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Digital Transformation Considerations for Business Management

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Abstract

The advancement and evolution of information and communication technologies provides constant opportunities for business improvement and transformation in global business environments. The investment in digital technology often involves the evaluation of a value proposition and the corresponding impact on business operations. The ability to identify unanticipated or secondary impact factors associated with digital transformation is increasingly important to determine sustaining and disruptive effects of technology innovation on core business functions and processes. This paper provides an overview of selected digital technologies and examines potential secondary business impact factors related to knowledge management, governance and compliance, and security and privacy.

Keywords: Digital transformation, digital technology, technology innovation, technology adoption, strategic investment, business management.

1. Introduction

The innovation and commercialization of information and communication technologies offer distinct opportunities for business operations and management. The investments in digital technologies provide opportunities for existing business processes and the development of new business models (Nwankpa & Merhout, 2020). These models have the potential to disrupt existing business practices, improve functional efficiencies, and introduce new products and services that produce digital value propositions and expanded range of business opportunities (Baiyere, Salmela, & Tapanainen, 2020; Li, 2020). Ivančić, Vukšić, & Spremić (2019) suggest digital transformation has the ability to improve and expand organizational dimensions into entirely different industries. There are also potential competitive advantages for businesses capable of adopting specific technology at the optimal time and appropriate scale and level of adoption.

The decision to invest in digital technologies has the potential to present distinct complexities for business leaders confronted with increasingly competitive markets. These decision processes are further complicated by the inconsistent terminology and variability in the methods of technology integration (Venkatesh, Mathew, & Singhal, 2020). An additional factor for consideration is the inability for leaders in many business verticals to maintain a comprehensive level of knowledge of the diverse technologies impacting decisions relating to digital transformation (Venkatesh, Mathew, & Singhal, 2020). These factors have contributed to the incomplete or insufficient understanding of transformative technologies and the potential impact on strategic business processes. The establishment of strategic approaches to digital technology investment and innovation require a comprehensive review and assessment of organizational roles, structure, and skills required to incorporate new business models that include digital transformation practices.

2. Digital Technology Investment and Innovation

The organizational impact of digital transformation has redefined the vision and strategy of organizations (Gurbaxani & Dunkle, 2019). Digital transformation relates to the constant evolution of an organization as opposed to the representation of the state of completion for a particular transformation process. This concept of evolutions involves the integration and alignment of digital strategies to core business functions and processes. A survey of chief information officers identified key factors that influence digital investment and innovation as information technology competence, competitive pressure, and organization agility (Nwankpa & Merhout, 2020). This survey also identified a relationship between digital investment and information technology, with the exception of digital competence and innovation, which could potentially indicate the lack of strategic alignment between information technology and innovation functions. Research conducted by Gurbaxani and Dunkle (2019) identified six dimensions of enterprise digital transformation defined as the strategic vision of the organization, alignment of vision and its investments, suitability and culture for innovation, intellectual property and personnel assets, digital capabilities, and use of digital technologies. These dimensions are useful for internal and external comparisons of digital transformation competence, readiness, and progress. The development of business and technology requirements does not necessarily represent a sustainable strategic methodology for the investment in digital technology. The establishment of strategic technology investment practices represents a comparatively new business concept for many sectors despite existing organizational reliance on technology as a primary factor to achieve mission objectives.

The study of organizations that have successfully developed a technology innovation and investment strategies as a primary business consideration provides valuable insight of the unique aspect of technology adoption and integration processes. The United States National Aeronautics and Space Administration (NASA) developed a comprehensive Strategic Technology Investment Plan (STIP) that details a systematic method to identify and prioritize critical technology areas required deliver capabilities that meet the mission and goals of the organization (National Aeronautics and Space Administration, 2017). The evaluative process involved a comprehensive review and analysis of a series of organizational technology roadmaps with input from internal stakeholders and external subject matter experts. An effective strategic technology investment assessment is based on dynamic evaluation process that accounts for the rapid rate of change in technology innovation and evolving business environments. In addition, NASA also created the NASA Technology Executive Council (NETC), which is comprised of multidisciplinary representatives from across the entire organization. This collaborative approach to technology assessment provides senior decision makers with a unified representation of capabilities, gaps, and investments impacting the organization. The NETC model also provides the ability to adjust priorities based on mission requirements to maintain a balance between near-term, mid-term, and far-term investments (National Aeronautics and Space Administration, 2016).

The strategic investment decisions of an organization have immediate and noticeable impact on the financial and information technology operations of an organization. Additional considerations relating to the efficiency and risk impact associated with the implementation of transformative technologies include:

- Technology accessibility
- Resource duplication
- Compatibility and interoperability
- Legal and regulatory compliance
- Information security and privacy

According to a MIT Sloan Business Review article, the development of key performance indicators for innovation practices provides measurable indicators and an improved level of understanding for complex business relationships (Mangelsdorf & Posner, 2017). A related article in the Sloan Business Review recommended a process that included assessment, improvement, and deployment of core innovation measurement practices (Richtnér, Brattström, Frishammar, Björk, & Magnusson, 2017). Additionally, in order to maintain the value proposition associated with technology investments it is essential for organizations to implement an integrated enterprise risk management framework with the processes, procedures, policies, and controls to manage these risks at a defined and acceptable level.

3. Digital Technology Adoption

The concept of technology adoption relates to the establishment of methods to identify and integrate candidate technologies. Technology adoption can transpire at any phase of the technology adoption process represented as innovation, early adoption, early majority, late majority, and laggards (Figure 1). The rapid rate of adoption can result in the compression of the phase segments, especially at the initial phases of the adoption process. Businesses have experienced difficulties with the adoption process due to organizational prioritization and technology diversity (Gartner, 2020). The rate of adoption is influenced by the organization sector, size, and model with the additional factors of capability, features, and challenges (Sharma, Gupta, & Acharya, 2020). There is a contrast between larger and smaller organizations, where business models are typically able to support the financial and personnel resources required to implement digital technology transformation and adoption. Smaller business models may have comparatively limited financial and personnel resources, but have the agility to adapt more rapidly to options that support opportunities for changing requirements, cost, scalability, and efficiency.

In a study to identify factors that effect the adoption of technology in small business, the results identified the personality traits of the executive and technology readiness of the organization as factors that correlated with the adoption of technology (Reynolds, Cotrino, Ifedi, & Donthu, 2020). The technology readiness of an organization is an important factor for the implementation and success of technology integration. The technology-organization-environment (TOE) is a framework that represents the organizational influences on innovation adoption and implementation (Baker, 2012). An additional factor that impacts the ability for organizations to adopt and apply technology is their technology readiness level (TRL), which is an indicator of the degree of development in a specific technology (United States Department of Energy, 2020). The applicability of TRL has variability based on business sector where research suggests a relationship exists between technology readiness, continued use of technology, and business success that is impacted by post adoption models (Son & Han, 2011).

The ability to measure the rate and impact of adoption is another important consideration for businesses to determine the overall value to the organization. In many instances digital technology adoption will provide improved levels of performance, efficiency, and effectiveness for business operations, such as improved access and availability to data that informs and expedites business decision processes with greater precision and confidence. This emphasizes the importance of communicating the benefits of the technology to the organization with application use cases to maximize employee acceptance and use of the technology. The Cutter Consortium, an information technology research organization, conducted a survey to measure the identification and deployment of new business technologies and identified differences in the adoption of emerging and disruptive technologies, transition of personal technology into the business environment, immediate and continuous adoption models, and shared governance as significant factors (Andriole, 2016).

4. Digital Technology Adoption

An appealing characteristic of emerging technologies is the potential to offer new and improved functionality and increased efficiencies for organizations. Organizational adoption and integration practices are critically important to the potential success of the technology. An expansive range of business applications and technology use cases range from automation to data-driven solutions support strategies for organizational growth and performance improvement. The selected digital technologies presented in the subsequent sections have become established differentiators in diverse competitive business environments.

4.1 Cloud and Virtualization Services

The introduction of cloud based infrastructure, storage, and computing platforms have revolutionized accessibility to scalable computer and network resources with economic benefits and business value that included the following examples (Lacity, & Reynolds, 2014):

- Cost avoidance
- Reduced deployment time
- Scalability
- Resiliency

The fundamental cloud based services are categorized as infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS).

These services revolutionized the concept of virtualized computing and storage capabilities with the ability to provision scalable resources on demand. These services reduce the cost and acquisition period for existing businesses and removed the barrier of entry for startup ventures with the ability to rapidly scale functionality and infrastructure at minimal cost (Alam, 2020; Hofmann, & Woods, 2010). Cloud services are offered in several different deployments to include public, hybrid, and private models capable of supporting most business infrastructure requirements. Cloud based services have served as an enabler for other technologies and processes, such as data center consolidation, virtual collaboration, communications mobility, and artificial intelligence applications.

A selection of business functions and applications for cloud and virtualization services is provided in Table 1.

4.2 Next Generation Wireless Communication

The transformative advancements in voice and data communications have enhanced the ability to maintain essential connectivity with the workforce, partners, and customers. These enhancements provide the foundation for the innovation and the evolution of systems and processes that revolutionize global business environments.

The development and expanding availability of next generation 5G wireless communications provides reliable high-speed connectivity and data services for mobile and Internet of Things (IoT) devices. This advanced mobile network infrastructure includes the integration of innovative services and features to include software defined networking (SDN) and network function virtualization (NFV) to provide high performance, reliable, configurable communications to provide enhanced capabilities that include:

- Mobility
- Increased data rates
- Increased capacity
- Decreased latency

The increased requirement for workforce collaboration and customer interaction has prioritized technologies that enable multimedia collaboration. Video conferencing, content sharing, and virtual presence technologies that utilize mobile network connectivity provide low cost options that improve operational efficiencies, new products and services, and enhanced customer experience. The reliability and data rates associated with these communications technologies are equivalent or exceed traditional business information technology infrastructures.

A selection of business functions and applications for next generation wireless communication is provided in Table 2.

4.3 Data Analytics

The development of business information, intelligence, and analytics to support the business decision process is a critical factor for operations, marketing, profit, and growth. The increasing volume and variety of data creates significant opportunities and challenges associated with the identification of relevant and actionable patterns and predictions. Analytics also has the ability to identify gaps in business performance and potential for opportunities to establish a competitive advantage. An illustrative example of the advancement of data analytics involves the use of big data sets to perform systematic analysis and extraction of information for particular business requirement with near real time reporting. The integration of cloud-based technologies provides enhanced analytic and visualization resources for complex analytic requirements. The access to these capabilities represents a major advancement for small and medium businesses that was previously available only to large business organizations with considerable computational resources.

A selection of business functions and applications for data analytics technology is provided in Table 3.

4.4 Blockchain

Blockchain technology initially emerged as the core technology to support secure digital currency transaction management systems. Blockchain has advanced as a technology with the potential to significantly improve global business and transaction management. This technology provides specific benefits for existing and emerging business functions such as secure auditable multi-party transaction processing.

Implementations of blockchain technology provide businesses with the ability to automate and enhance security, transparency, resiliency, and accountability with a decentralized model for transaction control management processes.

A selection of business functions and applications for blockchain technology is provided in Table 4.

4.5 Artificial Intelligence and Machine Learning

Artificial intelligence (AI) is a transformative technology focused on the study and application of machine intelligence. This technology has the ability to increase value for business organizations in several areas to include improved performance, cost reduction, and customer experience. There are numerous subfields of AI that include machine learning and deep learning models. Machine learning involves the development of algorithms that are capable of providing predictions and decisions based on mathematical models and training data sets. Machine learning has emerged as a leading technology investment for businesses to provide unique insight into business metrics and decision support. A unique aspect that differentiates machine learning from data analytics is the ability to identify unrealized patterns and correlation in business data to improve business decisions. Machine learning systems are also able to perform forecasting and anomaly detection functions that have extensive applications in business for the identification of deviations from baseline performance data (Tang, Qiu, Huang, Chen, Yan, Lian, & Li, 2020). Deep learning is a specialized subset of machine learning based on a neural network consisting of multiple layers of interconnected nodes that replicate aspects of human learning. The concepts of machine intelligence applications are not conceptually complex although the design and implementation of these systems require multidisciplinary subject matter expertise to develop accurate models.

A selection of business functions and applications for artificial intelligence technology is provided in Table 5.

5. Considerations and Implications

The motivation and benefits of modern digital technology adoption focus primarily on the increase in productivity, efficiency, and performance, which represent observable indicators of business value and performance. There are others factors for consideration during the technology evaluation process that include the assessments of current workforce knowledge and training to support the integration and operation of the technology, governance and compliance factors impacted by the implementation of technology, and impact on security and privacy interests (Figure 2).

The focus on business performance factors can often lead to the inability to recognize potential issues that may result in a the reduction or failure of critical business functions. The quantity and complexity of these secondary factors differ in requirements and potential impact and often difficult to identify the interdependencies associated with the simultaneous adoption and integration of multiple digital technologies. The selected topics of knowledge management and training, governance and compliance, and security and privacy are briefly examined to provide insight into the potential impact when assessing the adoption of digital technology.

A summary of considerations and implications of selected secondary impact factors is provided in Table 6.

5.1 Knowledge Management and Training

Knowledge management represents a critical asset for any business or organization. Knowledge management strategies should align with other business strategies as a core driver for organizational growth, sustainability, and competitiveness (Chapman, Soosay, & Kandampully, 2003). Employee knowledge is categorized as the single greatest asset for organizations with latent knowledge as the primary element of success for small and medium enterprises (Baporikar, 2020; Maier & Hadrich, 2011). It is essential to recognize knowledge, information, and expertise assets that exist within an organization to maximize business operations and intelligence functions and improve decision and evaluation processes. The ability to establish a strategy to effectively store, manage, and transfer essential knowledge and information remains a critical challenge with the integration of digital technology into an organization.

The adoption of digital technologies requires the recruitment, training, and retention of qualified personnel with business and technology expertise. Information technology systems are often installed and maintained by employees with appropriate levels of training or experience. Sousa and Rocha (2019) conducted research relating to organizational assessment strategies for skills development relating to digital transformation.

The complexities of the implementation, configuration, and management of complex cloud service infrastructures, data science methods, or artificial intelligence systems without insufficient workforce expertise may impact the original value proposition for adopting the specific technology. Gartner (2020) suggested that organizations that are successful with technology integration appoint or hire specialized staff and create an organizational center of excellence. The development of an integrated workforce development plan will enhance organizational capacity to support strategic technical adoption and integration.

5.2 Governance and Regulatory Compliance

The global increase in compliance rules and requirements by regulatory agencies has raised awareness of the importance of establishing and maintaining an organizational governance strategy. The failures to maintain acceptable levels of compliance can result in substantial fines and in certain instances include criminal prosecution. The introduction of certain technologies such as cloud services can lead to potential violations of compliance regulations especially relating to the storage of protected or other sensitive information. The requirement to protect sensitive information must be a primary consideration during the digital technology adoption and implementation processes, especially in regulated industries or sectors. The ability to identify strategies for technology governance in coordination with incorporating digital technology to support the process will enhance compliance and reduce organizational risk. A particular area of importance for organizations is data governance and the establishment of controls that enable business objectives while maintaining accessibility, availability, integrity, security, and privacy of organizational data (Gartner, 2020). The implementation of controls that are consistent with regulatory requirements provides an effective and auditable framework to identify and enhance potential gaps in compliance. The integration of cloud service models represents an example of the importance of establishing an effective data governance framework where data previously controlled and stored in separate repositories are transferred to a single or multiple cloud environment. The benefits of cloud services include the ability to maximize visibility and accessibility of data for analytical and operational processes and without proper controls could also introduce risks for the integrity, security, and privacy of organizational data.

5.3 Security and Privacy

The exponential increase in the creation, collection, and storage of data represents a significant risk especially for sensitive information. The requirement to implement effective security and privacy protection methods that align with the implementation of digital technologies is essential. Security was considered as an area of consideration when implementing technology adoption models (Sharma, Gupta, & Acharya, 2020). It is essential for security and privacy protection methods to be implemented during the systems engineering and implementation of digital technologies to provide the most effective defense against potential compromise (Baca & Carlsson, 2011). The digitization and automation of customer, finance, and human resources information presents increased information security risks that require enhanced security and privacy risk assessments in coordination with the review of applicable governance and compliance regulations.

6. Conclusion

The innovation and adoption of emerging digital technology applications represent an increasingly important consideration for all business organizations. The ability to develop strategic technology investment and assessment processes that measure organizational capacity, productivity, and profitability should consider secondary impact factors to provide comprehensive insight into the collective impact on business processes. The secondary impact factors of knowledge management, governance and compliance, and security and privacy represent examples of potential opportunities, limitations, and risk factors associated with the integration of digital technology into existing business functions. The process required to identify business specific secondary impact factors requires a comprehensive review and assessment of the digital technology characteristics, strategic investment planning, and adoption and integration practices in order to enhance the organizational investment and value proposition for current and emerging digital technologies.

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Figures

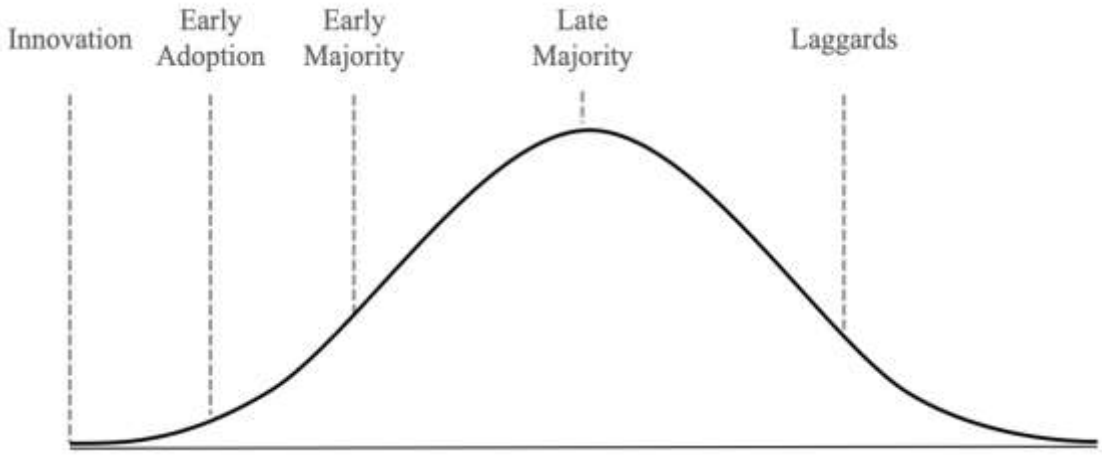

Figure 1. Technology Adoption Life Cycle. Adopted from Bohlen, Beal, Rogers, Iowa State University (1957).

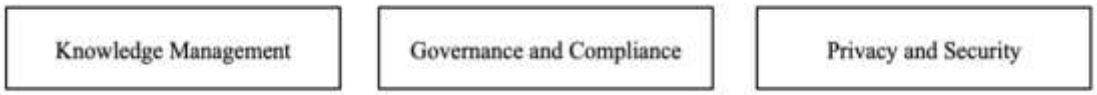

Figure 2. Selected digital technology considerations and implications.

Tables

Table 1. Cloud and virtualization services business applications and functions.

Cloud and Virtualization Services	
Business Function	**Applications**
Human Resources	• Improved workforce management efficiencies • Centralized data consolidation and processing
Finance	• Enhanced financial agility • Support new analytical functions
Business Development	• Digital marketing services • Customer lead tracking and analysis
Management	• Enhanced enterprise resource planning • Reduced on premises computer and storage requirements
Information Technology	• Scalable on demand processing efficiencies • Improved data storage and recovery capabilities
Risk and Compliance	• Central compliance for rapidly changing regulatory environment • Cloud service provider regulatory compliance agreements

Table 2. Next generation wireless communication business applications and functions.

Next Generation Wireless Communication	
Business Function	**Applications**
Human Resources	• Employee location and notification services • Remote training and professional development
Finance	• Enhanced communication services • Consolidation of technology and cost savings
Business Development	• Improved communication options • New product and service growth opportunities
Management	• Convergence of communication services • Improved management of mission critical services
Information Technology	• Secure device communication support • Integration with Internet of Things (IoT) devices
Risk and Compliance	• Secure communication for regulated data • Auditable communication transactions

Table 3. Data analytics technology business applications and functions.

Data Analytics Technology	
Business Function	**Applications**
Human Resources	• Enhanced human resources analytics • Data driven performance analysis
Finance	• Forecasting and financial risk analysis • Enhanced intelligibility of complex reports
Business Development	• Predictive consumer trends and opportunities • Personalized marketing services
Management	• Improvement of resource utilization • Interactive data visualization of complex business processes
Information Technology	• Centralized provisioning of analytic applications • Consolidation of analytical processing resources
Risk and Compliance	• Real time compliance validation • Visualization of compliance gap analysis

Table 4. Blockchain technology business applications and functions.

Blockchain Technology	
Business Function	**Applications**
Human Resources	• Digital identity management • Payroll and disbursement validation
Finance	• Smart contract functionality • Transaction level accounting
Business Development	• Supple chain management • Customer transaction records
Management	• Business process management automation • External partner transaction management
Information Technology	• Decentralized records management • Improved digital security features
Risk and Compliance	• Auditable transaction records • Enhanced trust and transparency

Table 5. Artificial intelligence technology business applications and functions.

Artificial Intelligence Technology	
Business Function	**Applications**
Human Resources	• Targeted candidate search methods • Predictive personnel requirement analysis
Finance	• Complex fraud detection algorithms • Identification of accounting anomalies
Business Development	• Personalized customer content delivery • Intelligent customer search methods
Management	• Automated natural language processing (NLP) services • Intelligent scheduling services
Information Technology	• Enhanced security event and incident management capabilities • Predictive fault detection models
Risk and Compliance	• Automated compliance monitoring • Regulatory change detection notification

Table 6. Considerations and implications of selected secondary impact factors.

Considerations and Implications	
Secondary Impact Factors	**Considerations and Implications**
Knowledge Management	• Establish or enhance organizational knowledge management framework and strategies to identify and manage knowledge assets and capabilities • Improvement in knowledge management functions, strategic technology investment decisions, and organizational performance
Governance and Regulatory Compliance	• Establish or enhance organizational data governance framework with a comprehensive assessment of candidate and existing technology investments • Increased capacity to predict, detect, and reduce the number and severity of compliance related violations
Security and Privacy	• Establish or enhance security and privacy protection processes that align with the integration of digital technologies • Increased awareness of technology based vulnerabilities, reduced risk of compromise, and protection of critical organizational assets