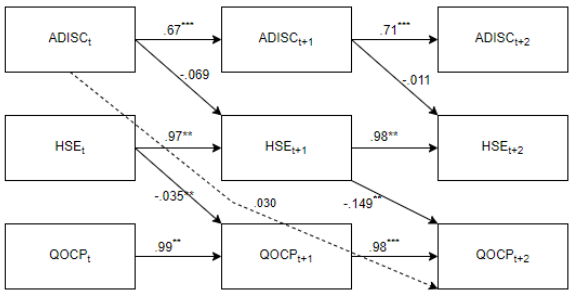
CISC – HPE – QOCP



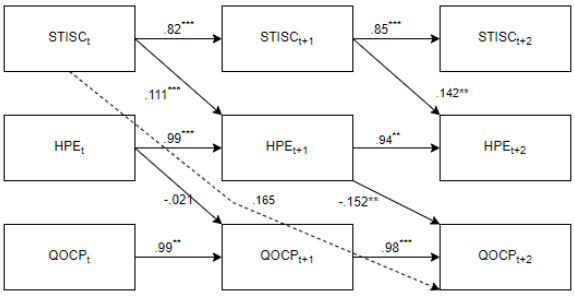
CISC – HSE – QOCP



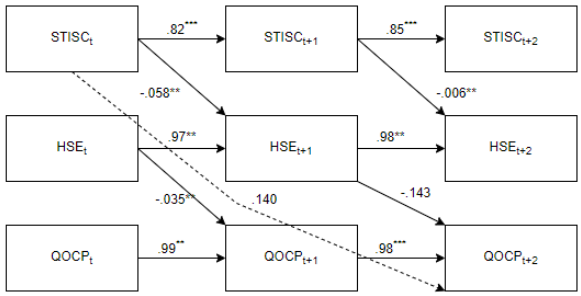
ADISC – HPE – QOCP



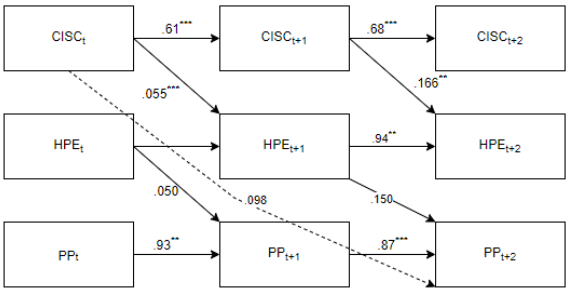
ADISC – HSE – QOCP



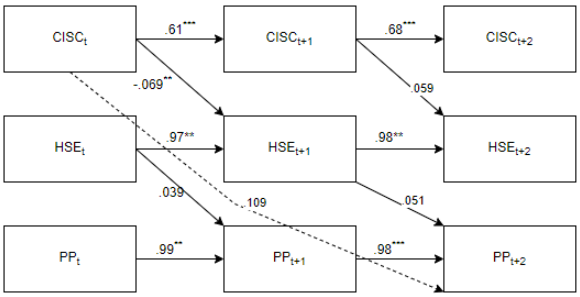
STISC – HPE – QOCP



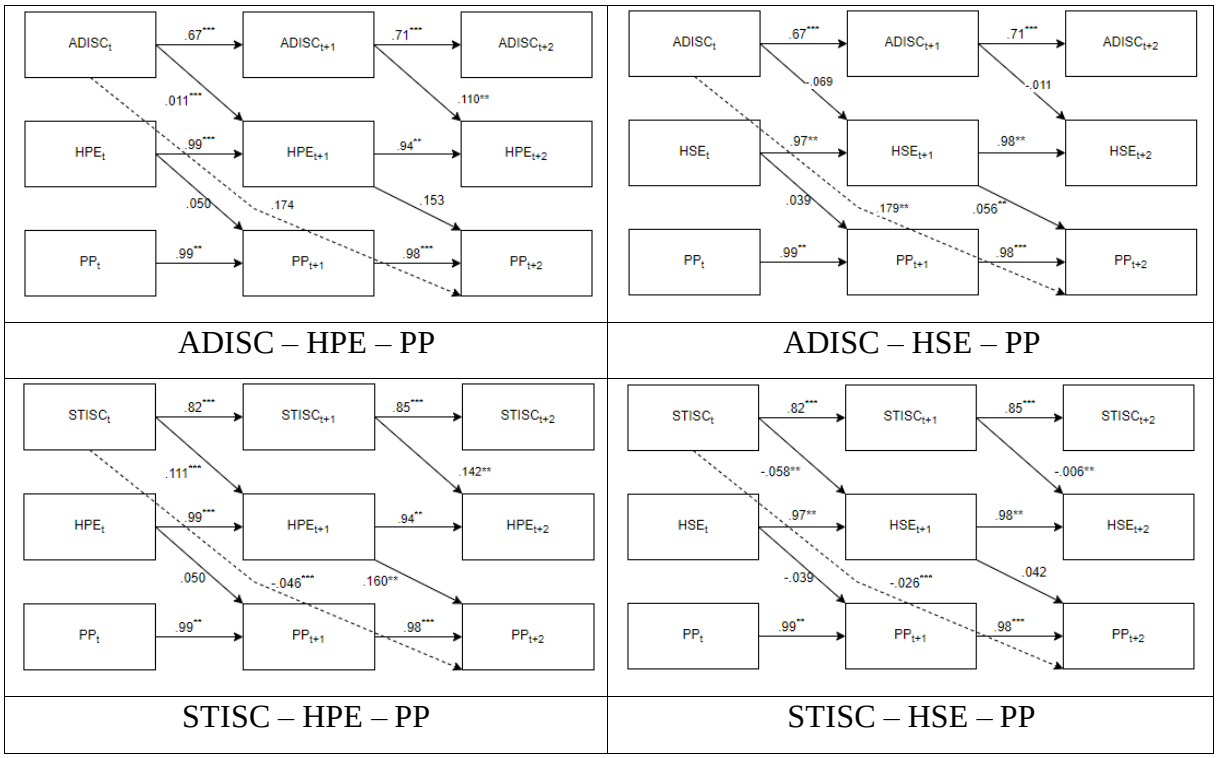
STISC – HSE – QOCP



CISC – HPE – PP



CISC – HSE – PP



The figure displays the cross lagged and auto-regressive associations between the measures. *p<0.10, **p<0.05. ***p<0.001

Figure 3. CLPM model results

Figure 3 shows the results for the CLPM models.

CISC-HPE-QOCP : As per the result output presented in Figure 3, there is a significant positive cross-lagged effect (*Coeff*=.055, $p<0.05$) for the CISC-HPE (a1) path and also a significant negative effect (*Coeff*=-.135, $p<0.05$) for the HPE-QOCP (b2) path. The latter result is consistent with the inverse measurement definition (the lower the better) for the QOCP construct. However, there is no significant effect for the CISC-QOCP (c') path. Thus, overall, we have a significant full (a1 x b2) mediation for the CISC-HSE-QOCP path here (Baron & Kenny, 1986).

CISC-HPE-PP : There is a significant positive single lagged effect (*Coeff*=.055, $p<0.05$) for the CISC-HPE (a1) path, but no significant HPE-PP (b2) path, thus there is a significant indirect cross-lagged mediation (a1 x b2) as per (Hayes, 2017) since there is an indirect mediation, of

a1 path is significant. The CISC-PP direct (c') is not significant, thus, overall, there is a full cross-lagged mediation on the path (Baron & Kenny, 1986).

CISC-HSE-QOCP : There is a significant relationship for the overall CISC-HSE-QOCP path (CISC -> HSE (a1), *Coeff*=.055, $p<0.05$; HSE->QOCP (b2), *Coeff*=-.135, $p<0.05$), whereas the direct effect between CISC-QOCP is not significant. Thus, full mediation is detected for this path.

CISC-HSE-PP1: There is a significant negative single lagged effect (*Coeff*= - .07, $p<0.05$) for the CISC-HSE (a1) path, but no significant HSE-PP (b2) path, thus there is a significant indirect cross-lagged mediation (a1 x b2) (Hayes, 2017). The CISC-PP direct (c') is not significant, However, since the c' path is opposite in sign to a1 x b2, thus, the mediation may be referred to as full negative mediation.

ADISC-HPE-QOCP : There is a partial mediation for the ADISC-HPE-QOCP path since there is a significant (*Coeff*=.011, $p<.05$) indirect effect (a1 x b2) detected on the ADISC-HPE (a1) path, along with a significant direct effect (*Coeff*=.042, $p<.05$) despite a non-significant b2 path (Hayes, 2017). Since a1 x b2 effect overall has a negative sign, whereas c' effect is positive, thus the mediation is referred to herein as partial negative mediation (Baron & Kenny, 1986).

ADISC-HPE-PP : In this case, an indirect mediation (a1 x b2) is detected, since there is a significant (*Coeff*=.011, $p<.05$) ADISC-HPE (a1) path, and no significant ADISC-PP (c') path (Hayes, 2017). Thus, there is a full mediation (Baron & Kenny, 1986). Therefore, hospital process efficiency fully mediates the effect of administrative IS capability on hospital profitability over a crossed two lag period.

ADISC-HSE-QOCP : The ADISC-HSE-QOCP cross-lagged path is found to exhibit no mediation since, there is a non-significant ADISC-HSE (a1) path, with a non-significant ADISC-QOCP (c') path.

ADISC-HSE-PP : For the ADISC-HSE-PP cross-lagged path no mediation is detected since there is no significant ADISC-HSE (a1) path, even though there is a significant (*Coeff*-=.179, *p*<.05) ADSC-PP (c') path found herein.

STISC-HPE-QOCP : In the STISC-HPE-QOCP cross-lagged path, an overall negative full mediation is exhibited. There is a significant positive (*Coeff*=.111, *p*<.05) STISC-HPE (a1) path and a significant negative (*Coeff*=-.152, *p*<.05), HPE-QOCP path (b2) here, with a non-significant STISC-QOCP (c') path.

STISC-HPE-PP: For this STISC-HPE-PP cross-lagged path, a partial inconsistent mediation is found owing to a significant indirect (a1 x b2) mediation and a significant negative direct (c') mediation. There is a significant (*Coeff*=.111,*p*<.05) STISC-HPE (a1) path, a significant (*Coeff*=.160, *p*<.05) HPE-PP (b2) path, and a significant negative(*Coeff*=-.046, *p*<.05) STISC-PP (c') path. Thus, in this case, Hospital Process Efficiency is acting as a suppressor. An indirect lagged effect of Hospital Process Efficiency on the relationship between strategic IS capability and profitability of hospitals is observed. However, in such a case, the overall effect is likely to be very small, since the direct (c') and indirect effects (a1xb2) will likely cancel each other out to a great extent (Baron & Kenny, 1986).

STISC-HSE-QOCP: We have a full mediation for this path, since there is a significant (*Coeff*=-.058, *p*<.05) STISC-HSE (a1) path, and a non-significant STISC-QOCP (c') path detected herein.

STISC-HSE-PP : Partial mediation is detected for the cross-lagged STISC-HSE-PP path owing to a significant (*Coeff*=-.058, *p*<.05) STISC-HSE (a1) path and a significant (*Coeff*=-.026, *p*<.05) STISC-PP(c') path being detected herein.

Autoregression (AR) results. While mediation analysis formed the core results of the study, AR effects are inevitable to a cross-lagged panel study. More importantly, they were crucial in determining the persistence and stability of the mediation variables and relationships of this study. The AR results generated for each model variable were classified primarily by the major

vector type that is independent, mediator, and dependent. The results showed that the AR paths for all the variables over the three waves were significant (p<.05). The coefficients for the same are presented below, for a comparative assessment.

AR paths for HISC variants (CISC, ADISC, & STISC). The AR paths for the HISC variants' results show the greatest overall stability over the three-wave paths.

AR paths for HOE variants (HPE and HSE). The AR path results for HOE variants show a high level of stability with coefficient values ranging between .937 and .989 across both variants over the entire three-wave path. However, the HPE stability somewhat declined from intervals 0 to 1.

AR paths for HP variants (QOCP and PP). The AR paths for HP variants show a high level of stability over the three waves with Effect sizes ranging between .868 and .990 across QOCP and PP. However, PP showed a considerable decline in persistence over the period.

Table 9 and Table 10 presents the hypothesis validation for hypothesis set 1.1 and 1.2 respectively.

Table 9. Hypothesis 1.1 Validation

1.1	***Hypothesis Validation***	***Supported/Not Supported***
1.1.1	There is a significant cross-lagged mediation effect of HOE variants at t+1 on QOCP at t+2	
1.1.1.1	There is a significant cross-lagged mediation effect of HPE at t+1 on QOCP at t+2 with CISC at t	Supported
1.1.1.2	There is a significant cross-lagged mediation effect of HPE at t+1 on QOCP at t+2 with ADISC at t	Not Supported
1.1.1.3	There is a significant cross-lagged mediation effect of HPE at t+1 on QOCP at t+2 with STISC at t	Supported
1.1.1.4	There is a significant cross-lagged mediation effect of HSE at t+1 on QOCP at t+2 with CISC at t	Supported
1.1.1.5	There is a significant cross-lagged mediation effect of HSE at t+1 on QOCP at t+2 with ADISC at t	Supported
1.1.1.6	There is a significant cross-lagged mediation effect of HSE at t+1 on QOCP at t+2 with STISC at t	Not Supported

1.1.2	There is a significant cross-lagged mediation effect of HOE variants at t+1 on PP at t+2	
1.1.2.1	There is a significant cross-lagged mediation effect of HPE at t+1 on PP at t+2 with CISC at t	Not Supported
1.1.2.2	There is a significant cross-lagged mediation effect of HPE at t+1 on PP at t+2 with ADISC at t	Not Supported
1.1.2.3	There is a significant cross-lagged mediation effect of HPE at t+1 on PP at t+2 with STISC at t	Supported
1.1.2.4	There is a significant cross-lagged mediation effect of HSE at t+1 on PP at t+2 with CISC at t	Not Supported
1.1.2.5	There is a significant cross-lagged mediation effect of HSE at t+1 on PP at t+2 with ADISC at t	Supported
1.1.2.6	There is a significant cross-lagged mediation effect of HSE at t+1 on PP at t+2 with STISC at t	Not Supported

Table 10. Hypothesis 1.2 Validation

1.2	**Hypothesis Validation**	**Supported/ Not Supported**
	There is a significant two lag direct effect of HISC variants on HP variants over time.	
1.2.1	There is a significant effect of HISC variants at t on QOCP at t+2	
1.2.1.1	There is a significant effect of CISC at t on QOCP at t+2	Not Supported
1.2.1.2	There is a significant effect of ADISC at t on QOCP at t+2	Supported
1.2.1.3	There is a significant effect of STISC at t on QOCP at t+2	Not Supported
1.2.1.4	There is a significant effect of CISC at t on QOCP at t+2	Not Supported
1.2.1.5	There is a significant effect of ADISC at t on QOCP at t+2	Not Supported
1.2.1.6	There is a significant effect of STISC at t on QOCP at t+2	Not Supported
1.2.2	There is a significant effect of HISC variants at t on PP at t+2	
1.2.2.1	There is a significant effect of CISC at t on PP at t+2	Not Supported
1.2.2.2	There is a significant effect of ADISC at t on PP at t+2	Not Supported
1.2.2.3	There is a significant effect of STISC at t on PP at t+2	Supported
1.2.2.4	There is a significant effect of CISC at t on PP at t+2	Not Supported
1.2.2.5	There is a significant effect of ADISC at t on PP at t+2	Supported
1.2.2.6	There is a significant effect of STISC at t on PP at t+2	Supported

Discussion, Implications, and Recommendations

Discussion

The research problem has been addressed in terms of the mediation impacts of hospital operational effectiveness on the hospital IS capability and performance relationship and associated effects. The various paths detected, based on the results of the statistical analysis, hypotheses testing, and validation inform the research questions posed in the introduction section. The twelve three-wave cross-lagged mediation models consisting of the Hospital IS Capability (HISC)-Hospital Operational Effectiveness (HOE)-Hospital Performance (HP) model variants were built and tested for this purpose. The relationships were examined overarchingly in terms of the cross-lagged mediation effects representing causal predominance (Kearney, 2017), AR effects representing supportive persistence of the constructs, and mediation effects and relationships.

The results show that overall, there is partial yet strong evidence for a mediating effect of hospital operational effectiveness and the underlying constructs on the way the Hospital IS capabilities affect the hospital performance in service efficiency and financial terms. The mediating effect assumes greater significance since the model shows evidence of the causal predominance of the effect through cross-lagged time paths (Mou & Cohen, 2018). The evidence is consistent with (Campbell, 2012) who called for accounting for the time-lagged effects of the IT investments on firm performance. Further, the empirical evidence supports the finding by (Mithas et al., 2011) who observed an important role of information management capability. This is a construct close to IS capability on process efficiency and service efficiency and in turn on operational and financial performance. The results suggest that hospital operational effectiveness can be seen as a set of intermediary competencies of the Hospitals. They aggregate the procedural and qualitative efforts into a coherent set affecting the performance (Thambusamy & Palvia, 2020). As per the mediation results, the Clinical IS capabilities of hospitals have emerged as the most consistently effective among the three Hospital IS capability variants. Such effects may be gauged in terms of their interaction with the hospital operational effectiveness represented by the process efficiency and service efficiency of hospitals. The findings show that such mediation effect influences both the quality

of care and profitability aspects of hospital performance. This finding is consistent with (Bardhan & Thouin, 2013), who found a positive association between the usage of clinical IS and aspects of hospital operations and process efficiency, such as patient scheduling applications. The clinical usage was also found to affect conformance with the best practices for outcomes like heart attacks, heart failures, and pneumonia. These outcomes are close to the QOCP construct of our study.

Thus, while (Bardhan & Thouin, 2013) did identify an association of Clinical IS with both intermediate processes' efficiencies and care outcomes at a certain level, our study articulates the same more clearly by establishing an explicit mediation effect therein. A later study by (L. Sharma et al., 2016) is more supportive of Clinical IS as a meta construct of augmented clinical HIT and its impact on conformance quality of hospitals. The finding is also partially supported by (Angst et al., 2012) who found a positive clinical IT impact on procedural quality of patient services, in turn affecting mortality rates. However, unlike (Bardhan & Thouin, 2013) who did not address the impact of Clinical IS on cost and profitability outcomes, our study found specific evidence for the same. This evidence is still more in contrast with the empirical finding of (L. Sharma et al., .2016) who analyzed but did not find any evidence of Clinical IS on cost or profitability outcomes.

The strategic variant of hospital IS capabilities have been shown to perform decently, though next only to the clinical variant, in terms of leveraging hospital operational effectiveness for improved hospital performance. Further, our research shows that Strategic IS capabilities affect the quality-of-care outcomes more than profitability. This may be attributed to a more clinical focus of large, urban, and not-for-profit hospitals and a more strategic focus of the for-profit hospitals on IS capability (Aydiner et al., 2019; Bardhan & Thouin, 2013).

An area of concern among the hospital IS capability constructs, however, is the administrative variant. The hospitals seem unable to employ their operational effectiveness consistently and significantly for leveraging their Administrative IS capabilities towards performance, especially for the service efficiency mediated ones. This is a novel finding of our study and has policy implications as discussed in the relevant section below. No significant mediation effects of hospital service efficiency were detected between administrative IS capability and hospital quality of care outcomes. The finding though the novel is close to evidence from (Angst et al., 2012) who detected an adverse impact of administrative IT on

interpersonal care processes. This could be attributed to the intrusive nature of administrative IT and unfavorable for interpersonal care quality. However, a positive full mediation was found for profitability outcomes, consistent with (Aydiner et al., 2019). The administrative IS are more in sync with process efficiencies for profitability than the quality of care. This finding is in conformance with (Bardhan & Thouin, 2013) who found that Administrative IS like financial management systems positively affected hospital profitability through lowering expenses.

The extent of mediation effect from HOE, attained during the period, on the IS capabilities' impact on performance was almost equivalent overall, in quality and profitability terms. However, quality outcomes held a slight edge here going by the number of full and partial mediation effects detected. The most productive aspect of hospital operational effectiveness emergent from the mediation analysis across the IS capabilities, outcome variants, and waves of data is the process efficiency (HPE). HPE has a slight but distinct edge over service efficiency effectiveness (HSE). This can be easily gauged from the frequency and extent of mediation effects detected. Specifically, Hospital Service efficiency was found to negatively mediate the relationship between Clinical IS capability and profitability, consistent with (Thambusamy & Palvia, 2020).

There were a couple of noteworthy findings of the direction of relationships between certain variable combinations. The cross-lagged effect of clinical IS capability on profitability was fully mediated by service efficiency, but the mediation effect was found to be negative. This implies that the service efficiency of hospitals may not be compatible with the clinical IS capability for improvement in profitability. It is rather negating the effect of clinical IS on hospital profits over time, by possible misallocation of IS funds to unsuitable quality mechanisms. This finding can be contrasted with that of (Thambusamy & Palvia, 2020) who found a positive mediating role of service efficiency on IT capabilities and performance in general. The contrast may, however, be attributed to their generic IT capability focus rather than on clinical IS.

A partial negative mediation of the hospital process efficiency on the relationship between the Administrative IS capabilities and quality of care (QOCP) outcomes were found. Herein the indirect mediation effect is negative, whereas the direct mediation is positive. However, this may be construed in essence as a positive effect since QOCP has been defined as an inverse metric. Thus, consistent with larger findings of this study, the hospital process

efficiency does enhance the positive impact of administrative IS capabilities on the quality of care. The finding is supportive of the empirical evidence from (Aydiner et al., 2019) who found a critical mediating role of decisional and procedural abilities and efficiencies in the impact of administrative IS capabilities on performance.

A partial inconsistent mediation of the hospital process efficiency on the effect of strategic IS on profitability was found. In a partial inconsistent mediation, the direct effect is negative, while the indirect mediation effect is positive, and counters the impact of direct mediation (Baron & Kenny, 1986). In this case, process efficiency is counterbalancing the negative impact of strategic IS capability on the hospital profits. This shows that the strategic decision-making is not aligned with the profitability goals of the hospitals, however, process efficiency does to some extent make up for the same. Empirical evidence from (Aydiner et al., 2019) aligns with this finding wherein no effect of decisional infrastructural IS capabilities was found on firm performance across a cross-section of industries. Thus, our research detected an inconsistency and suppressing effect leading to a very small net impact. This finding is in contrast with their research, which failed to detect an impact in this context. Thus, our research may be deemed as adding to the findings of (Aydiner et al., 2019) through a hospital industry-specific focus and strong causal lagged modeling.

The results when seen in the temporal and time-lagged context overall, suggest a considerable causal impact of hospital IS capabilities on performance as mediated by operational effectiveness over the three-wave (t1- t+2) sample period. The AR results furnish further evidence of significant stable and persistent construct effects over time. The results also suggest that the cross-lagged relationships of these persistent constructs are also likely to be stable over time. Specifically, however, the strategic IS capability showed the greatest persistence impacts over time. Clinical IS capability showed the greatest increment over the sample period owing to greater focus on basic as opposed to more augmented and meta-level IS capability. The hospital's operational effectiveness and overall performance outcome showed very high stability over time. However, process efficiency as a mediator and profitability among outcomes declined in persistence slightly. The differential stability and persistence among quality and cost performance may be attributed to the differential focus of the mix of hospitals in the sample by size and type.

Research Implications

The most important research implication of our study is that empirical models of causal hospital-IS capability research may now be developed to suit different types of hospitals. The unique needs of say, for-profit, non-profit, large, or small hospitals may be considered, to arrive at these customized models. Further, varying the number and size of waves or lags in the mediation models may yield different results in varying healthcare contexts. This will open up novel research opportunities. The future (a2) paths of our model variants can be used to guide research on the impact of IS capability on hospital operational effectiveness in the future waves.

Practical and Managerial Implications

The most notable practical implication of our research is that the hospital management may build an evaluative framework to align operations with IS for desired outcomes. The framework can be built based on our findings, especially to optimize effort and resources for the same. While the clinical IS affects the quality-of-care outcomes mediated through both process efficiency and service efficiency, it is administrative IS which particularly interacts with process efficacies to produce improved cost and profitability outcomes. Thus, consistent with (Bardhan & Thouin, 2013) an important implication of our findings is that non-profit and urban hospitals are more likely to be investing in clinical IS, whereas for-profit hospitals are more likely to invest in administrative IS. This may, however, create an imbalance in the operational, financial, and customer outcomes, as hospitals may tend to emphasize one at the expense of the other. Further, as discussed above, hospitals are unable to effectively use their operational competencies for leveraging their administrative IS capabilities for better performance. This implies a gap in the managerial and execution aspects of Hospital IS implementation and calls for greater focus on alignment of decisions and application. In managerial terms, the strategic IS decision making has been found not aligned with profitability goals of the hospitals, though process efficiency does to some extent make up for the same. However, this over-reliance on procedural efficiency devoid of optimal IS capability deployment may be counterproductive in the longer term. The hospital managers may want to arrive at ways to achieve an optimal balance here.

Contribution, Limitations, and Future Research Recommendations

The most significant contribution of this study is the novel application of a lagged mediation framework for the evaluation and management of operational competencies to better align the hospital IS capabilities and performance. To our knowledge, this is the first study to establish a causal predominance and impact of hospital IS capabilities, especially in clinical and strategic terms through cross-lagged mediation impact of hospital operational effectiveness. The study guides an establishment of frameworks by hospitals' management to arrive at a cost-quality balance in operational decisions.

There are some limitations of this research that must be taken into consideration. Firstly, the data used for this study is secondary data collected from HIMSS and CMS and there is a lack of clarity and control over data collection. There may be several systematic, design, instrument, collection, or respondent biases within the data, over which we have no control. This is despite the source of data being credible and widely used. Secondly, Synchronicity of data is an important assumption of the Cross-lagged panel models used herein. The synchronicity of the data may be an issue as there is no way to ascertain the extent to which different variables were collected contemporaneously. We are restricted with small sample of hospitals. Future studies should consider large sample of hospitals to make study generalizable. Our data for the study was retrieved for years 2012-2014. As technology has evolved in recent years, future research should consider recent data on hospitals to ensure greater validity of study.

Several future research avenues emerge from this study. Consistent with implications, research is recommended that considers varying the number and size of waves or lags in the mediation models. This may yield different results in varying healthcare contexts. Empirical research is also suggested to test the efficacy of the Hospital IS capability-operational effectiveness-performance model and establish its generalizability to more geographical, especially non-U.S. contexts. Further, managerial and applied research is warranted to establish better models of the cost-quality tradeoff in different hospital settings. Such research will enable better leveraging of operational effectiveness for improved IS capability-performance outcome fit.

CHAPTER 5

CONCLUSIONS

This study extends prior HIT research and performance impacts, executing a causal research design and process. Herein, the HIT investments were operationalized as meta-level IS capabilities. The mediation impact of hospital operational effectiveness on the hospital IS capability and performance relationship were studied under a cross-lagged panel model. The model was adapted to the Hospital domain to ascertain greater causality through time-lagged mediation by the intervening procedural and quality competencies, which thus far did not find the deserving focus in the preceding HIT and IS research. This is a novel approach in the given Hospital IS research context. The Hospital IS was studied under clinical, administrative, and strategic variables. Hospital operational effectiveness was studied as process efficiency and service efficiency, and hospital performance in the quality of care and profitability terms. Based on a cross-lagged panel analysis of the U.S.-based three-wave (2012-2014) data, the results for the cross-lagged, mediation, and autoregressive paths were arrived at, to inform the research questions and hypotheses.

Our results show that overall, there is partial yet strong evidence for a mediating effect of hospital operational effectiveness variants, on the impact of Hospital IS capabilities on quality and profitability. The mediating effects detected, hold greater significance owing to the causal predominance of effects established through our model (Kearney, 2017; Mou & Cohen, 2018). Mediation results suggest that Clinical IS capabilities have the most consistent operational effectiveness mediated relationship with performance. Strategic IS also performed decently in this context, though there were some concerns with the Administrative IS. Notably, hospitals were found unable to effectively leverage operational effectiveness for improved IS capability implementation-performance outcome fit. This is a novel finding of our research. Further, it was found that the service efficiency of hospitals may not be compatible with the clinical IS capability for improvement in profitability. Further, the strategic decision-making is not aligned with the profitability goals of the hospitals. However, process efficiency to some extent makes up for the same. The AR results show significant stable and persistent construct

effects over time, which support the considerable causal impact of hospital IS capabilities on performance as mediated by operational effectiveness.

Further research is recommended for studying the model with different numbers, and sizes of lags. Future paths may be researched for similar data based on the results for a2 paths. Future research for empirically testing our model in varying geographic contexts, other than the U.S is suggested. Cost-quality tradeoff focused research is also warranted to ensure improved allocation of IS and operational resources.

PROJECT 2

Upper Echelons Communication Styles and their Effect on Firm Performance

CHAPTER 1

INTRODUCTION

Upper Echelons of a firm have a deep impact on the organizational performance. According to upper echelons theory, a CEOs observable and psychological characteristics influence his or her decisions, and thus company performance. CEO communication is one of the major observable and psychological characteristic that can help understand CEO behavior. With the growing need for effective corporate governance and authenticity fueled by social media, the public has tended to recognize greater access to the views and vision of corporate executives through more open interactions. CEOs' public personas have shifted to one that is more personable, sociable, and open to the public than ever before (Booth & Matic, 2011). As head of the company, CEOs have greater responsibility to engage both internal and external stakeholders. Social media is a powerful communication medium, with widespread influence all over the world. CEOs' can leverage social media platforms such as Twitter, to interact and engage with various stakeholders. As a key psychological characteristic, CEO communication has been considered as one of the key managerial cognitive abilities that achieve superior business performance (Bakker-Pieper & de Vries, 2013).The CEOs help uniquely create an appropriate organizational context and environment, directing the organization, bonding with key stakeholders, reputation management, and achieving organizational effectiveness (Men & Tsai, 2016) ; (Resick et al., 2009). So far a lot of research has gone into understanding how the CEOs and other business leaders affect the performance (Bass, 1997); (Men & Tsai, 2016); (Fanelli & Misangyi, 2006);(Riedle, 2015). Leadership theories, such as the Upper Echelons theory (Hambrick & Mason, 1984); (Carpenter, 2002); leadership styles and personality traits frameworks have been at the core of such approach (Riedle, 2015); (S. Wang & Chen, 2020). Attempts have been made to understand how and why leaders behave the way they do and how their behaviors and decisions could affect the various internal and external stakeholders of an organization (Bakker-Pieper & de Vries, 2013); (Riedle, 2015)**;** (Resick et al., 2009). For example, aspects like subordinates' and associates' motivation as part of leadership style (Riedle, 2015); communicative versus task-oriented basis of charismatic leadership (de Vries et al., 2010); and leadership style as equivalent to personality

type of the leader (Othman et al., 2017), were being researched. However, a need for establishing the underlying role of communication styles in leadership impacting performance was lately being felt and researched (Othman et al., 2017).

CEO communication was lately being analyzed for cues, which could predict various aspects of performance, such as financial (Gao, 2019); conversation shaping (Malhotra, 2015); team behavior (Düren, 2016); leader-subordinate relationship (Brown & Sarma, 2007); customer-relations, cost to market reduction (Parveen et al., 2016), etc. However, majority of the studies looked at the emotionality (Rajah et al., 2011) and personality (Andersen, 2006) aspect of CEOs. As per as per (Bakker-Pieper & de Vries, 2013) the communication styles, however, were more strongly linked to the leader outcomes than emotionality and personality traits. Communication styles have an incremental relevance, suitability, and validity over personality traits, for leader outcomes (Bakker-Pieper & de Vries, 2013). Communication styles are closer to actual leadership styles as they are more flexible and subject to change as per leader situation and may be exhibited as a mix of more than one style over time. From a comprehensive view, communication comprises multiple dimensions and all dimensions take effect simultaneously when a CEO makes decisions. So, we adopt (Schulz von Thun, 1983) communication theory, which is the widely accepted framework for measuring communication types, to capture every aspect of CEO communication styles. According to this theory, every utterance reveals important information about the sender, the receiver and the topic in four different aspects, namely, Experience – which provides self-revealing information about the user, Factual – which contains facts and data-related information, Appeal – which contains desires and effects that the user seeks and Relationship – which provides information on how the sender feels about the receiver.

To solve this problem, many researchers sought to study personality styles as a more fundamental construct of leadership style (Riedle, 2015; S. Wang & Chen, 2020). However, most of the research in the area inevitably brought out the role of communication style in the linkage between personality and leadership styles. (Bakker-Pieper & de Vries, 2013) had pointed out that personality behaviors are associated with communication styles of leaders and influence the way they will lead. (Riedle, 2015) saw communication styles as narrow, yet important facet level domain within the overall personality sphere. However, the measurement

of leadership to associate it with performance was still a challenge and the traditional static ways to assess leadership and personality or communication such as standardized questionnaire was leading to suboptimal results (Stajner et al., 2021). The scenario improved with the application of AI and ML approaches to assessment of leadership-outcome fits through various representations of leadership style, which included both communication (Choudhury et al., 2019) and personality variants. (Choudhury et al., 2019) produced an important work in this respect, however, they analyzed oral communication using AI and ML techniques from different electronic media to analyze communication styles. Moreover, they did not analyze the relationship between communication styles and firm performance, rather they cited literature to reflect the performance implications of their work.

Thus, the problem of a lack of evidence and model of predicting the relationship between CEO communication styles and performance still remains at large. This problem represents a pertinent gap in Upper Echelons literature. The problem is compounded by a lack of application of textual mining approaches based on social media usage of CEOs and the fact that a suitable dynamic measure of leadership such as communication styles is not in place for the purpose. The study by (S. Wang & Chen, 2020) is perhaps the most evolved work in this respect, which used ML programming to study the personality traits of CEOs through their Social media posts and analyzed its relationship with firm performance. (S. Wang & Chen, 2020) observe social media behavior to recognize CEO's personality, to study how it in turn affects organizational performance. However, as per (Bakker-Pieper & de Vries, 2013) the communication styles, were more strongly linked to the leader outcomes than their personality traits. Communication styles have an incremental relevance, suitability, and validity over personality traits, for leader outcomes (Bakker-Pieper & de Vries, 2013). Communication styles are closer to actual leadership styles as they are more flexible and subject to change as per leadership situation and may be exhibited as a mix of more than one styles over time. On the other hand, personality types are a more static construct, which may at times, fail to capture the leadership nuances (Symanto, 2022). Further, (Bromiley & Rau, 2016) suggested further research on personality versus communication styles as related to performance outcomes. This represents an empirical research gap in the latest body of research in the area. We argue that CEO communication style modeling for impact on organizational performance is the new and appropriate path for the same.

The purpose of this study is to present a model to establish a relationship between CEO communication styles on social media and firm performance. Additionally, we apply text mining, which is not commonly used in to identify communication styles of CEO in the literature. The communication styles being the variables of interest in the study, as identified through a preliminary review of literature and drawing primarily from (Stajner et al., 2021) include Self-Revealing, Action-Seeking, Fact-Oriented, Information-Seeking, as contextuality styles; and Emotional as psychological or emotionality states.

CHAPTER 2

REVIEW OF LITERATURE

Communication styles of CEOs : Constructs and models

Communication style was being intensely investigated as early as 1970s (Norton, 1978). As per (Norton, 1978), Communicator style is defined as – "the way one verbally and para-verbally interacts to signal how literal meaning should be taken, interpreted, filtered, or understood." (Norton, 1978) conceptualized communicator style construct as consisting of ten sub-constructs. Of these, the first nine constructs included – dominant, dramatic, contentious, animated, impression leaving, relaxed, attentive, open, and friendly. The tenth sub-construct – communicator image was seen as an evaluative consequent of the first nine. Later, (Ganster & Others, 1981) used scaling procedures on Norton's communicator style construct to assess whether leaders' communication styles varied between or within work groups and concluded that leaders did maintain a stable or habitual and highly consistent difference in communication styles in terms of being open, friendly, calm, relaxed, and attentive, leading to different levels of subordinate satisfaction (Stajner et al., 2021). (Tixier, 1994) examined the management and communication styles of CEOs and other corporate leaders in a 15-country study in Western Europe. They took a holistic view of the communication style of the leadership of a company as a function of and relevant to the management styles therein. The dimensions or components

of management styles identified by them included - the degree of employee participation, the innovation potential of leaders, the insistence on performance and results, problem-solving pragmatism, and attitudes towards problem-solving and risk-taking. (Luo et al., 2016) explored the structure of a leader communication style in the context of organizational change and proposed an integrated conceptual model for comprehending a leader's communication style for achieving subordinates' commitment to change. They found communication styles composed of five dimensions within change management context, namely – hope orientation, reality orientation, subordinate orientation, support orientation, and enforcement orientation – to be positively associated with employees' affective commitment to change.

(Obi, 2018) identified five forms of communication used by transformational leaders to influence employee motivation, namely – a) respectful communication, b) two-way communication, c) charismatic communication d) listening and e) feedback. (de Vries et al., 2010) defined a communication style as –"the characteristic way a person sends verbal, paraverbal, and nonverbal signals in social interactions denoting (a) who he or she is or wants to (appear to be), (b) how he or she tends to relate to people with whom he or she interacts, and (c) in what way his or her messages should usually be interpreted. (de Vries et al., 2010) proposed and operationalized a six-dimensional model using the Communication Styles Inventory (CSI). The CSI proposed by the authors conceptually and empirically distinguished between six domain level communicative behavioral scales namely – Expressiveness, Preciseness, Verbal Aggressiveness, Questioningness, Emotionality, and Impression Manipulativeness. The CSI scale showed good reliability of domain-level scales, beyond 80%, and medium to high convergent validity. Their communication styles constructs were found to have medium to strong associations with personality traits. (Brown & Sarma, 2007) used the above six-dimensional CSI model as a theoretical lens to empirically test the effect of leaders' communication style on employees' affective organizational commitment. The corporate leaders especially the CEOs have a unique organizational role in creation of an appropriate organizational context and environment, driving the organization in a desirable direction, establishing, and maintaining relations with key stakeholders, maintenance of corporate image and reputation, and achieving organizational effectiveness. The same is achieved by the CEOs through the establishment of a collective purpose, communication of the vision and managing the culture. The communication style of CEOs is the interface through which the CEOs interact

with the organization and its stakeholders to achieve the above objectives (Fanelli & Misangyi, 2006; Luo et al., 2016; Resick et al., 2009).

It is clear from the preceding discussion that CEOs and members of the upper echelons of a company, as leaders do not always consciously communicate with subordinates specifically to influence their performance**.** The CEO communication process is a) composed of both intentional and unintentional aspects, b) driven by both conscious effort and sub-conscious motivations, directed at not just the employees or subordinates, but the larger stakeholder audience.

Why Social-Media for CEO communication?

In the highly time-intensive and fast-paced world of today the CEOs are switching from top-down communication platforms to adoption of faster, more efficient, and bottoms-up communications options facilitated by social media (Locander & Ladik, 2017). However, the electronic media and more so the social media in recent times is dominated by narrative and drama as opposed to the logical reasoning of the print media, which was the prime communication medium for CEOs until the late 1990s (Gozzi, 1999). One of the key skills identified among CEOs is the ability to be communicative, implying the management of the media and reaching out to both internal and external stakeholders (Grafström & Falkman, 2017). As per a 2012 IBM survey, it was argued that if a company does not have a social CEO, it is going to be less competitive. Majority of employee respondents in the UK and the US as per another survey by a social media branding firm BRAND fog, believed that CEO social media engagement communicate company values effectively and build its brand reputation.

In a more recent and significant empirical study, (Men & Tsai, 2016) focusing on CEOs communication style on social media and its impacts, served to enhance the theoretical understanding of CEO sociability and the underlying effectual dynamics of public relations outcomes. Based on a quantitative survey of 332 social media users, they showed how the responsive and assertive communication styles of CEOs on social media affected the followers' social media advocacy for the company. The favorable public advocacy and reputational outcomes for the company, in turn have a positive impact on their business, operational and financial performance outcomes (Gao, 2019; Song, 2018). Therefore, it is theoretically evident

that social media can be leveraged to extract psycholinguistic clues. In our case, we leverage Twitter, one of the popular social media platforms, to extract psycholinguistic clues of CEOs from their posts and thereby identify their communication styles. Further, we believe that text from social media platforms such as Twitter effectively reflects the CEOs' statements or behavior more effectively than traditional mediums such as conference transcripts, newsletters, or interviews since CEOs can express themselves freely on social media.

Most Relevant Leadership Styles in the Study of Corporate Communication

(Riedle, 2015) extensively assessed as to what leadership styles were most effective in motivating employees to perform their best for the organization. Understandably, the communication styles of these leaders were the critical aspect of their leadership behavior that likely elicit increased employee motivation. The leadership styles identified therein included authoritarian, paternalistic, democratic, laissez-faire (subordinate trusting and reliant), transactional and transformational leaders. However, the transactional and transformational styles were identified and acknowledged as the most relevant, being on two ends of a communication relevant leadership continuum. Transformational and Transactional leaders also vary in their communication styles.

Transactional leaders facilitate a social exchange process including communication that is limited to accomplishment of specific tasks and the fulfillment of subordinate needs immediately relevant to the task. Transactional leaders do not communicate with subordinates unless there is a deviation from the task standards. However, the contingent reward system used by transactional leaders has been found to be associated positively with organizational outcomes (S. Wang & Chen, 2020). Transformational leaders tend to motivate their subordinates and associates as part of their leadership style and always try and communicate proactively and in inspirational, charismatic, challenging and stimulating ways, so as to maximize employee effectiveness (Riedle, 2015).

Linkage and Distinction between Corporate Leader Personality and Communication Styles

(de Vries et al., 2010) found that charismatic and human-oriented management or leadership styles are more communicative based, whereas the task-oriented management styles are less communicative based. The former may be seen as what are termed as transformational and the latter as transactional leaders in leadership literature. Each is a characteristic leadership personality trait and have clearly distinct communication styles, which may briefly be characterized as active and passive respectively. Communication is the key component in the leadership process and a lack of appropriate and suitable communication skills and styles can adversely impact an organization. However, this also implies that communication style, though overlapping is a construct distinct from leadership style.

Communication styles were found to be strongly associated with knowledge sharing behaviors, perceived leader performance, satisfaction with the leader. Also, leadership styles were found to mediate the relationship between communication styles and performance outcomes (de Vries et al., 2010). As per (Bakker-Pieper & de Vries, 2013), personality behaviors are associated with communication styles of leaders and influence the way they will lead. The communication styles, however, were more strongly linked to the leader outcomes than their personality traits. Communication styles have an incremental relevance, suitability, and validity over personality traits, for leader outcomes (Bakker-Pieper & de Vries, 2013). The communication styles of expressive and precise leaders were found to be more effective in attaining improved organizational outcomes than the extraversion and conscientiousness styles. While leaders' personality traits are linked to communication styles, they clearly are distinct from each other in how they affect organizational outcomes. Another important distinction between personality traits and communication styles is that personality traits are observed in all the behaviors of a leader, whereas communication styles are observed only in a subset of behaviors – namely communicative behaviors. Thus, communication styles are seen as narrow, yet important facet level domain within the overall personality sphere (Riedle, 2015).

Leadership style can be seen as conceptually equivalent to personality type of a leader. Within the corporate context, this applies to the CEO or other top members of upper echelons of an organization. (Othman et al., 2017) studied the moderating effect of leadership

communication style on the relationship between leadership style and employees' engagement outcomes. (S. Wang & Chen, 2020) observed that extraverted individuals are expressive and articulate their views and emotions better and more often. They are more effective in communicating their ideas and opinions on their employees. The productivity of the employees is also related to the clarity of thoughts and their communication by their leaders and managers. The transformational leaders' traits and thus, communication styles though linked, are distinct from each other, and generate greater academic and practical interest than those of the transactional leaders.

Upper Echelons Communication and Recognition

Numerous studies have investigated the effect of CEO communication on organizational performance. However, most of the studies utilized traditional content analysis and survey assessment techniques. The study by (Yadav et al., 2007) used CEO letters to stakeholders to identify CEO communication styles using content and coding analysis and showed some aspects of CEO communication are positively associated with the deployment of new technologies within the organization. Similarly, a study by (D'Aveni & MacMillan, 1990) utilized CEO letters to stakeholders to understand aspects of CEO communication using content analysis and found that CEO communication strongly affects the structural aspects of the organization. Whereas a study by (Waldman et al., 2001) used a survey-based approach to understand aspects of CEO communications and found that CEOs' transactional and charismatic leadership was shown to have a significant association with financial outcomes. With the advent of technological improvements in recent years, few studies have adopted more dynamic approaches such as linguistic inquiry, word count (LIWC), and video-metric methods to understand CEO communication. A study by (Pan et al., 2018) used the LIWC approach to code leaders' conference call presentations and found that the style of language used by CEO is associated with the positive reactions of investors. Further recent studies such as (Petrenko et al., 2016) used CEO video to analyze the communication patterns and found some significant correlation with corporate social responsibility measures. In a recent study, (Choudhury et al., 2019) used a deep learning-based approach to analyze the communication styles of CEOs using facial expressions from videos and verbal aspects from transcripts. They found that CEO communication styles have a significant association with acquisitions. Similarly, a study by (S.

Wang & Chen, 2020) used a deep learning-based text mining approach to identify CEO personality traits and reported that personality traits are significantly related to company performance. A recent study by (Stajner et al. 2021) presented a BERT-LSTM based classification model to classify psychologistic textual characteristics for better interaction with users. In this study, we employ the text mining approach presented by (Stajner et al. 2021) to derive the communication styles based on the four-sided communication model proposed by (Schulz von Thun, 1983). According to (Schulz von Thun, 1983) which every utterance or message has four aspects – 1) Self-revelation, 2) Facts, 3) Appeal, and 4) Relationship. The speaker sends the message, with the above four aspects and the listener hears with four different perspectives also related to the four aspects of the message. When the communication is favorable from both ends, and has a flow, the four aspects, along with the speaker/listener roles swing back and forth, between two individuals or parties, with requisite sensibility on both ends. However, problems occur, when in a communication, the speaker and listener emphasize different sides of the model (Schulz von Thun, 1983). Such emphasis from one side to the other is inherently related to the former's personality traits, can exhibit a pattern under certain similar circumstances and social contexts. (Stajner et al., 2021) based their framework of identification of psycholinguistic patterns in textual human-computer and human-human communication on Schulz's Four Sides Communication Model. Their framework can in turn be deemed suitable to classify psycholinguistic cues and thus, the communication styles reflected in social media posts.

Relationship between Communication Styles of CEOs and Firm Outcomes

Transformational leaders use effective communication to positively affect subordinate motivation (Obi, 2018). A study of personal twitter accounts of 226 CEOs showed that a high proportion of the tweets contained information, which predicted financial performance, such as future abnormal returns (Gao, 2019). (Malhotra, 2015) emphasized that the CEOs could help shape the conversation around the company on social media, influencing the image and reputational outcomes for the company.

(Düren, 2016) analyzed the empathic change in communication style of leaders and found that it had a signaling effect on team members. (Brown & Sarma, 2007) analyzed the impact of leaders' communication style on the quality of interpersonal exchange between

leaders and followers and its subsequent effect on employee's organizational commitments in Peru. They found a significant direct relationship between the preciseness dimension of leadership communication to employees' affective organizational commitment. Top managers' social media usage helped achieve greater performance outcomes, such as enhancement of customer relations, customer service, information accessibility and reduction in marketing costs (Parveen et al., 2016). (Capriotti & Ruesja, 2018) found that global CEOs fared well on the corporate communication results, and improved strategic communication for the organizations.

The social media presence of CEOs was found to strongly correlate with their perceived communication responsiveness, quality, and employee-organization relational outcomes. The responsive communication styles of CEOs have been found to strongly correlate with the quality of CEO communication, in turn improving employee relations. An assertive communication style of CEOs has a minor, yet significant effect on employee-organizational relationship quality (Waldman et al., 2001). (Bakker-Pieper & de Vries, 2013) found communication styles of corporate leaders to be strongly associated with knowledge sharing behaviors, perceived leader performance, contentment with the leader, and team commitment of the subordinates. (Dasgupta et al., 2012) examined passive, aggressive, and assertive styles of communication of managers and found a positive relation between assertive communication style and employee satisfaction.

Research has shown that CEO communication and personality influences the dynamics of the top management in a firm. CEOs' both observable (communication style) and underlying (personality traits) influence the firm outcomes (Bromiley & Rau, 2016; Peterson et al., 2012). (Bromiley & Rau, 2016) suggested further research on personality versus communication styles as related to performance outcomes. Global CEOs have been found to fare well in terms of communication outcomes of their use of Twitter and improved their strategic communication for the firm, depending on their communication styles. An industrial study by FTI Consulting, studied a CEO's communication style and his or her ability to impact the share price of their company, before and during the COVID-19 pandemic, based on an assessment of 100 high growth companies. The companies with CEOs having a more vocal communication style were found to be the one's exhibiting high growth, across sectors (FTI Consulting, 2020). CEOs with certain communication styles were more likely to recover from a share price slump. Among the

fast growth companies whose CEOs prioritized vocal communication, 81% had a strong brand. Further, all women CEOs in the study had a distinct brand and communication style. Such CEOs were able to combat negative financial impacts of COVID-19 crisis and protect close to $260 billion in shareholder value.

Performance Outcomes

A review of literature pertaining to the impact of CEOs' social media usage and effort as a corporate internal and external communication tool is well researched. Majority of the studies show that reputational, marketing or branding outcomes is an area, that is most directly researched for impacts of CEO social media communication and usage such as market information dissemination outcomes (Kelton & Pennington, 2019)**;** relational outcomes, such as perceived authenticity and approachability (Song, 2018)**;** marketing performance of the firm (Lacoste, 2016)**;** relational marketing (Men & Tsai, 2016) **;** business promotion and employee recognition outcomes (Huang & Chuang, 2016)**;** reputation and sustainable development (Reilly & Hynan, 2014); and social capital creation and favorable investor recommendations (C.-W. Wu, 2016)**.**

Operational outcomes were another focal area in this line of research, wherein issues such as productivity outcomes (S. Wang & Chen, 2020), organizational absorptive capacity and sustainable competitive advantage (Schlagwein & Hu, 2017)**,** organizational innovation performance (Chen et al., 2016), etc., were pertinent themes of research. Financial aspects of firm performance were also considerably researched with reference to the impact of social media communication of CEOs or other members of the top management team (Sahaym et al., 2021)**;** (Bank et al., 2019). (Fisch & Block, 2020) focused on multiple performance areas such as entrepreneurial, reputational, and operational consequences of leaders' twitter generated digital communication footprints. From the above-mentioned studies, it is evident that the communication aspect of leadership has a different magnitude of impact on various performance aspects, which is why we opted for a broader perspective of organization performance. This study operationalizes organizational performance into two types, namely, operational, and financial performance.

CHAPTER 3

METHODOLOGY

Theoretical Framework

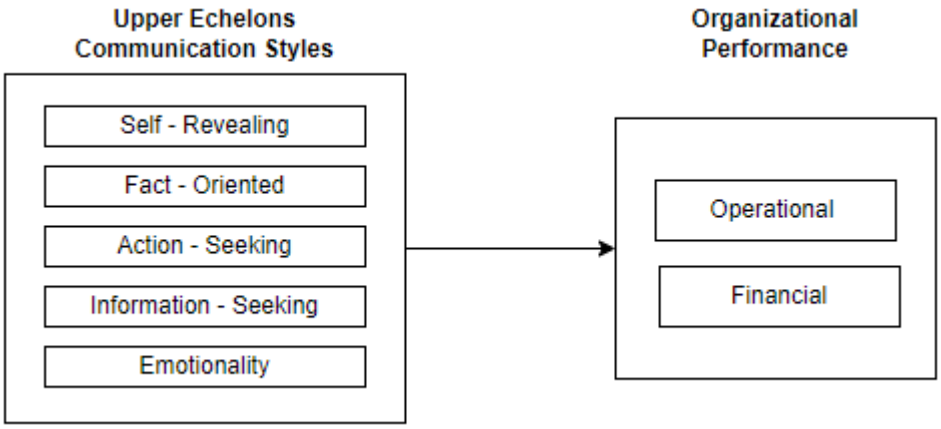


Figure 4. Theoretical Framework

Figure 4. presents the theoretical framework of our study. The overarching goal of our framework is to investigate the impact of CEO communication styles on organizational performance. We consider 4 constructs related to CEO communication styles, including the Self-revealing, Fact-oriented, Action-seeking and Information-seeking. We consider three major types of organizational performances including reputational, operational and financial performance.

Self-Revealing (SRS) style of communication is composed of utterances or statements wherein, the speaker shares personal information or experiences. In social media communication, self-revealing content or posts rely heavily on personal experience and opinion (Symanto, 2022). Within the corporate leadership and research, CEOs have been found to adopt this communication style to impact stakeholders with powerful results primarily in reputational terms (Craig & Brennan, 2012); and also to drive innovation by inviting collaboration and social exchange (Haasis, 2013). As per (McCallaghan et al., 2020) self-revealing practice or style of communication is an important aspect of CEO servant leadership style and connotes

transparency and is part of being authentic. CEOs following this style impact the firm stakeholders by becoming role models consistent with their higher purpose vision. Such leaders apply accountability better to continuously monitor performance, and improve systems, and policies, with positive operational and relational outcomes for the firm. Hence, Hypothesis 1: *There is a significant impact of a CEO's self-revealing style on organizational performance variables.*

Fact-oriented style (FOS) is composed of factual and objective statements (Stajner et al., 2021). From a social media perspective, such posts or communication are built employing facts and/or figures to explain their views on something (Symanto, 2022). Within the corporate leadership context, especially in the west, fact-oriented communication has been seen as traditionally vital for CEOs to achieve better negotiation outcomes for self and the firm (Bernard, 2009). However, in international negotiation terms, lately it has been recognized that fact-orientation may be coupled with more collaborative self-revealing style may be more effective for performance outcomes (Bernard, 2009). Fact-oriented communication of CEOs has been found effective in ensuring better change-management in the organization, with improved motivational and operational outcomes. Such style is particularly effective in smooth digitization and globalization transitions (Deschamps, 2020). Hence, Hypothesis 2: *There is a significant impact of a CEO's fact-oriented style on organizational performance variables.*

Action-seeking style (ASS) of communication consists of direct or indirect requests, suggestions, and recommendations, for action, which may be expected or invited from other people (Stajner et al. 2021). Within a social media textual context, action-seeking communication is understood as writing or posting in a way, which is targeted at triggering the recipients' action through offering advice, suggestions, or making requests (Symanto, 2022). Specifically, within the context of CEO communication, this is a construct conceptually close to task-oriented style of leaders. Such leaders communicate clear targets, plan processes, and set deadlines for others to follow. Usually, they back it up with some form of payoff. Action-seeking or task-oriented leadership communication has been acknowledged as particularly useful in emergency situations, or at times, when the company must be going through a crisis. In such cases, action seeking communication is synonymous with providing a definitive direction, and thus is likely to improve specific efficiency and productivity outcomes, falling

mainly within an operational domain (Groves, 2007). Hence, Hypothesis 3: *There is a significant impact of a CEO's action-seeking style on organizational performance variables.*

Information-seeking (ISS) communication style is one, wherein direct or indirect questions are sought from others (Stajner et al. 2021). In social-media communication terms, the information-seeking communication style involves engaging others by posing questions or asking for advice (Symanto, 2022). Within the CEO communication sphere, information-seeking communication largely connotes advice-seeking communication (Ma et al., 2020). Such communication behavior has been found to have important effects on business and operational performance aspects like strategic decision making, management effectiveness, entrepreneurial orientation, innovation, and financial performance. Such CEO communication also likely affects relative competitive firm performance (Heyden et al., 2013). Hence, Hypothesis 4: *There is a significant impact of a CEO's information-seeking style on organizational performance variables.*

Emotional state communication (ES) refers to a psychological state of being or feeling emotional, and the psycholinguistic cues that are generated in such a state are focused on values and emotions (Stajner et al., 2021). From a social-media posts perspective, Emotional state emanates psycholinguistic cues that may be categorized as emotional signals, which reflect one's personal beliefs and values (Symanto, 2022). Within the CEO and firm context, such communication maybe seen in terms of feelings as opposed to thinking (Theil et al., 2022), and is viewed as conceptually emerging and akin to the CEO emotional intelligence construct. Such communication as representing a state of meaningful display of a CEO's emotional intelligence is likely to affect diversification, and innovation performance, eventually impacting the operational and business outcomes for the CEO firm (Ezzi et al., 2016). Hence, Hypothesis 5 : *There is a significant impact of a CEO's Emotional state communication on organizational performance variables.*

Data

The overarching sets of constructs identified are proceed with the analysis may broadly be categorized as the communication styles and the organizational performance. The data for the communication styles are captured from Symanto Data insights platform (Symanto, 2022)

which is an AI – Psychology based deep learning API used to capture psycholinguistic clues from text. To construct our sample of CEOs, we first acquire the list of S&P 500 companies, and then visit the official website of each company. For those publicly owned companies, information about CEOs will be displayed thoroughly and updated timely for information disclosure to stakeholders. Information about CEOs displayed on an official website typically consists of full name of CEOs; CEOs education and working experiences. Thus, the CEO of a company will be easily recognized. We then search the combination of each CEO's name and the corresponding company name on Twitter. Results are filtered by comparing names from social media to official company website, comparing username of CEO twitter handle from multiple sources including company website, personal website, and Wikipedia, comparing education and/or work experiences disclosed on social media with officially described education and/or work experiences. After this time-consuming manual process, 120 CEOs are found on Twitter. Next, we crawl the tweets from CEOs twitter page using Twitter REST API from the day CEO posted their first tweet to the year 2020. To make the communication styles reliable, we only consider CEOs who posted more than 100 tweets. Finally, we obtained 89 CEOs from the 89 distinct companies.

Organization performance data was extracted from Compustat database (WRDS, 2022) from fiscal years 2015 - 2020. Combining CEOs communication style scores with organizational performance measures, we finally derived at 79 CEOs from 79 distinct companies. So, the final data size of the study is 79.The CEO firms' sample for the dependent variables corresponded to the CEO sample. The data for the respective firms' performance metrics was collected from S&P Compustat, a comprehensive online database of market and corporate financial information published by Standard & Poor's. The database covers thousands of companies worldwide and is a credible source for marketing and corporate intelligence. We used the CEO's firm Ticker symbol to retrieve the operational and financial data for the respective firm performance dimension variables.

The control variables in the study includes firm size, business performance industrial mean, CEO age and year. Data for control variables are captured from the Compustat database and Bloomberg.

Variables

In this study, we employ the text mining approach presented by (Stajner et al., 2021) to derive the communication styles based on the four-sided communication model proposed by (Schulz von Thun, 1983). (Stajner et al., 2021) presented a BERT-LSTM based classification model to classify psychologistic textual characteristics using text data collected from variety of sources such as but not limited to Facebook, Twitter, YouTube and Amazon Reviews. Using the collected data, authors recruited three annotators to classify the sample text corpus into communication styles namely, action-seeking, self-revealing, fact-oriented and information-seeking. The authors trained and tested the proposed text mining approach against the manually labeled text corpus and achieved average F1 score of 94% making it reliable to use.

Although the algorithm presented by (Stajner et al., 2021) was rigorously tested and commercialized for ready to use purpose, we tested it again for our study purpose using annotation procedure. We hired two annotators and trained them on how algorithm captures and classify the text into communication styles. Then, we performed random sampling of tweets and acquired 500 tweets from the corpus. We asked our annotators to review and code each tweet into 4 types of communication styles and the emotionality state. Upon procedure, we compared the annotator results to the text-mining results and achieved high satisfactory agreement (Cronbach alpha = 84%). Thus, the text-mining approach provided by (Stajner et al., 2021) is reliable use in our case.

Independent variables in this study include four types of communication styles namely, Self-revealing, Fact-oriented, Action-seeking, and Information-Seeking. Communication styles in this study helps us to detect the purpose of text, which provides a lot of valuable information about the CEO. The communication styles are operationalized as average percentages of communication style score of elements in each of the sample tweets of a given CEO, as determined through the Symanto text-mining application. Thus, Communication styles are the numeric ratio variables measured on a percentage scale.

Table 11. Example tweet for each communication style

Communication Style	Example

Self-Revealing	All we had back then was carpet & a mariachi band. Now, SPACESHIP!!
Fact-Oriented	Due to high levels of demand for FSD Beta, adding "Download Beta" button to Service section of car display in ~10 days
Action-Seeking	Join me at the Bloomberg Technology Summit tomorrow as we explore the opportunities and challenges of #techtransformation .
Information-Seeking	Here are some of my takeaways from #Think2020: https://ibm.co/2ToFZWD. What stood out to you?
Emotionality	A distinct honor to welcome the 44th POTUS @BarackObama to @servicenow as we kickoff Black History Month. A true leader of consequence who continues to instill hope in every corner of the world. Thank you for joining us, Mr. President.

Table 11 shows the examples of each of the four communication styles.

The dependent variable in this study includes two types of organizational performance namely, Operational and Financial performance. Operational Performance is the systematic and synergistic aggregation of vision, planning, operating, efficiency, quality, customer, motivational, and workforce activities and measures, which improve the internal, and external efficiency of a firm (Taouab & Issor, 2019). Operational performance is likely to be affected by CEO communications styles on social media, as suggested by literature, in various terms such as productivity performance (S. Wang & Chen, 2020); absorptive capacity (Schlagwein & Hu, 2017); and operational efficiency (Fisch & Block, 2020). While there are several measures of operational performance, we chose, Employee Productivity – an employee efficiency measure. It measures employee efficiency in the company in generating sales revenue in the organization. Financial performance is a firm's ability to manage and control its own resources. It is the attainment of the financial objectives for a specific period through collection and allocation of financial resources. It is a measure of how well a firm uses its business assets to generate revenues, and also its financial health over a period (Kenton, 2021). Financial performance has also been referenced in literature as to the likely effect of CEO communication styles via their social media usage (Bank et al., 2019; Chung et al., 2015; Sahaym et al., 2021).

To incorporate, revenue, profitability, and liquidity aspects, filtering for ambiguity, we chose the Return on Equity to gauge the financial performance of the sample CEO firms. Return on Equity is a measure of profit to equity based financial performance. It is measured as, Return on Equity : Income before extraordinary items (IBE)/ Common Equity. IBE represents the total income of the organization after all expenses. Both IBE and Equity are in millions of dollars.

The control variables in the study includes firm size, business performance industrial mean, CEO age and year. Firm size is measured as natural log of revenues in year t+n-1, because large and small companies may encounter distinct organizational dynamics and CEOs may have various levels of authority in company of different sizes. We control the industry central tendencies by incorporating the industry average (BPIndMean). BPIndMean = (m* n – c)/(n-1) where m is the industry mean, n is the number of companies in the industry considered to arrive at the mean, and c is the value of the variable for the company of the interest. We control for CEO age because the desire to engage in the corporate matters may likely vary with age. age is a continuous numeric variable that denotes the age in years, of the CEOs in the sample.

Regression Models

This study employed a panel design to examine the effect of the CEO communication styles on the firm performance. The reason to perform panel modeling was to account for greater time variability in the performance outcomes through the model, which is not possible through cross sectional design. The relationships have been modeled based on the study objectives, variables, and hypotheses, employing a set of multiple Generalized Least Squares (GLS) regression models. Because the firms in our study sample are not all from same industry or of same size, there may be heterogeneity among them. In order to account for group-wise heteroscedasticity and autocorrelation, We first test for heteroscedasticity between the groups using Breusch-Pagan test and also test for autocorrelations within group using Wooldridge test. The figures in the APPENDIX A2 and A3 show there is considerable heteroscedasticity and autocorrelation in our panel data respectively, so we used generalized least squares estimation for our panel data models.

The overall regression model is presented below:

$$BP_{it} = \alpha_{it} + \beta_1 * SRS_i + \beta_2 * FOS_i + \beta_3 * ASS_i + \beta_4 * ISS_i + \beta_5 * ES_i + c_1 * AGE_{it} + c_2 * BPIndMean_{it} + c_3 * FS_{it} + c_4 * Year_{it} + e$$

Herein, BP is the business performance vector, consisting of the Operational and Financial performance variables. Where, the model terms are as follows:

OP = Operational Performance of the CEO firm

FP = Financial Performance of the CEO firm

OP, and FP, are the dependent variables

i = CEO or CEO firm number or serial in the CEO sample; such that total sample: i = 1 to n

t = business performance year

SRS = Self-Revealing Communication Style of the CEOs

FOS = Fact-Oriented Communication Style of the CEOs

ASS = Action Seeking Communication Style of the CEOs

ISS = Information-Seeking Communication Style of the CEOs

ES = Emotional State Communication of CEOs

AGE= CEO Age

BPIndMean = Business Performance Industry average

FS = Firm Size

Year = Year

e = error term

CHAPTER 4

RESULTS, INTERPRETATION AND FINDINGS

Descriptive Statistics

As per the panel data descriptive result output (Table 12), consistent with the strongly balanced data, the time dimension observations for most variables are T=6, except for a few, where some observations may have been missing. Such values are represented by an observation - number of weighted average value T-bar. The 'between' variation on the time dimension and the within variation on the time dimension is zero supported by strongly balanced data. Among the dependent variables, employee productivity (EP) shows much greater 'between' variability than within variability, while Return on Equity (ROE) shows considerably greater within variability than between variability. The greater 'within' variability in ROE may cause lesser 'within' variability to be explained in the same as opposed to that in EP when regressed on the same set of predictors. Among the variables of interest, the four communication styles and the emotionality style, the within variation is close to zero, consistent with their time-invariant nature. For all the control variables except year, the variability is greater than the respective within variability. Comparing the outcome variables, the coefficient of variation (CV = std dev/mean) for EP = .6831/6.1 =0.1119, as opposed to ROE (CV = .8795/.1786 = 4.92) showing much greater overall variability in the latter. Among the communication style variables, ASS (CV=1.600) shows the greatest variability as opposed to ISS (CV=.216), which exhibits the least variability.

Table 12. Descriptive Statistics

Variable		Mean	Std. Dev.	Min	Max	Observations
Company ID	overall	40	22.8276	1	79	N = 474
	between		22.94922	1	79	n = 79
	within		0	40	40	T = 6
Year	overall	17.5	1.709629	15	20	N = 474
	between		0	17.5	17.5	n = 79
	within		1.709629	15	20	T = 6
Employee Productivity (EP)	overall	6.109902	0.686179	4.210449	7.885764	N = 462
	between		0.675748	4.366966	7.67772	n = 79
	within		0.148532	5.113469	6.852107	T-bar = 5.848

Return on Equity (ROE)	overall	0.17865	0.879574	-8.33646	8.471605	N = 472
	between		0.572477	-2.25296	3.388637	n = 79
	within		0.669351	-5.90486	5.261617	T = 5.97468
Action Seeking (ASS)	overall	0.458433	0.735084	0.009897	5.458833	N = 474
	between		0.739	0.009897	5.458833	n = 79
	within		4.43E-17	0.458433	0.458433	T = 6
Information Seeking (ISS)	overall	5.751497	1.246961	0	7.379236	N = 474
	between		1.253604	0	7.379236	n = 79
	within		4.15E-16	5.751497	5.751497	T = 6
Fact Oriented (FOS)	overall	0.335896	0.489452	0.00642	3.541126	N = 474
	between		0.49206	0.00642	3.541126	n = 79
	within		4.11E-17	0.335896	0.335896	T = 6
Self Revealing (SRS)	overall	5.437247	1.266095	0	7.43729	N = 474
	between		1.27284	0	7.43729	n = 79
	within		5.01E-16	5.437247	5.437247	T = 6
Emotionality (ES)	overall	0.613386	0.132561	0	0.96937	N = 474
	between		0.133267	0	0.96937	n = 79
	within		6.76E-17	0.613386	0.613386	T = 6
Firm Size (FS)	overall	9.563347	1.416181	5.611302	12.86376	N = 466
	between		1.401744	6.332601	12.41065	n = 79
	within		0.235667	8.203695	10.65596	T-bar = 5.8987
Employee Productivity Industry Mean (EP_IndMean)	overall	6.164711	1.047992	-4.50801	7.119774	N = 456
	between		0.851776	-0.50335	7.001777	n = 76
	within		0.617039	2.160056	13.73855	T = 6
Return on Equity Industry Mean (ROE_IndMean)	overall	0.176249	0.23874	-0.42287	1.070666	N = 472
	between		0.15297	0	0.520168	n = 79
	within		0.18370	-0.289134	0.7445571	T = 5.97468
Age (Age)	overall	50.74051	6.103595	30	64	N = 474
	between		5.890486	32.5	61.5	n = 79
	within		1.709629	48.24051	53.24051	T = 6
Year (year)	overall	3.5	1.709629	1	6	N = 474
	between		0	3.5	3.5	n = 79

	within		1.709629	1	6	T = 6

Table 13. Correlations between the variables

	EP	*ROE*	*ASS*	*ISS*	*FOS*	*SRS*	*ES*	*FS*	*EP_IndMean*	*ROE_IndMean*	*Age*	*Year*
Employee Productivity (EP)	1.000											
Return on Equity (ROE)	-0.146*	1.000										
Action Seeking (ASS)	-0.231*	0.360*	1.000									
Information Seeking (ISS)	0.567*	-0.045	-0.069	1.000								
Fact Oriented (FOS)	-0.205*	0.403*	0.692*	-0.167*	1.000							
Self Revealing (SRS)	0.581*	-0.066	-0.018	0.699*	-0.141*	1.000						
Emotionality (ES)	0.636*	-0.077	-0.081	0.689	-0.150*	0.711*	1.000					
Firm Size (FS)	0.192*	0.086	0.099*	0.016	0.285*	0.048	0.106*	1.000				
EP Industry Mean (EP_IndMean)	0.181*	-0.022	0.007	0.031	-0.056	0.091	0.123*	-0.024	1.000			
ROE Industry Mean (ROE_IndMean)	-0.095*	-0.009	-0.056	-0.111*	-0.031	-0.157*	-0.155*	0.034	-0.070	1.000		
Age	-0.122*	0.074	0.131*	-0.052	0.116*	-0.072	-0.076	0.194*	0.033	0.010	1.000	
Year	0.060	0.037	0.000	0.000	0.000	0.000	0.000	0.091*	0.107*	0.141*	0.280*	1.000

The correlation matrix (Table 13) shows the correlations with significant values at a 5% level between each of the model variables. Several bi-variate associations emerge. The dependent variables (EP and ROE) though being studied under separate models in this study have a significant but small and negative correlation (r=-.1460, p<.05) between them. This is consistent with the fact they measure considerably different aspects of business performance.

EP has a significant moderate to high positive correlation with ISS (r=.5674, p<.05) and SRS (r = .5813, p<.05) and ES (r=.6361, p<.05). This indicates that emotional content and

critical information inflow and outflow during CEO communication may have a significant impact on employee performance. ROE on the other hand has a significant, positive, and moderate to high correlation with FOS (r=.4029, p<.05) and a moderate correlation with ASS (r=.3595, p<.05). This is consistent with the fact that an objective and result-oriented approach to communication may have a greater impact on the financial aspect of business performance. Notably, most of the predictors have a correlation level of r<.70, even though many of them are significant, which indicates that the presence of multicollinearity is unlikely in the data.

Inferential Results

Table 14 shows the estimated results for Panel Data Regression for the model variants, based on the two Dependent Variables (DVs) namely – Employee Productivity (EP) and Return on Equity (ROE), respectively representing the two dimensions – Operational and Financial of Organizational Business Performance. A robust version of the random effects model, known as the random effects GLS model based on the assumption testing was administered.

Table 14. Inferential Results – Panel Data Regression

Variables	**Operational Performance**	**Financial Performance**
	Employee Productivity (EP)	Return on Equity (ROE)
Action-Seeking Style (ASS)	- .0493 (.0800)	.1830 (.1218)
Information-Seeking Style (ISS)	.1508 (.1311)	.0484 (.0524)
Fact-Oriented Style (FOS)	- .2774** (.1146)	.5354*** (.1930)
Self-revealing Style (SRS)	.1546** (.0621)	- .0324 (.0587)
Emotionality Style (ES)	1.5654* (.8805)	- .2472 (.3817)
Firm-Size (FS)	.2051*** (.0615)	-.0091 (.0405)
Business Performane Industrial Mean (EP/ROE_IndMean)	- .0007 (.0031)	.0222 (.1407)
Age	- .0095 (.0085)	.0014 (.0078)
Year	-.0206** (.0109)	.0173 (.0256)
Constant	1.9813*** (1.1731)	- .0820 (.4543)
R2		
R2-Within	0.2572	0.0023

R2-Between	0.5538	0.4176
R2-Overall	0.5762	0.1789
Sigma u	0.3898	0.3498
Sigma e	0.1413	0.7400
Rho	0.8837	0.1826
Theta	0.8535	0.3464
Obs	447	466
Groups	76	79

*p < 0.10; **p < 0.05;
***p<0.01
Std. errors in parentheses

As per the model variant with DV=EP, Self-Revealing Style (SRS) of CEOs has a significant positive impact (β=.1546, p<.05) on Employee Productivity (EP) of CEO firms. This implies that a one unit increase in Information-seeking content of the CEO communication from its prevalent level at a point in time is likely to improve the Employee Productivity by 15.46%. Fact-oriented style (FOS) has a significant negative impact (β=-.2774, p<.05) on Employee Productivity (EP) of CEO firms. This implies that a one unit increase in Fact-oriented content of the CEO communication from its prevalent level at a point in time is likely to impair the Employee Productivity by 27.74%. Whereas Emotionality style (ES) of CEOs has a significant positive impact (β=1.565, p<.10) on Employee Productivity (EP) of CEO firms. This implies that a one unit increase in Emotionality content of the CEO communication from its prevalent level at a point in time is likely to improve the Employee Productivity by 15.65%. In this model, the firm-size, controls for the tendency of the CEOs to engage with stakeholders or the firm to perform differently in different years, as unrelated with their communication styles. In this case, firm-size has a significant positive impact on the firm's employee productivity (β=.2051, p<.01), which has been controlled for from the perspective of the variables of interest, namely the CEO communication styles. Whereas, Year has a significant negative impact on the firm employee productivity (β=-.0206, p<.05). Under this model, the proportion of total variance due to the individual specific effects u_i is favorably high (Rho=88.37%) and the rest is due to idiosyncratic error. Such individual specific error can be ascribed to individual CEOs or firms, even though its source may not be determined. Also, the random effects estimates are much closer to the within effects estimates than OLS estimates in this case (Theta=85.35%) showing an overall high accountability for time-based variability in EP. The R-squared metrics for this

model overall show a good model fit, as a considerable 57.62% variability (R sq. overall = 0.5762) in the EP outcome is explained by the model predictors. However, the model explains much greater between firms' variability (R sq. between = 0.5538) than within firms one (R sq. within = 0.2572), in the outcomes.

For the DV=ROE model, Fact-Oriented style (FOS) of CEOs has a significant positive impact (β=.5354, p<.05) on the return on Equity (ROE) or Financial Performance (RP) of CEO firms. This implies that a one unit increase in the Action-seeking content of the CEO communication from its prevalent level, at a point in time is likely to improve the firm's Return on Equity by 53.54 %, under the model. Under this model, the proportion of total variance due to the individual specific effects u_i is low yet considerable (Rho=18.26%) and the rest is due to idiosyncratic error, which shows greater unexplained variance. Also, the random effects estimates are much closer to the within effects estimates than OLS estimates in this case showing an overall accountability for time-based variability in ROE being on the lower side. The R-squared metrics for this model overall show an acceptable model fit (R sq overall = .1789) explaining 17.89 % variability in the ROE outcomes. However, the model explains much greater and considerable between firms' variability (R sq between = 0.4176) than within firms one (R sq within = 0.0023), in the outcomes.

Comparatively, the DV=EP model predictors explain greater variability than DV=ROE model and showing greater model strength. Also, both models explain greater between variability than between variability, which may be explained by a considerable number of time-invariant predictors of interest. However, the DV=EP model explains a much higher level of respective between variability than within variability, as compared to DV=ROE model.

Table 15. Inferential Results – with interaction (moderation) variable

Variables	**Operational Performance**	**Financial Performance**
	Employee Productivity (EP)	Return on Equity (ROE)
Action-Seeking Style (ASS)	.4667 (.6178)	1.4210** (.5761)
Information-Seeking Style (ISS)	.3564 (.6954)	-.0398 (.2147)

Fact-Oriented Style (FOS)	- 1.7762 (1.2329)	.6020 (.4968)
Self-revealing Style (SRS)	-.5130 (.7483)	.0235 (.2505)
Emotionality Style (ES)	-3.2135*** (.9459)	.5422 (.8456)
ES_ASS Interaction	- .6304 (.9976)	- 2.1589** (1.088)
ES_ISS Interaction	- .1318 (1.0859)	.1172 (.3399)
ES_FOS Interaction	2 .5548 (2.0705)	- .3896 (.8462)
ES_SRS Interaction	1.1563 (1.1779)	-.1058 (.3878)
Firm-Size (FS)	.1519*** (.0514)	-.0117 (.0409)
BPIndMean	- .0006 (.0033)	.0142 (.1404)
Age	- .0028 (.0065)	- .0012 (.0081)
Year	.0173* (.0103)	.0204 (.0253)
Constant	3.9749*** (.5770)	- .1981 (.4818)
R2		
R2-Within	0.2363	0.0022
R2-Between	0.7611	0.4685
R2-Overall	0.7309	0.2000
Sigma u	0.3074	0.3392
Sigma e	0.1414	0.7400
Rho	0.8254	0.1736
Theta	0.8155	0.3350
Obs	447	466
Groups	76	79

*p < 0.10
**p < 0.05
***p <0.01
Std. errors in parentheses

The previous literature suggested that emotional content of the CEO messages may interact with the communication style content of the CEO messages to affect latter's' impact on the firm performance. Thus, interaction terms were introduced in the main GLS model to account for any moderation effects in the data and compare the same with the main results. The results for moderation version of the operational and financial model variants is presented in Table y.

From the table 15 we can interpret that; Overall Emotionality state interaction effects have enhanced the R sq. of both the Employee productivity and Return on equity models.

Emotionality state has a suppressing effect on the relationship between Action-seeking style (ASS) and return on equity (ROE) performance as revealed under the Return on equity moderation model. Whereas Emotionality state has an enhancing effect on the positive impact of Self-Revealing style and a negative impact of Fact-oriented style on the Employee productivity performance of the CEO firms, which is revealed in the Employee productivity moderation model.

Discussion

The research problem of a lack of evidence and prediction of the relationship between CEO communication styles and firm performance has been addressed. The styles both purposive or contextual and emotionality-based, were gauged from CEOs' Twitter feeds, through state-of-the-art AI and ML-based application and were regressed on the operational, and financial variables of firm performance. The direct effects and direct and interaction effects under moderation model variants detected, based on statistical analyses , address the research objectives. The models under direct and moderation models were based on two firm performance dimensions – operational and financial with two underlying dependent variables namely Employee Productivity (EP) and Return on Equity (ROE). Thus, two models based on these two dependent variables were tested for the purpose. The predictors of interest – namely the four communication styles and the emotionality variable were time-invariant variables. To account for their impact on the firm performance, thus random-effects model was deemed fit. The time-varying controls were introduced in the model to account for the endogeneity in the outcome and also balance the impact of time-invariant variables as per the requirements of random-effects modeling (Bell et al., 2019).

Apart from the main models, a pair of moderation model versions were also tested to see the impact of emotionality style on the relationship communication style and firm performance. To correct for the heteroscedasticity and autocorrelation issues detected in the model data, we ran a robust version of the random effects model or a Random Effects Generalized Linear Model. The panel data for the models consisted of 79 entities and six-time points measured in years T to T+6 (2015 through 2020), making a total of 474 data points for the analyses. The data were found to be strongly balanced, supporting the strength of the results.

The main results have shown that there is partial yet strong evidence of a direct impact of CEO communication styles on both the operational and financial aspects of firm performance. The overarching importance of these results emanates from the incremental relevance, suitability, and validity over personality traits, for leader outcomes (Bakker-Pieper & de Vries, 2013). However, there is a clear delineation and distinction in terms of which aspects of CEO communication style impact which dimension of firm performance. There is a specific combination of CEO communication styles and the emotionality construct that have distinct direct and interaction effects on different performance variables. This is a critical insight offered by the study, which is consistent with (S. Wang & Chen, 2020) in that they acknowledged and implied that personality styles work through how CEOs communicate to affect employee behavior and firm performance. The different communication styles having differential importance for different outcomes may be vital for not just CEO performance appraisal but modeling CEO performance for improved firm outcomes (Bakker-Pieper & de Vries, 2013). An overall examination of the results showing which communication styles exert significant influence on which types of performance, with a comparative view of the direct and moderation model results, is thus a worthy guide to assess the contribution of this study.

Specifically, the Self-revealing style (SRS) was found to have a highly significant and positive relationship with Employee Productivity under the robust direct effects model. Such an impact may be attributed to corporate engagement situations and is highly relevant for CEO communication contexts, where CEOs may help enhance employee self-esteem through the communication of a decisive, expressive, and accessible, self-image. This finding, consistent with (Men & Tsai, 2016) is suggestive of indirect motivation employees receive from the CEOs to spread positivity into both the internal and external environment of the firm. The positive and charged-up interactions between the employees and stakeholders also help enhance the social media capital of the firm, further accentuating the employee productivity outcomes (Saxton & Guo, 2020). Greater flows of the information under this open and transparent style also encourage improved operational effectiveness consistent with firm performance modeling literature (Taouab & Issor, 2019), change management and negotiation performance (Bernard, 2009), and advice-seeking behavior effects of corporate leadership (Ma et al., 2020). All these factors eventually impact the employee motivation and productivity, as well as the quality of their work. (Coetzer et al., 2017) pointed out that the Self-revealing style is an important aspect

of CEO servant leadership style, connoting transparency, and authenticity, which encourage employee engagement. Thus, this finding reinforces the theoretical collaborative leadership aspect of the Upper Echelons of a firm (S. Wang & Chen, 2020). The results, however, could not establish a significant impact of SRS on financial performance. This can be explained by the fact that SRS being an approach that relies heavily on personal experience and opinion (Symanto, 2022), may miss out on the objective and accurate details (Stajner et al., 2021), with clarity of purpose critical for setting and appraising financial goals of a firm (Gao, 2019).

On the other hand, the Fact-oriented style (FOS) was found to have a considerable and significant positive relationship with firms' Return on Equity representing the financial performance. This finding may be attributed to the objective and goal-based approach to CEOs' communication (Stajner et al., 2021). A greater objective information flow, facilitating clarity of financial and operational decisions helps improve profitability outcomes and in turn affect the ROE. Consistent with (Bernard, 2009) such impacts are very relevant to corporate negotiation and transition scenarios, which form an important part of a CEO's work (Deschamps, 2020).

This delineation of styles in terms of their differential impacts on performance is representative of the fact that while the fact-oriented style (FOS) is at the one extreme of the objectivity of exchange continuum, the self-revealing style is at the other end (Stajner et al., 2021). Thus, not unexpectedly, a significant negative association between FOS and employee productivity (EP) was found. Such a negative impact of a fact-oriented approach to communication on employee productivity in this study may be attributed to insensitive, cold, and calculative perception of CEO communication. CEOs with a fact-oriented style may tend to focus too much on objective facts about performance while failing to engage the employees at an intrinsic identity and recognition level. The CEOs when focusing too much on facts may tend to establish a controlled rather autonomous motivation environment. At a theoretical level, this finding is consistent with the self-determination theory (Osborne & Hammoud, 2017), which posits that different types of motivation may have different types of catalyzers and consequences and, that employees have a basic need for autonomy, competence, and relatedness. Fulfillment of such needs is necessary for autonomous motivation and high-quality performance (Deci et al., 2017). The sample CEOs in the sample time frame, with a Fact-oriented approach, have evidently not been able to fulfill such needs.

Emotionality style as a variable under the direct effects robust model does not have a significant impact on the ROE performance, whereas it exhibits a significant effect on EP at a 10% ($p<.10$) level. This shows that emotionality, by itself does not have a considerable impact on organizational performance. Notably, the emotionality construct in our study is a composite binary construct, which by definition includes both emotional and rational cues. In this study, the emotionality scores by default represent the mean score on the emotional dimension, the rational aspect is a complement of (rational percent score =1-emotional score). Whereas the moderation or interaction effect of the same is discussed further ahead, the main results regarding the impact of emotionality on firm performance represent that emotionality of CEO communication by itself may not be a decisive factor in determining the firm performance outcomes. A feasible explanation of the same is that overall, an empty emotional appeal emanating from the CEO communication without much factual, informational, or result-oriented impetus may be perceived as merely rhetorical by the CEO audience, especially so by the external stakeholders. Emotionally inclined and highly empathic CEOs though will gain greater stakeholder appreciation via displays of compassion more quickly and may be more committed to healing the relational climate of the organization (König et al., 2020). This approach may work to some extent with the internal stakeholders, who may have greater confidence based on access to more realistic and internal information about the CEOs. This also explains the 10% significance shown by emotionality under the EP model. However, the lower level of significance representing a greater chance of randomness in effect calls for further investigation on this part of the result. There is some empirical evidence from China consistent with the impact of rhetorical and emotionally charged content in CEO communication on employee performance (Liu et al., 2019). Within the context of the US though, from where a large part of the sample CEOs and firms has been drawn, this may not be as relevant, probably owing to cultural differences (Hofstede, 2011). However, for other stakeholders, in absence of reliable inside information or lack of familiarity with the CEO and his personality, such confidence in the communication which borders largely on the rhetorical side, may still be wanting. Such CEOs even though empathic may be predisposed to false alarms, may be more biased in the assessment of crises, inclined to apologetic gestures, and less committed to repairing the 'operational' system of the firm (König et al., 2020). Thus, such a style may prove

to be ineffective in bringing about any meaningful change to the business and financial outcomes of the firm.

Results further showed that firm size, which was introduced in the models to control for any differences in relationships of interest owing to varying sizes in terms of levels of operations and revenue has a significant, positive impact on the employee productivity, though not on the return on equity. This justifies accounting for firm size as a control in the model. Moreover, this effect of the firm size may be attributed to the differential in resources, and accordingly, different levels and types of motivation. Consistent with the self-determination theory (Deci et al., 2017), the CEOs and firms with a large pool of resources at their disposal may focus more on autonomous motivation, as compared to the smaller firms and CEOs, who may want to achieve a greater controlled motivation.

The results under the robust models did not show any significant impact of Action-seeking style (ASS) and Information-seeking style (ISS) on either of the two organizational performance dimensions. A lack of impact of these styles represents the possibility that the CEO stakeholder audience for the sample firms within the given time frame may have perceived the action and information-seeking communication as overly demanding, generating little or no meaningful response in most cases. Prior evidence shows that the action-seeking style is characteristic of task orientation and is mostly relevant when a firm is going through a period of crisis (Baker, 2021). This may explain the lack of impact of ASS on performance. ISS, on the other hand, connotes advice-seeking and may be relevant in situations where strategic decision-making is required (Ma et al., 2020). However, if the CEO relies heavily on advice seeking, especially in scenarios of low performance, it could reduce their propensity to corporate change, connoting stagnation (McDonald & Westphal, 2003). Thus, failing to produce any meaningful performance improvement, such a style may have proved ineffective for the sample firms.

Under the moderation versions of the models, largely no significant positive effects of communication styles nor their interactions on firm performance were detected. Statistically, this may indicate an enhancing moderator impact on the major relationships detected in the main model if the moderator model were indeed plausible. It may seem that introducing emotionality style as a moderator in the model, as supported by an enhanced R sq of the model helps detect a meaningful improving impact on the main relationships, particularly under the

robust Employee productivity model. However, a review and search for a sound theoretical basis for such an enhancement did not yield any convincing results. On the other hand, since a highly significant impact ($p<.01$) of Action-seeking style (ASS) on ROE was detected, it may similarly be argued that ES was having a suppressing effect on the impact of ASS on the ROE in the main model, which was meaningfully revealed under the moderation model. A rational explanation for the same springs from the previous argument about how such a style is relevant when a firm is going through a period of crisis (Baker, 2021). Possibly a sizeable number of firms may have gone through such periods of crisis during the sample span. Thus, an implicit interaction impact of Emotionality not accounted for in the main model was kept suppressed, until it was revealed when ES interaction or moderation was introduced.

Finally, the results showed that in general that the EP model explained greater overall variance than the ROE model under both the main and moderation models. This implies that communication style and control factors overall have a greater fit with the operational than the financial dimension of the firm performance. Further, both models explained much greater 'between' variance than 'within' variance. This is attributable to a large number of time-invariant predictors of interest in the model. Further, the Rho values show that the EP model detected a much higher percentage of unknown individual-specific effects than the ROE model. A feasible explanation of this insight is that the CEOs and respective firms had a much greater level of unknown but firm or CEO specific factors, which affected Employee productivity than a similar set of factors, which were associated with the ROE of the firms. Thus, the results show that primarily the direct or main results models offer explanatory value for the study. The moderation model to some extent complements the main results by revealing the suppressor effect of ES on the Action-seeking style and ROE relationship. Also, the moderator added to the explanatory power of the model, even though it did not mostly detect statistically significant and theoretically meaningful main or moderator effects. Consistent with the proposed empirical framework, the results primarily showed specific communication flows and resultant values for the EP and ROE models respectively. The results are also relevant in terms of the theoretical lens used in the study, wherein the specific effects of communication styles detected on the firm performance help generate social media capital for the Upper Echelons, and in turn firm as a whole. Thus, consistent with the Upper Echelons theory (Carpenter et al., 2004) exert their leadership influence and generate action-seeking psycholinguistic cues with both rational and

emotional appeals, consistent with the four sides communication model (Schulz von Thun, 1983). Thus, they generate value flows in actionable terms, consistent with the social-media capital theory (Saxton & Guo, 2020). Finally, they generate positive outcomes for the firm on all the reputational, financial, and performance dimensions, completing the circle of influence, also consistent with the Upper Echelons theory.

Research Implications

The most pertinent research implication of our study is that the findings of the study employed within the confines of the proposed empirical and theoretical lens may be used to develop further research models. Such models may be especially useful in understanding not just CEO behavior and firm dynamics better, but also help arrive at suitable CEO selection and recruitment frameworks, applicable to various industrial and geographical contexts. The findings may be used to determine the emotional tonality patterns through further applied research. Such patterns imply great asset building in terms of social media capital for firms, most effective for accentuating the appeals made to the larger audience. An important implication of the findings is the need to investigate purposive communication cues on the relevant CEO communication styles further empirically. For example, empirical research may facilitate action-seeking, self-revealing, or fact-oriented styles to be reinforced further, through effective and conscious emotionality, as applicable. Also, as explained above, there is a lower level (10%) of significance in the impact of Emotionality on employee productivity. This implies ruling out the same through further investigation, taking a cue from prior research evidence (Liu et al., 2019).

Practical and Managerial Implications

In practical and managerial terms, the most overarching implication of our research is that corporate firms may now devise ways to evaluate the CEO leadership through communication rather than a personality lens. The evaluations may be based on our findings and the empirical framework proposed and demonstrated in this research. For example, Operational performance is positively affected by the Self-revealing style and financial performance by the Fact-oriented style. This may be used as a guide to direct the CEOs' communication, especially on social media platforms like Twitter. The CEOs may, for instance,

fine-tune their messaging to include more self-revealing cues for a greater operational and employee engagement advantage. Another important practical implication of the research consistent with our empirical framework is value flows manifested via the performance outcomes. Such value flows back and forth between the CEOs, firm, and other internal and external stakeholders to create win-win scenarios for the firm and its environment. The operational outcomes offer advantages and competencies, which may also contribute to financial outcomes for the firm. These insights may be suitably adapted to specific managerial situations, based on individual firm contexts, and used to shape the communication effort of the Upper Echelons and CEOs for maximizing communication-linked firm outcomes.

Contribution, Limitations, and Future Research Recommendations

This study most significantly contributes to the IS literature on Upper Echelons leadership impact by establishing CEO communication styles and emotionality appeals and their interactive combination as a novel standard for evaluating leadership impact on firm performance. Further, the empirical framework offered by the study is a new and insightful practical research structure rooted in relevant IS theories in the field. The communication flows and values offer practical insights and are supported by the results of the study. The said flows offer a research-based view of how CEO communication may be shaped over time and context to maximize firm performance outcomes.

There are several limitations of the research which must be considered while interpreting and applying its findings. Firstly, the sample of this study was mostly geographically concentrated within the US. While this was necessitated by the inclusion criterion, which was to include top companies from the S&P 500 companies list, based on their Twitter presence, it resulted in the CEOs and firms mostly from the US being selected in the sample. Secondly, the sample size on the entity dimension itself may be considered rather small, however, since we eventually performed a panel data regression, this limitation was compensated for to quite an extent by the inclusion of a time dimension to the data. The six years (T through T+6) data dimension finally resulted in 474 data points adding to the strength of the analysis. There were several missing values in the data, however, since the dataset was found to be strongly balanced, this limitation did not pose a major problem. An important limitation of the study, however, remains that the reputational or branding aspect of firm

performance, which may be a critical third dimension of performance, within the context of our study could not be accounted for, owing to a lack of time-series data for the same. Further, this being a novel study employing communication style as a dynamic construct of leadership evaluation, we could consider only the more obvious but underlying emotionality interactions as the possible moderating paths for the communication styles' impact on firm performance. However, there may exist more constructs and paths through which the value flows.

Based on the above limitations and as suggested by the findings of our research we recommend several important future research directions. Firstly, it is advised for future researchers in the field to establish more conceptual paths and constructs for the value flows and firm outcomes. Researchers may identify more communication flow and value paths based on our findings. It is recommended to further test the empirical framework in different geographical and industrial contexts as well. The researchers are advised to access data from a range of social media platforms offering unique psycholinguistic cues and holistic insights on the topic. It is hereby suggested to explore ways to find credible sources of marketing and branding performance of firms over the years to enable accounting for reputational performance in the robust panel data regression model. This may also require modeling the communication styles and cues differently than they are done in this research. It is important to establish various other forms of written and textual communication suitable for empirically testing the effect of CEO communication style constructs on firm performance. They may also establish a standardized academic algorithmic tool or approach for gauging psycholinguistic cues from CEO messages. Finally, it is advised to identify and establish more appropriate firm performance dimensions and measures to establish a core theoretical basis, augmenting and solidifying the composite theoretical lens put forth in this research.

CHAPTER 5

CONCLUSIONS

This study extends the empirical Upper Echelons research on leadership impact and firm performance. Proposing communication styles as a novel way to assess the textual social media

communication influences of CEOs on the stakeholder and general audience, the study assessed the CEO communication styles' impact on firm performance.

The proposed framework was statistically tested through direct and moderation-based panel regression models applied to psycholinguistic, firm performance, and control factors, and supported by the study assumptions and results. The type of variables employed, and effects being studied necessitated applying a random-effects model to the panel data collected for the purpose. However, a careful assessment and testing of the data revealed a violation of assumptions like homoscedasticity and lack of autocorrelation. Thus, a robust GLS version of the random-effects model was applied to analyze the data, which yielded more accurate and reliable results. These analyses helped establish the relationships towards the validation of the study hypotheses and fulfillment of the research objectives.

The main results have shown that there is partial yet strong evidence of a direct impact of CEO communication styles on both the operational and financial aspects of firm performance. The study shows that specific communication styles affect the firm performance on specific dimensions.

Notably, the Self-revealing style (SRS) was most significantly and positively associated with operational performance and the fact-oriented style (FOS) had a significant positive impact on the financial performance of the firms. Firm size a control variable also had a strong, positive relationship with employee productivity. The introduction of emotionality style (ES) moderation or interaction effects with communication styles yielded a model which explained greater variance in the respective ES and ROE models. However, under the moderation versions of the models, largely no significant positive effects of communication styles nor their interactions on firm performance were detected. The introduction of ES interactions yielded a significant and positive impact of the Action-seeking style on the ROE of the firms. With a solid conceptual and literary basis, this was construed as ES having a suppressor effect on the relationship between ASS and ROE, which was eventually revealed in the moderation model. These outcomes were suitably explained and were mostly found consistent with the relevant literature on the topic.

Further, the results showed that in general that the Employee productivity (EP) model explained greater overall variance than the Return on Equity (ROE) model under both the main and moderation models. Both models explained much greater 'between' variance than within

variance. EP model detected a much higher percentage of unknown individual-specific effects than the ROE model. Overall, the results show that primarily the direct or main results models offer explanatory value for the study. The moderation model to some extent complements the main results by revealing the suppressor effect of Emotionality (ES) on the Action-seeking style and ROE relationship. The results show that both direct and moderation models offer explanatory value for the study. The control variables also helped better explain the effects and relationships.

The implications including the novel use of communication styles, social-capital building, facilitation of CEO evaluation frameworks, and fine-tuning of Upper Echelons' social media communications were reported. Recommendations included the establishment of conceptual and empirical paths, more communication and value flow paths, and employing more social-media platforms for a holistic approach to the psycholinguistic analysis of CEO communication. The establishment of more firm performance measures and consolidation of the theoretical base through further research is recommended.

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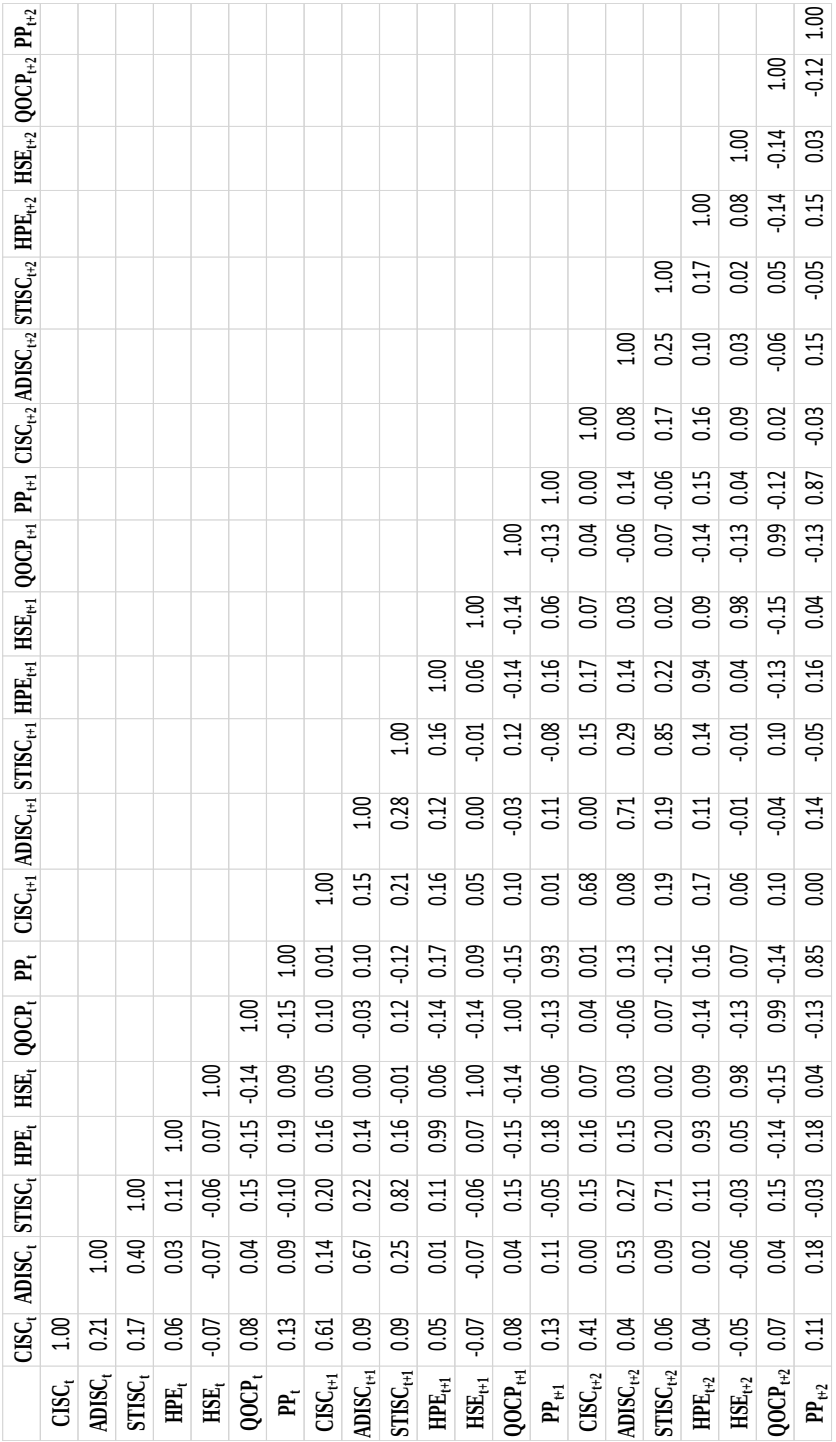
APPENDICES

A.1: Correlations between study variables for Project 1



	$CISC_t$	$ADISC_t$	$STISC_t$	HPE_t	HSE_t	$QOCP_t$	PP_t	$CISC_{t+1}$	$ADISC_{t+1}$	$STISC_{t+1}$	HPE_{t+1}	HSE_{t+1}	$QOCP_{t+1}$	PP_{t+1}	$CISC_{t+2}$	$ADISC_{t+2}$	$STISC_{t+2}$	HPE_{t+2}	HSE_{t+2}	$QOCP_{t+2}$	PP_{t+2}
$CISC_t$	1.00																				
$ADISC_t$	0.21	1.00																			
$STISC_t$	0.17	0.40	1.00																		
HPE_t	0.06	0.03	0.11	1.00																	
HSE_t	-0.07	-0.07	-0.06	0.07	1.00																
$QOCP_t$	0.08	0.04	0.15	-0.15	-0.14	1.00															
PP_t	0.13	0.09	-0.10	0.19	0.09	-0.15	1.00														
$CISC_{t+1}$	0.61	0.14	0.20	0.16	0.05	0.10	0.01	1.00													
$ADISC_{t+1}$	0.09	0.67	0.22	0.14	0.00	-0.03	0.10	0.15	1.00												
$STISC_{t+1}$	0.09	0.25	0.82	0.16	-0.01	0.12	-0.12	0.21	0.28	1.00											
HPE_{t+1}	0.05	0.01	0.11	0.99	0.06	-0.14	0.17	0.16	0.12	0.16	1.00										
HSE_{t+1}	-0.07	-0.07	-0.06	0.07	1.00	-0.14	0.09	0.05	0.00	-0.01	0.06	1.00									
$QOCP_{t+1}$	0.08	0.04	0.15	-0.15	-0.14	1.00	-0.15	0.10	-0.03	0.12	-0.14	-0.14	1.00								
PP_{t+1}	0.13	0.11	-0.05	0.18	0.06	-0.13	0.93	0.01	0.11	-0.08	0.16	0.06	-0.13	1.00							
$CISC_{t+2}$	0.41	0.00	0.15	0.16	0.07	0.04	0.01	0.68	0.00	0.15	0.17	0.07	0.04	0.00	1.00						
$ADISC_{t+2}$	0.04	0.53	0.27	0.15	0.03	-0.06	0.13	0.08	0.71	0.29	0.14	0.03	-0.06	0.14	0.08	1.00					
$STISC_{t+2}$	0.06	0.09	0.71	0.20	0.02	0.07	-0.12	0.19	0.19	0.85	0.22	0.02	0.07	-0.06	0.17	0.25	1.00				
HPE_{t+2}	0.04	0.02	0.11	0.93	0.09	-0.14	0.16	0.17	0.11	0.14	0.94	0.09	-0.14	0.15	0.16	0.10	0.17	1.00			
HSE_{t+2}	-0.05	-0.06	-0.03	0.05	0.98	-0.13	0.07	0.06	-0.01	-0.01	0.04	0.98	-0.13	0.04	0.09	0.03	0.02	0.08	1.00		
$QOCP_{t+2}$	0.07	0.04	0.15	-0.14	-0.15	0.99	-0.14	0.10	-0.04	0.10	-0.13	-0.15	0.99	-0.12	0.02	-0.06	0.05	-0.14	-0.14	1.00	
PP_{t+2}	0.11	0.18	-0.03	0.18	0.04	-0.13	0.85	0.00	0.14	-0.05	0.16	0.04	-0.13	0.87	-0.03	0.15	-0.05	0.15	0.03	-0.12	1.00

Figure A.1. Correlations between the variables for the Project 1

A.2: Heteroscedasticity

The Breusch-Pagan/Cook-Weisberg test based on preliminary iterations of inferential tests for heteroscedasticity was conducted. The result of the tests (Figure A.2) shows the presence of heteroscedasticity or non-constant variance in both the DV=EP and DV=ROE data, which may affect the confidence intervals of coefficients, but not the coefficients themselves. In this study, care was taken to ensure best modeling practices, and the data were also pre-processed to minimize data issues, within the constraints of secondary sourcing of the same. Since the heteroskedasticity in the data is unlikely to be owing to model and data issues, it was deemed as what may be termed "essential heteroskedasticity" (Knaub Jr, 2017; Koenker, 1981). However, it is important to test for serial-autocorrelation in the data to be sure about this insight.

```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of EP

         chi2(1)      =   498.65
         Prob > chi2  =   0.0000

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of ROE

         chi2(1)      =   285.83
         Prob > chi2  =   0.0000
```

Figure A.2. Breusch-Pagan test for Heteroscedasticity

A.3: Serial Autocorrelation

Data were tested for autocorrelation, and for both the DV=EP and the DV=ROE models, a strong presence of autocorrelation in the data was found (Figure A.3). The presence of serial autocorrelation along with heteroscedasticity in the data was a cause of concern. Thus, instead of a regular random effects panel regression model, we finally administered the robust version of the same, which is a random-effects GLS (Generalized Least Squares) regression. The GLS model is robust to the presence of heteroscedasticity and autocorrelation in the panel data. The

GLS regression was applied to both sets of data models namely DV=EP and DV=ROE variants and the results are presented in the inferential results section.

DV=EP model

```
Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,      73) =     41.552
           Prob > F =      0.0000
```

DV=ROE model

```
Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,      76) =     12.750
           Prob > F =      0.0006
```

Figure A.3. Woolridge Test for Autocorrelation