Exploring Implementation Strategies of IoT Technology in Organizations: Technology, Organization, and Environment

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Abstract

In the process of adopting internet of things (IoT) technology in the organization, many corporate information technology (IT) leaders faced challenges during implementation. Grounded in technology-organization-environment (TOE) theory, this qualitative, pragmatic inquiry study explored strategies corporate IT leaders use to implement IoT technology in their organizations. The six qualified research participants, holding positions from project manager to chief executive officer to founder in the healthcare industry, responded to semi-structured questions. Data were collected in semi-structured interviews and industry security documents. Using the thematic analysis to analyze the data, six themes were identified: using all identified internal project staff skills, aligning current IoT technology with business needs, using all identified existing internal infrastructure, using all recognized external support technologies, taking full advantage of vendor support, and using all identified external influencers and influences. A key recommendation for IT leaders is to use the IoT ecosystem from the IoT solutions to promote benefits and profits. Implications for business practice for this study include improved technology to support and promote benefits to organizations and increase the number of organizations successfully implementing IoT technology and continuing to use it. Businesses and end-users can benefit from the IoT ecosystem with IoT devices in smart cities, offices, hospitals, and homes.

Keywords: Internet of Things Technology, IoT Technology, IoT Implementation, Implementation Strategies, Implementing IoT Technology, IoT Technology Project, Social Change, TOE Conceptual Framework, IoT Influencers, IoT Influences, Healthcare IoT Technology, Healthcare Innovation, Healthcare Innovative Solutions.

Introduction/Background

Researchers and corporate IT leaders have encountered challenges in adopting and implementing IoT technology to realize its benefits. For example, there are challenges in the implementation of IoT technology with mobile cloud computing (MCC), wireless sensor network (WSN), and medical monitors or applications such as collecting IoT data in real-time or shortening IoT device lifecycle from energy-draining on the network (Dinh et al., 2017; Li et al., 2018; Luo & Ren, 2016). Thus, the studies' researchers reported issues implementing IoT technology with other technologies such as MCC, WSN, or medical systems. However, some practitioners had successful strategies for adopting and implementing IoT technology to benefit their organizations, such as the six research participants in this study.

Cloud computing service providers and corporate IT departments could integrate cloud computing with WSN and mobile networks to realize benefits from IoT devices' mass data. Researchers and organizations proclaimed the successful implementation of IoT technology with other technologies such as industrial IoT (IIoT), Industrial 4.0, WSN, and big data to improve business decision-making strategies (Castro et al., 2017; Cedeno et al., 2018; Kobusinska et al., 2018; Song, 2017). Thus, these studies researchers reported the benefits of successfully implementing IoT technology in industries with the convergence of cloud computing and big data. In this study, we explored the factors of implementation strategies for IoT technology that researchers and corporate IT leaders successfully used to realize IoT benefits for their organizations.

Summary of the Literature

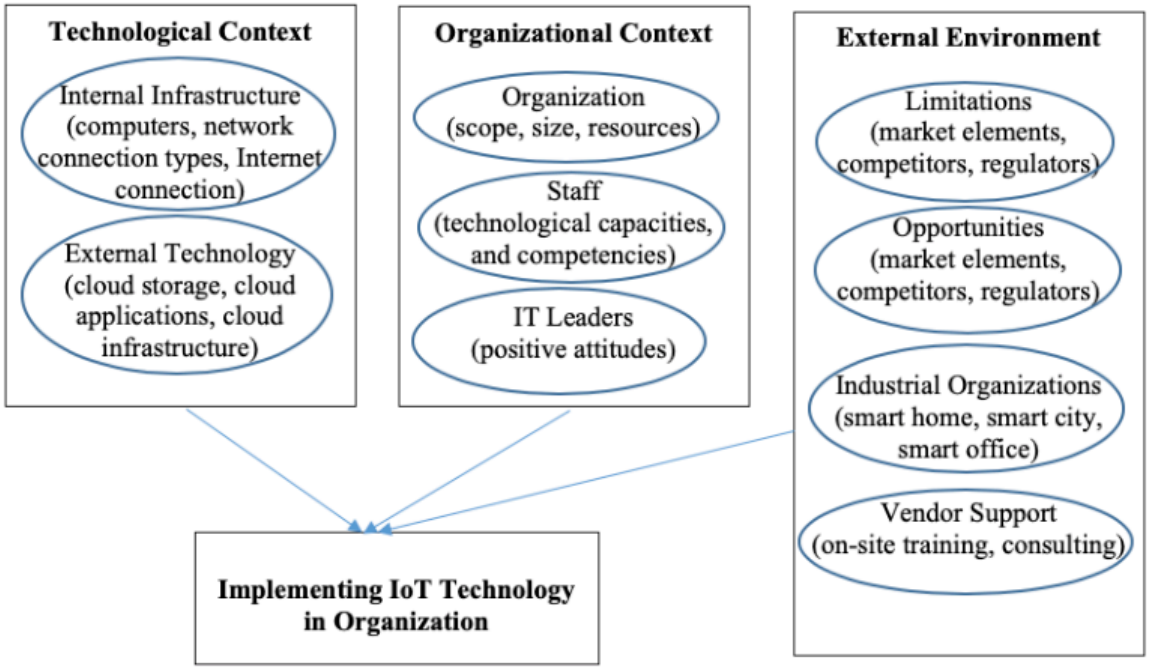
After adopting the innovation, organizations and corporate IT leaders have failed to integrate IoT systems with existing business resources. The United States Department of Defense (DoD) has reported that some IT offices within government agencies have failed implementations of IoT technology (Kirschbaum, 2017). According to Ives et al. (2016), 37% of US organizations strived to embrace IoT technology, with 73% of the agencies unsuccessfully integrating their IoT systems with existing resources noting that 59% failed during the implementation phase, and 14% failed during the integration phase. Corporate IT leaders need adequate implementation strategies for IoT technology to realize IoT benefits for their organizations. This study explores successful implementation strategies that healthcare corporate IT leaders use to implement and integrate IoT technology solutions in their organizations. Literature resources are crediting this study as the foundation knowledge regarding conceptual framework and IoT technology prior to employing the research study activities.

Technology-Organization-Environment (TOE) Conceptual Framework

DePietro et al. (1990) designed the TOE framework that researchers and organizations could use to research technological innovation decision-making for adoption and implementation at the firm level. DePietro et al. (1990) designed the context for change, including factors of organization, technology, and environment, to form the TOE framework. The organization context contains the descriptive measures in an organization, such as firm size, managerial structure, or human resources (DePietro et al., 11990, p. 153). The technology context has factors describing the technology internally and externally relevant to the firm (DePietro et al., 1990, p. 153). The environmental context contained factors

pertinent to an organization's interfaces, such as industries, competitors, vendors, or government regulators (DePietro et al., 1990, pp. 153-154). Numerous peer-reviewed articles demonstrate how researchers and organizations have applied the TOE framework as the base model theory for designed frameworks to adopt and implement technology innovations. This study model would warrant success in exploring IoT technology implementation in organizations with the three factors of technology, organization, and external environment. Figure 1 presented the three factors of the TOE framework for implementing IoT technology in the organization to carry out the IoT solutions and benefits.

Figure 1. Technology-organization-environment (TOE) Framework.



Note. This figure illustrates three factors for implementing IoT technology in the organization based specifically on this study.

The Current Benefits of IoT Technology

Manufacturers added sensor(s) on an IoT device for collecting a specific type of data about or surrounding the object carrying this device. The term internet of things (IoT) technology relates to the network(s) connecting all IoT devices attaching to objects such as the cloud network, mobile network, wireless sensor network, or only the legacy network. Like computer production systems producing personal computers or mobile devices, manufacturers produce IoT devices targeting consumers needing to collect specific objects data to support business decision-making. Manufacturers produce IoT devices, applications, and the pre-configured network connecting IoT devices before selling and delivering to consumers (Reyna et al., 2018), wearable or attached to parts of the body with the manufacturer's intrinsic settings (Qi et al., 2018), and sophisticated network attaching device like 6loWAN border-router manufactured by Intel and Weptech (Hossain et al., 2018). Thus, the studies' researchers reported

that manufacturers had significant roles in setting, configuring, and controlling IoT devices before and after delivery to consumers. From that point of view, it is fewer IT-focused on implementing IoT technology than current IT infrastructure implementation strategies in organizations.

IoT Technology Benefits to Industries

Higher profit would significantly influence the business decision to adopt and implement technological innovation, especially IoT technology. Castro et al. (2017) reported that businesses had higher profits when they adopted and implemented IoT technology, such as healthcare, logistics, industrial, security, agriculture, and the environment. Henze et al. (2016) reported that organizations gained customers by enforcing personal privacy before uploading data to the cloud. Qi et al. (2018) emphasized that organizations gained business partners from cost-effective and accurate conventional hub-based systems based on IoT technology. These studies researchers addressed that organizations reported higher profits from adopting and implementing IoT technology to advance their business alignments and decision-making activities.

IoT and Fast Access to Information

Corporate IT leaders and researchers could use IoT networks and their natural characteristics in automation network activities to enable organizations accessing information quickly. Researchers and organizations reported that staff and end-users increased data demands, especially among medical staff using healthcare IoT applications (Castro et al., 2017). Jiang et al. (2018) found that data volume is increasing with the number of network equipment from the rapid development of IoT technology. Rahmani et al. (2018) reported that automating tasks increased cloud access within IoT-based systems. Thus, organizations addressed businesses' decision-making benefiting from IoT technology primarily by fast access to information at all layers of the IoT network.

IoT and Advantages in All Industries

Researchers and organizations observed advantages in all industries by adopting and implementing IoT technology. Alkhalil and Ramadan (2017) reported that organizations implementing IoT technology have opportunities for business advancement in all industries, such as increased sensor data collection. Boukerche and Grande (2018) emphasized that there were advancements in management technology for cloud computing resources. Researchers also found advancements in web services to increase accessible information on food security (Abeysiriwardana & Kodituwakku, 2016). Hence, researchers and organizations discovered opportunities for advancements in all industries by adopting and implementing IoT technology.

Current IoT implementation issues in security, privacy, scalability, reliability, and reusability

Researchers and corporate IT leaders have encountered issues when implementing IoT technology in many areas, such as security, privacy, scalability, reliability, and reusability. Talbot et al. (2018) reported IoT technology implementation issues with the IoT environment security system failing to identify rogue IoT devices in the platform. Fu and Xu (2018) described those hackers used transduction attacks to access data privacy within wearable devices equipped with sensors. Yang et al. (2018) emphasized that the IoT data in the marine field would be much more complicated than traditional data information, in which scalability issues lie among the raw and processed data. Sohal et al. (2018)

reported reliability issues with the collected data using IoT technology caused by attacks from malicious edge devices in the fog computing environment. Jacobson et al. (2017) noted that stakeholders and developers reported reliability and reusability issues as the nature of the IoT technology, especially in implementation such as failure modes or degraded security levels to maintain mobility communication. Thus, researchers and corporate IT leaders needed to focus on IoT issues when implementing IoT technology for business benefits.

Methods

Based on the background and literature review, the specific problem for this study is that many corporate IT leaders lack implementation strategies of IoT technology to realize IoT benefits for their organizations. A qualitative pragmatic inquiry design was used to explore the strategies corporate IT leaders use for IoT technology implementation to realize IoT benefits for their organizations.

Research Question

What implementation strategies do corporate IT leaders use for IoT technology implementation to realize IoT benefits for their organizations?

Data Collection

The researchers employed semi-structured interviews and reviewed the literature to collect data from participants (*n*=6), publicly available technical reference documents (*n*=117), and publicly available reference documents on factors of the TOE conceptual framework (*n*=36). This study's population consisted of IT leaders from healthcare organizations in the United States. The participants are currently holding IT professional roles related to IoT technology implementation in healthcare organizations, such as chief operating officer (COOs), president, founder, chief product innovation officer (CPIO), principal program manager, and women in cyber security vice president (WiCyS). All six participants worked for small and medium-sized healthcare enterprises in four states of the United States: California, Florida, North Carolina, and Washington.

There were three contexts of the research model based on the TOE conceptual framework as guidance for data analysis to discover the implementation strategies for implementing IoT technology at organizational levels, such as technological, organizational, and environmental. There was a member-checking procedure to validate the accuracy of the participant's inputs in this study (*n*=6). The study used methodological triangulation to align information among collected participant data, available literature resources, and documents related to the TOE conceptual framework to validate this study's collected participants' information.

Data Analysis

After verifying the collected interview data with all participants, data were uploaded to the NVivo software, release 1.6.2 (4831). The researchers used the NVivo software to assign codes, identify themes

and subthemes, and categorize the codes into themes and subthemes to generate the database of codes for the study. There were six themes to present the findings with meaningful information organized within the study database of codes based on the collected data from interviews. Participants were in the healthcare industry, volunteered, and consented to participate in the study's qualitative semi-structured interviews. The six research participants were from four different states in the United States. There were additional literature resources on top of the literature review resources to support the validation of findings by aligning participants provided information, literature resources, and literature resources related to the TOE conceptual framework.

Results

After analyzing the alignments of technological, organizational, and environmental factors of both participants' information and literature on the TOE conceptual framework, the results presented included strategies for implementing IoT technologies in an organization's IoT project, such as IoT technologies alignment with business needs, skillful internal staff and external influencers, and external support technologies.

There were six major themes discovered and are discussed in more detail below.

Theme 1: Take full advantage of vendor support.
Theme 2: Use all identified external influencers and influences.
Theme 3: Align current IoT technology with business needs.
Theme 4: Use all identified internal project staff skills.
Theme 5: Use all identified current internal infrastructure.
Theme 6: Use all identified external support technologies.

Theme 1: Take Full Advantage of Vendor Support

This theme represents an aspect of the external environment context to support the implementation strategies for IoT technology in an organization. Four subthemes supported this theme: identifying, assessing, and recruiting vendors for support, onsite training, consulting experience, and good technical support.

Identify, Assess, and Recruit Vendors for Support

This subtheme is relevant to locating, assessing, and hiring the right vendors for the IoT implementation project. Participants' responses support this subtheme as one of the four major points the organization could take full advantage of vendor support. For example, Participant AA reported that vendors must have specialties in dealing with regulations to keep the project moving forward. Participant BA reported that the organization created a backup plan when recruiting vendors and seeking vendors with specific expertise matching the required skills for the project. Participant DA added, "We hired some level of skilled individuals for the project. I do not want someone with no skill, knowledge, or excitement about that technology." Last, Participant EA indicated that vendors provided support in either resolving challenges or attaching with the project team from the beginning to the end. The organization could

successfully identify, assess, and recruit vendors for help by following the participants' inputs. This step in identifying, assessing, and recruiting vendors for support is essential before approaching them.

Onsite Training

Onsite training is a topic used to take full advantage of vendor support. The first approach is acquiring vendors with skillsets and experience in providing onsite training to implement the project. This approach helps build the foundation for implementing IoT technology, and everyone in the company acknowledges that they would welcome and use this new technology soon. The second approach is organizations acting as vendors offering onsite training because they are experts in supporting their IoT products. Participant CA reported, “We have found some experts with many experts who are both clinical psychologists and software development engineers.” Participants found themselves and their organizations as the expert in their products that uniquely provide the best onsite training and certifying as vendor roles (AA, BA, DA, EA). In this strategy, the organization or customer would receive support from the best support teams that own the consequences. This subtheme provided what and how a vendor could provide onsite training based on participants' experiences.

Consultant Experience

This subtheme supports fully leveraging vendor support using the participants' vendor consultant experience. The project team could inherit the vendor consultant experience to use as strategies to implement the IoT technology for the organization. Consultant experience is the vendor quality to help the project team and organization implement the IoT technology successfully. Participant AA reported that vendor support must acknowledge the obstacles. Participant DA noted, “There are areas you cannot reach that is when you want the partners to be engaged in implementing your brand by reselling yourself.” Last, Participant EA reported that recruited vendors must have consultant experience, “I think we can use partner solutions that do the translation and aggregation We are also trying to help our partners to grow their IoT practice to have the right skillsets.” The participants' inputs for this subtheme showed that vendors with consultant experience provided advice based on their perspectives on implementation to support the project team in processing the project forward in the right direction.

Good Technical Support

This subtheme reinforces taking full advantage of vendor support because the organization would benefit from vendors providing good technical support. Vendors with good technical support would be efficient and productive in supporting organizations. Participant AA reported, “We trained customer support and service on how to install, deal with FAQs, and troubleshoot devices and things. The app or instructions must be very clear and concise.” Participant BA responded with specific applications, “We say we can support hundreds of devices through Apple Health Kit or Google Fit. We have done a compatibility test and checked it out to ensure the data will flow.” Participants DA, EA, and FA provided multiple approaches to locating good and reasonable technical support, such as feasibility methods or have done similar cases in the same industry. There are several areas where good technical support can be recognized, such as technical support in training or implementing the project. Hence, vendors assist the project team in implementing the project with a plan and pace by using their good technical support skills, such as building support applications and training the company support teams.

Theme 2: Use All Identified External Influencers and Influences

This second theme supports the implementation strategies for IoT technology in an organization by using all identified external influencers and influences toward the organization's IoT projects from participants' inputs. Organizations can seek input from newly hired vendors or consultants of the IoT project to participate in identifying and using external influencers and influences. Four subthemes supported this theme, including identifying and using external influencers and influences, regulations, standards, those from other industries, and vendors. There were 19 identified secondary quality resources with 24 references supporting the participants' inputs.

Identify and Use External Influencers and Influences

During the data analysis process, the information from the participants formed this subtheme to support the external environment aspect of the TOE conceptual framework. This subtheme has two approaches supporting each other: identifying the external influencers and influences and using the external influencers and influences. Participant BA and Participant CA reported that external influencers were people collaborating with the organizations directly or indirectly to promote benefits and ROIs based on IoT solutions. The external influences could be government regulations and standards, assistance programs to promote healthcare organizations to implement IoT solutions such as Medicare and Medicaid programs, and management telehealth services to elderly care patients (BA, CA, DA, EA). Participant AA and Participant BA reported that organizations worked with external influencers using partnership strategies to assume product management roles or drive IoT sales. Participant BA noted that the organization used the identified external influences, such as regulations or standards, to deploy IoT devices into practice, such as IoT devices with specifications that were cleared or approved by FDA. Last, Participant EA reported that the organization used the OPC UA standard to speed up the adoption and implementation processes of IoT solutions. Thus, organizations identified and used external influencers and influences to motivate employees and successfully implement innovative solutions.

Using Identified Regulations and Standards

Participants indicated that regulations and standards were external influences and influencers helping IoT projects focus on complying with the IoT technology, including hardware, software, data, or communication. First, participants reported regulations and standards organizations should use to adapt the IoT technology and comply. Second, participants provided available government accommodations and legal vendors to support and encourage organizations to implement IoT technology. Government regulations and standards included FCC certification, UL certification, the seal of approval from other entities, FDA cleared, FDA approved, or in the FDA list (AA, BA). Participant CA and Participant DA reported that IoT and cloud service providers assisted healthcare companies in complying with regulations and standards, including HIPAA-compliant privacy and security on AWS, with monthly or annually fees on services and licenses. Thus, organizations acknowledge benefits from identified and applied regulations and standards when implementing innovations.

Using Those from Other Industries

This subtheme presents the identified external influencers and influences that organizations from other industries successfully used to implement similar IoT technology. Participants indicated that both external influences and influencers from vendors from other industries that implemented similar IoT technology that guided them to successfully implement the current IoT technology also supported the current IoT implementation project. In addition, the IoT product might have a chance to emerge in other industries. Participant DA reported that vendors from different industries provided valuable support to regulate the temperatures range to protect the Covid-19 vaccine transported around the US during the pandemic. Participant EA reported that the IoT ecosystem might be the key point to connecting companies or industries together, that might lead to IoT standards in the future. The participants' inputs showed that environmental factors positively impact the implementation of the company IoT project, such as using identified external influencers and influences.

Through the Vendors

This subtheme reinforces that the IoT project team can use external influencers and influences through the vendors currently cooperating with the IoT project team to implement the IoT project. The vendors would provide and discuss with the project team influencers and influence that they had positive experiences working with to complete past IoT projects. This subtheme is significantly helping the IoT project team identify other external influencers and influences that were not identified or used on previous themes or subthemes. Participant DA reported that partners and vendors recommended influences such as cloud storage services and their service rates. Participant EA indicated, “My customers are more confident in my partners. So, there is no influencing but direct programs to ensure that my partners are certified or trained in the technology I need.” Thus, organizations used vendor channels to use the recommended influencers and influence to implement innovative solutions.

Theme 3: Align Current IoT Technology with Business Needs

This third theme reinforces aligning IoT technology with business needs based on participants' responses to the current IoT project as one of the organizational aspects of the TOE framework. The IoT project team can consolidate the organization's business needs and align them with the current working IoT technology implementation project to ensure the IoT technology fully supports the organization. Four subthemes supported this theme, including providing current IoT technology alignment with business needs, measuring the benefits of IoT technology, project buy-in, and size, scope, and resources. There were 21 identified secondary quality resources supporting the participants' inputs.

Ensure Current IoT Technology Alignment with Business Needs

This subtheme presents research participants' strategies to ensure current IoT technology solutions align with business needs to support the IoT implementation project. There are two approaches to consider. First, the IoT project team identified the technology's possible solutions and current company business needs. Second, the IoT project team ensured the alignment of IoT technology and business needs

promoting profits and benefits to the organization. Each participant provided different methods to identify the possible IoT technology solutions and benefits and align them with current business needs. Participant BA reported the business needs of the healthcare industry were security compliance requirements on top of the infrastructure of IoT systems, such as PHI protection, HIPAA requirements, and IoT data security. Participant EA reported that organizations must focus on business vision in goals, challenges, and ROI and then align the IoT solutions with this vision to achieve customer satisfaction. The project team must also identify the IoT technology benefits to implement them correctly to support and promote benefits to the organization. Thus, organizations align innovative solutions with business needs to promote benefits and profits from implementing the innovations.

Measure the IoT Technology Benefits

This subtheme supports the alignment of current IoT technology with business needs by reporting IoT technology benefits with several measuring methods. The IoT project team could use implementation strategies to successfully implement the IoT technology and its future benefits, promoting company profits. There are three approaches that participants focus on methods to measure the IoT technology benefits, such as internal functioning departments relating directly or indirectly to implementing IoT technology, focusing on organizations bringing IoT technology solutions on board, and internal functioning departments benefit from implementing IoT technology solutions. All three approaches above ensure organization and IoT project team measure the benefits of current IoT technology implementation. Participant BA reported that the organization measured the success of IoT solutions by monitoring the reduction in the number of hospitalization trips to ER or escalations to management teams in 3, 6, 9, or 12 months and published a case study. Participant DA reported that organizations reorganized the IoT solutions' success by the increasing number of invoices in customers' work orders, including millions of packaged objects shipping to business partners. Thus, organizations measured the innovation solution benefits based on the success of decision-making, and functioning units applied the innovative solutions.

Project Buy-In

This subtheme reinforces presenting the IoT project passing the project buy-in milestone when the project team implements the current IoT technology solution for the organization. The project team could focus on two approaches to address the management buy-in and the customers' or consumers' buy-in. Participants provided information regarding the project buy-in topic to keep the IoT project moving forward, focusing on both management buy-in and customers' or consumers' buy-in. The project team could use strategies to pass the project buy-in, such as better sales generation, better people's lives, cost of IoT efforts, capital investment, reoccurring investment for upkeep, IoT solutions, risk mitigation plan, data driving business outcomes, and stakeholder analysis. Participant AA and Participant BA reported that IoT manufacturers did not have project buy-in, but the partners and customers of manufacturers have the management's buy-in to initiate the IoT financial orders to generate sales. Participant DA reported the IoT reoccurring investment opportunities that drive sales and support project buy-in from the top management team and stakeholders. Last, Participant EA reported, "Getting buy-in, there are two ways. First, it is providing the data that is driving the business outcome. However, the other aspect is doing this to make business sense. Moreover, if it does not make business sense, then it is pointless in

that." Thus, organizations and the project teams needed to pass the project buy-in process to keep the project moving forward.

Size, Scope, and Resources

This subtheme reinforces identifying the size, scope, and resources the IoT project team would need to implement the IoT technology solutions. First, the IoT project team must propose the size, including the timeline to complete the IoT project, possible expenses, available staff, and possible barriers during the project's progress. Second, participants respond with IoT project scope to meet stakeholder requirements and successful IoT solutions. Last, the IoT project team must consolidate all available resources to implement the project. Participant BA reported that the IoT project team used the Agile model for the IoT project to keep everyone collaborating and communicating daily to keep the project moving forward. In another approach, Participant DA reported that the project team would do a pilot study to cover IoT device connectivity, ensure performance, and then roll out the project to cover architecture and the number of endpoints to manage the IoT solutions onsite or remotely. Last, Participant EA reported that data security and governance would be the keys to supporting the project buy-in. Successful and profitable organizations with readiness in size, scope, and resources were ready to adopt and implement innovative solutions to promote benefits and business opportunities.

Theme 4: Use All Identified Internal Project Staff Skills

This theme reinforces implementing IoT technology in an organization using all identified internal project staff skills based on participant's responses. Internal IoT project staff's skills would be the core staffing to carry out the IoT technology solution for the company successfully. This theme consists of information from all 6 participants with 135 references to the database of study codes sharing how they identify and use internal project staff skills. Three subthemes supported this theme, including ensuring internal project staff skills, using identified staff's capabilities and competencies, and using identified staff from other internal functional units. There were 16 identified secondary quality resources with 18 references supporting the participants' inputs.

Ensure Internal Project Staff Skills

This subtheme presents strategies participants used to identify, assess, and ensure internal project staff skills are sufficient to support the IoT implementation project. The information from all six participants formed this subtheme to support the second organization aspect of the TOE conceptual framework. This subtheme has two approaches supporting this theme: staff expertise, abilities to work with others, and experience in security and compliance. Participant BA reported that the IoT project team recruited project staff with IoT knowledge, healthcare workflow knowledge, speaking the same language at the same level with users and customers, and IoT solutions' human aspects. Participant DA reported that the IoT project team assessed internal staff with skill, knowledge, and excitement about the technology and provided these staff training as needed. Hence, the IoT project team has internal staff contributing to the project would be part of the organizational factors to share ownership of the IoT solutions with internal departments.

Use identified staff capabilities and competencies

All six participants responded to this subtheme to support the implementation strategies for the company's IoT project. The first approach is to identify and use the project staff's identified capabilities to carry out the project. This approach helped the project management team ensure sufficient skills to complete and deliver the implementation project on time. The second approach is to identify and use the project staff's competencies to guarantee the project's completeness and future related projects. Both approaches ensure that the IoT project team uses both project staff's capabilities and competencies to support the whole IoT implementation project lifecycle. Participant AA reported that the internal staff who joined the IoT project team would receive training to support the new technologies with customer service capabilities, technical support in installing the IoT devices, and be responsible for FAQs and troubleshooting the devices. Participant CA asserted that the project staff must be multidisciplined to perform the project effectively, "Our approach always involves skilled clinicians, skilled software engineers, social learning experts, regulatory expertise, people who understand clinical workflows, and artificial intelligence tools." Thus, organizational factors relating to using project staff capabilities and competencies helped implement the innovative solutions.

Use identified staff from other internal functional units

This subtheme supports using identified staff from other internal functional units to assist the IoT project team in completing the IoT implementation project. The project team can identify and use staff from other departments with matched skills as strategies to speed up the company IoT project progress. Participant AA reported that the IoT project team onboarded staff from many departments, including retail, marketing, customer service, and manufacturing. Participant BA said that IoT project team members must be representatives from other departments to assist with those departments' special skills or authorizations, including nurses or medical assistants. Participant CA said that the organization organized an in-house engineer team to support the IoT project. Last, Participant DA reported that the IoT project team hired IoT experts of different expertise, including legal, HR, or marketing. Hence, organizations adopting innovative solutions at the organizational level would collaborate with internal functional teams, business teams, or the entire enterprise.

Theme 5: Use All Identified Current Internal Infrastructure

This theme reinforces the implementation strategies for IoT technology projects in an organization using all identified current organizations' internal infrastructure. Using those strategies; the IoT project team can identify all available internal infrastructure to support the IoT project. This theme consists of information from all six participants with 153 references to the database of study codes sharing how they identify and use current available internal infrastructure. We used four subthemes to support this theme, including the use of identified and assessed current internal infrastructure, the use of identified adequate network connections and protocols, the use of identified adequate peripherals, and the use of identified secure internet connections. There were 21 identified secondary quality resources with 24 references supporting the participants' inputs.

Use identified and assessed current internal infrastructure

This subtheme presents strategies that research participants reported to identify, assess, and use the organization's current internal infrastructure to support the IoT implementation project. Supporting the first technological aspect of the TOE conceptual framework, this subtheme has two approaches: identifying and assessing the internal infrastructure and using it to support the IoT implementation project. Each participant provided a different method to identify, assess, and use the current internal infrastructure. Participant BA reported information regarding internal infrastructure, including transmitting data among medical devices using Bluetooth, WiFi, or cellular network connections. Participant DA reported that the IoT project teams designed, planned, and determined the locations to deploy the IoT solutions by using the layers of IoT devices, such as API, middle, and application layers, to host applications and backend collected IoT data. Last, Participant FA reported that the IoT project team might have an IoT hub and an IoT gateway and then outsource the cloud infrastructure to service providers, such as Amazon, Google, or Azure. Thus, organizations identifying and using internal infrastructure to support innovative solutions would be one of the technological contexts supporting the organization's innovation solutions.

Use identified adequate network connections and protocols

The first approach is to identify and use network connections. Hence, the IoT project team can have adequate network connections to support the IoT technology implementation. The second approach is to identify and use the network protocols. In this strategy, the project team uses adequate network protocols for the IoT technology. Both approaches ensure the IoT project team has adequate network connections and protocols to support the IoT technology implementation project fully. Participant AA reported, “IoT devices represent a unique solution in that they are all connected, and connectivity comes across. It could be Bluetooth, WiFi, or the direct cable.” Participant BA added that the infrastructure security would protect the IoT devices at vulnerable locations. Last, Participant EA reported that the IoT project team would be aware of internet connectivity and physical locations of IoT devices. Thus, organizations decided to adopt and implement innovative solutions when the internal existing internal technology and other innovative solutions were available to support them.

Use identified adequate peripherals

This subtheme reinforces the theme by identifying and using good peripherals for the IoT implementation project. The project team can identify, assess, and use adequate peripherals to implement the IoT technology for the company. Participant BA and Participant CA reported that the organizations identified and used different levels of peripherals to support the IoT solutions, including WiFi devices, Bluetooth devices, cellular devices, digital patient records, outbound data, inbound data, right source of data, and the right point of time to collect the data. Participant DA reported that the IoT project team deployed the IoT devices with PoE features (Power over Ethernet), receiving continuous power via the ethernet cables or solar panels to charge the devices if deployed onsite or out in hard-to-reach areas. Last, Participant EA reported, “And then the peripherals of all the different protocols, and I think we can use partner solutions that do the translation and aggregation.” Thus, the existing

peripherals supporting the innovations in organizations were factors of the internal technological context supporting the innovative solutions successfully.

Use identified secure internet connections

This subtheme reinforces using identified secure internet connections to support the IoT implementation project. The IoT project team can identify all secure internet connections to support the IoT technology during the project implementation. Participant BA reported that the project team used wireless protocols for IoT devices connecting to secure internet connections, “They are communicating over a wireless protocol. You cannot see it.” Participant CA reported, “I look at the flow of the data. Inbound data into our technology platform and separately. The flow of outbound data into other systems, third-party systems like billing systems, dashboards, and maybe executive dashboards for the company.” Participant EA said, “If you use GS, 4G, or GSM, how do you use your touch provision to ensure that the devices wake up and connect to the right mobile operators? Where is the endpoint?” Thus, the secure internet connections and strategies to transmit data securely over the internet were internal technological contexts, such as WiFi connections, and external technical contexts, such as internet connections.

Theme 6: Use All Identified External Support Technologies

This theme supports implementation strategies for implementing IoT technology projects in an organization using all identified external support technologies based on participants' inputs. The IoT project team can identify all available external technologies to support the current IoT technology implementation project. This theme consists of information from all six participants with 162 references to the database of study codes sharing how they identify and use external support technologies. We used four subthemes to support this theme, including using all identified and assessed external support technologies, all identified applications, all identified cloud infrastructure, and all identified cloud storage. There were 21 identified secondary quality resources with 24 references supporting the participant's inputs.

Subtheme: Use all identified and assessed external support technologies

During the data analysis process, the information from all six participants formed this subtheme to support one of the technical aspects of the TOE conceptual framework. There are two approaches: identifying and assessing all available external technologies and using them to support the current IoT implementation project. Specific support for IoT technologies includes WLAN, IEEE 802 ZigBee, Low Energy Bluetooth, 3G/4G/5G, RFID, NFC, extended network management (IPv6), infrastructure as a service (IaaS), software as a service (SaaS), platform as a service (PaaS), or machine learning (ML). For example, Participant BA reported that healthcare organizations could use consumer data services as a marketplace for storing and securely transferring data into the clinical workflow for use with applications or decision-making. Participant CA reported that external support technologies could assist in solving compliance issues and cost savings, such as HIPAA-compliant service globally with trust audits and privacy security from AWS. Thus, organizations identified technical contexts and used current internal and external technologies to support adopting and implementing innovative solutions.

Subtheme: Use all identified applications

The first approach is to identify and use the end-user or mobile applications, which helps the IoT project team to use all the identified applications. The second approach is that the IoT project team can identify and use other available applications, including online, intranet, or web server applications. Participant BA reported the IoT applications, "We say we can support hundreds of devices through Apple Health Kit or Google Fit. I have fewer devices to support because I am an expert in every single one." Participant CA reported the benefits of using software solutions or software-driven services to support IoT product design and development. Participant DA and Participant EA reported that an IoT application layer hosted the IoT applications and collected data connecting to network connections internally and externally, including intranet network connections and internet services like GS, 4G, or GSM. Thus, the applications that supported the innovative solutions were in technological contexts and connected to internal or external network connections.

Subtheme: Use all identified cloud infrastructure

In this subtheme, the participants provide information regarding using all identified cloud infrastructures to support this theme. The IoT project team can identify and use all available cloud infrastructure to support the IoT implementation project. Participant CA indicated that cloud infrastructure provided cloud services, especially the HIPAA-Compliant AWS service, privacy security, and trust audits. Participant DA reported that the cloud infrastructure included different components, such as hardware layer, API layer, public network, or private network in-house. Last, Participant FA added, "In any industries we are talking about, each device provider has its own IoT cloud." Thus, the cloud infrastructures and the technology supporting the infrastructures were technological contexts that organizations used to support innovative solutions.

Subtheme: Use all identified cloud storage

This subtheme reinforces the theme by identifying and using all available cloud storage. Participants provided information that the IoT project team could identify and use all available cloud storage to support the current IoT project. Participant CA reported that the AWS cloud storage service provided security, privacy, and encryption with HIPAA-compliant. Participant DA reported that cloud service providers had different charged rates for a different types of cloud storage services. Last, Participant EA reported about data security and governance as well as the expiration of the cloud data storage contracts. Thus, participants reported using cloud storage and its components as part of the cloud infrastructures for storing and accessing IoT data in external and internal technological contexts.

Summary

We explored the IoT technology implementation strategies of participants in the healthcare industry in this pragmatic qualitative inquiry study. There were 1,226 references from participants' inputs and literature resources supporting the study's six findings. The research analyzed collected data and the triangulation methodology and revealed the study's six findings using the research model based on the TOE conceptual framework.

Summary of Findings and Conclusions

There are challenges during the IoT implementation phase organizations must carry out a formal IoT implementation project to mitigate failures and realize IoT benefits for business; this defines the problem statement of this study. The study findings are based on 1,079 references from all six participants' responses resulting in 3 factors that corporate IT leaders, organization management teams, developers, and manufacturers can use to implement IoT technology solutions successfully. The six research participants are from six healthcare organizations. The IoT implementation project team can refine the implementation strategies with the study findings in all three factors: organization, technology, and environment.

Theoretical implications

The study explored the IoT implementation strategies of six participants from six different healthcare organizations used for their IoT implementation projects. The study findings presented the IoT implementation strategies for the organization's IoT project, including aligning IoT technology with business needs, assessing project staff skills, assessing internal infrastructure, external support technology, external influencers and influences, and recruiting vendors for support.

Organizational Factors

As organizations move to implement IoT projects, the project team and corporate IT leaders should recruit internal staff with IoT skillsets to be core staff for the IoT implementation project. Second, the IoT project team should use the project buy-in strategies from these findings to pass the buy-in of the top management team, stakeholders, customers, and consumers and keep the project moving forward as the project plan. Finally, the IoT project team, corporate IT leaders, developers, organization management teams, and manufacturers should plan for ongoing investment in IoT solutions per business needs. Therefore, as a recommendation for actions, organizations and IT leaders might establish internal training for employees and contractors regarding IoT solutions, IoT applications, and how to apply IoT technology to daily corporate tasks to improve everyday office life. As a result, top management teams would pass the IoT project buy-in faster, more employees with matched IoT skillsets join the IoT project team, and ongoing investments in IoT solutions are acceptable and essential to promote benefits and profits to the business.

Technological Factors

After establishing the IoT project plan, recruiting staff, and passing the project buy-in process, the IoT project team and corporate IT leaders select the IoT materials internally and externally. A recommendation to the IoT project team and IT leaders is to establish network connections, IoT protocols, and secure internet connections to employ IoT solutions to support IoT decision-making. Last, the IoT project team, IT leaders, developers, organization management teams, and manufacturers should adjust the internal IoT implementation strategies to align with their business partners current IoT solutions.

Environmental Factors

This study focused on the US healthcare industry and IT leaders implementing the IoT technology project. Organizations and IT leaders from different industries and countries, as well as other possible audiences, could adopt the study findings and refine the IoT implementation strategies to successfully carry out the IoT implementation projects. Organizations, IT leaders, and professionals who embrace the study findings to implement the IoT technology solutions would share with other professionals within the loops or present the successful results at IoT forums or conferences. Internally, enterprises, organizations, and IT leaders should schedule regular training courses for all employees and contractors to introduce the IoT technology and current IoT solutions applied within facilities.

Applications to Professional Practice

In this study, the findings addressed the problem that many corporate IT leaders lack implementation strategies for IoT technology to realize IoT benefits for their organizations. From six different healthcare organizations, all six participants provided their successful IoT implementation strategies to fully address the study's research question: What strategies do corporate IT leaders use for IoT technology implementation to realize IoT benefits for their organizations? The application to professional practice is discussed below.

Organizational Factors and Their Applicability to Professional Practice

The IoT project team must communicate and recruit talents internally to successfully carry out the IoT project. Applying this to professional practices, the IoT project team, IT leaders, organization management team, and manufacturers should implement IoT solutions in a full-scale organization-wide effort. Managers should ensure everyone can adapt to the IoT solutions and fully understand the data flow inbound and outbound. As a result, corporate IT leaders, developers, and manufacturers are essential to bringing IoT technology to the enterprise at full scale.

Technological Factors and Their Applicability to Professional Practice

Four factors found to be essential for professionals responsible for managing IoT were external support technologies, applications, cloud infrastructure, and cloud storage. In professional practice, corporate IT leaders, developers, organization management teams, and manufacturers relate to the IoT technology

world and refine their internal IoT technology solutions aligned with industry business partners. Corporate IT leaders and others should be responsible for implementing IoT technology as a must-have enterprise tool to support everyone's daily life.

Environmental Factors and Their Applicability to Professional Practice

Four environmental factors important in professional practice are external influencers and influences, regulations and standards, influencers and influences from other industries, and influencers and influences from vendors. The IoT project team, developers, organization management team, and manufacturers should work closely to actively monitor anything relating to IoT technology from the outside world, just like other contemporary technologies. In professional practice, corporate IT leaders and others should be proficient in utilizing IoT technology internally and combining the benefits internally and externally. This implication helped spread the IoT technology and its benefits to all industries.

Recommendations for Further Research

There are three possible recommendations for further research. First, participants reported that IoT technology is still far from government regulations and standards; hence, the findings would have room to fine-tune in future studies. Second, participants provided responses based on clinical resources, environments, and medical team members; hence, the study findings based on the medical data would not be transferable to other industries such as agriculture, transportation, or construction. Therefore, future studies focusing on implementing IoT technology could use similar settings as this study with a different set of semi-structured qualitative interview questions, target groups, or conceptual frameworks or theories. Lastly, these study findings are based on participants' experiences in the US. Hence, future IoT implementation studies might include participants from other available markets, such as European or Asia.

In another recommendation for further study, there were excerpts that participants were repeatedly concerned about the IoT data flow in both inbound and outbound. There were limitations in collecting qualitative inputs regarding IoT data flow because the study focused on the overall IoT implementation strategies. The study's data collection process did not allow the opportunity to drill in-depth into the IoT data flow strategy inside and outside the enterprise. The IoT-processed data tremendously contribute to the IoT decision-making processes to benefit organizations. Therefore, future studies focusing on IoT data and data flow processes sharpened the IoT data and increased its worthiness.

Conclusion

Organizational factors include the project staff and staff from other internal functional units, ensuring staff skills, capabilities and competencies, scope, and resources, measuring IoT technology benefits, project buy-in, and ensuring IoT technology alignment with business needs. Technological factors include internal infrastructure, adequate network connections and protocols, good peripherals, secure internet connections, external support technologies, applications, cloud infrastructure, and cloud storage. Environmental factors include external influencers and influences, regulations and standards, vendor support with on-site training, consulting experience, and good technical support. The results of a

successful IoT implementation project generate the IoT ecosystem from the IoT solutions that corporate IT leaders and organization management teams can promote IoT benefits and profits for their organizations.

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