How IT Service SMEs can strategize an agile enterprise architecture to adapt to dynamic circumstances

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Abstract

The pace of technological innovation and market demands instils the need for change. Further still, when plunged into dynamic and unprecedented times, organisations have to adapt to survive to secure business continuity.

Small to medium-sized IT Services enterprises must ensure their enterprise architecture is able to adapt to changing environments. Agility is considered imperative in this instance as it gives organisations the ability to recognise, react and cope. An agile Enterprise Architecture can facilitate better visibility for IT service organisations on the services provided, and anticipate stakeholder needs to meet organisational goals.

To develop an agile enterprise architecture, an organisation should follow the steps of understanding and modelling the capabilities of the business; look at the value chain of the enterprise; conduct a gap analysis on the technical infrastructure; adopt a service-based architecture; ensure that there is support and governance from top management and have continuous measurement and monitoring of the implementation progress.

However, developing an agile enterprise architecture has its issues and limitations, and therefore risks. These risks pose a threat to the people, processes, technology and vendors of the organisation and can be a deterrent for organisations to adopt. Nevertheless, these risks can be mitigated if they are well-considered and this can be done by ensuring there is risk governance and policies in place. Overall, the development towards an agile Enterprise architecture should be something that is considered by IT service organisations to remain competitive in the market.

1. Introduction

Enterprise Architecture (EA) is a well-defined approach to govern enterprise planning, analysis and implementation for successful establishment and execution of organisational strategies. It provides an understanding of the dependencies existing between several components of the organisation such as information, technologies, processes and organisational structure. Hence, EA establishes a comprehensive view of Business architecture, Application architecture, Data architecture and Technology architecture. Moreover, facilitating interdependencies in both vertical (between strategy, operations and implementation) and lateral (between information flow within application landscapes, resilience between capabilities) (Lankhorst 2020).

This paper essentially discusses the challenges faced by Small and Medium-sized Enterprises (SMEs) within the IT Services industry, while incorporating IT infrastructure capabilities to adapt to unexpected circumstances. Organisations need to constantly change operations due to change in customer demand, market fluctuations, adopting digitisation and innovation to improve their competitive advantage or to sustain business objectives due to a rise in the pandemic (Bossert & Laartz 2016). Most large-scale IT organisations are well-equipped and can adapt to these changing circumstances, however, it is seldom the case for growing companies. As a result, this requires these enterprises to revamp their business strategy, infrastructure, and IT capabilities to move fast to support the business objectives, but lack technology infrastructure or operating models to keep up (McDonagh 2020).

1.1 Challenges identified in organisations coping with changing circumstances

- Business continuity risks due to a shift in client contact or customer touchpoints, or unavailability of critical resources
- Inability to identify business capabilities critical to the organisation for survival, and which are difficult to access remotely
- Surges in transaction volumes due to transition from physical to digital platforms or deteriorations in demand
- Insufficient risk and gap analysis of people, processes, application and vendors dependent on the business-critical capabilities
- Inefficiency in monitoring, reporting and decision-making to respond to immediate business requirements in dynamic circumstances
- Lack of Regulatory and Standards compliance
- Challenges associated with Information Security and Connectivity directly impacting employee productivity during forced remote-working situations

In the face of rapid changes, the resilience of the system is evaluated like never before. Hence, organisations must operate during these conditions with minimal impact on core business and critical operational processes, and ensuring business process continuity. Moreover, eliminating system outages, mitigating business and IT risks, and recovering from disruptions (Accenture 2020) is essential. Furthermore, organisations should be equipped for scalability and flexibility to meet business needs and endure business ecosystem changes.

Therefore, to cope with the unprecedented events, organisations should embrace agility and consider incorporating an adaptable enterprise architecture, before making a paradigm shift.

1.2 Need for Enterprise Architecture

An agile Enterprise Architecture facilitates better visibility into the enterprise ecosystem and anticipates the needs of stakeholders to support teams in establishing organisational goals. It validates the enterprise's building blocks of information, people, processes and technology that are essential for the transformation of a business from a baseline state to a future state (Gartner 2019). This allows improvements in the alignment between the Business and IT by simplifying system complexities, planning and interoperability.

EA can link agile roadmaps to strategic initiatives based on targeted value streams. This allows projects to be prioritized, based on financial factors, efficient resource utilisation and risk ratios (Lambert 2019). Therefore, it is beneficial for organisations to leverage agile enterprise architecture to cope with these circumstances and sustain business ecosystems.

Following are the benefits that can be attained by organisations by incorporating Agile Enterprise Architecture:

- Standardisation and integration of business processes and systems
- Better interoperability of systems ensuring more responsive IT
- Reduced replication of data, systems, applications, and services across business units to enable transparency
- Minimisation of system implementation and operation cost
- Facilitates a birds-eye view of the IT landscape and Business ecosystem to improve decision-making, task prioritisation and optimise resource utilisation
- Improved collaboration between stakeholders and provides project planning and scope definition

Overall, organisations can leverage agile enterprise architectures to blend velocity and adaptability with rigidity and efficiency to ultimately facilitate transformation gains.

2. Challenges of changing environments

In the digital era, change is the only constant. From changing customer demands to changing market environments, companies are facing increasing competition. Organisations are constantly put in a position where they have to continuously improve to adapt to changes in the environment. These changes pose a challenge for organisations to have an ICT infrastructure that can support their needs.

2.1 Known vs Unknown threats

Implications of new technology, digitisation and climate change have given organisations the ability to adapt because the ongoing change is known. However, unknown threats to organisations that include life-threatening events such as terrorist attacks, forced remote-working due to pandemic and natural disasters are considered unforeseen external events (Alesi 2008, p. 215). This can create a major disruption to businesses and can threaten their survival (Hatton, Grimshaw, Vargo & Seville 2016, p.85).

Business continuity plans (BCPs) are created to temporarily mitigate operating risks in the event of unknown disruptions to organisations. The effects of life-threatening circumstances encouraged the Lehman Brothers to improve on their BCP by leveraging technology. Their enterprise-wide initiative built an intranet architecture to give remote access tools to staff to enhance resiliency (Alesi 2008, p.217). Studies in New Zealand further showed that a BCP in place helped ensure that back-ups of organisations' ICT systems were important when dealing with the Christchurch earthquake in 2010 (Hatton et al. 2016, p.87).

Nevertheless, even if BCPs can assist with unknown disruptions, Hatton et al. (2016) indicate that BCPs are not always effective. One prime example is the effect of the COVID-19 pandemic for the world at large. Many organisations have no doubt implemented their BCPs to assist with the current economic climate, yet many companies have come to a standstill and have had to halt business operations because of the effects of the virus. No doubt, for some organisations' BCPs that were created to temporarily mitigate operating risks are being put to the test (Boulton 2020).

3. Importance of Agility

Enterprise Architecture Management has earned substantial consideration over the last decade. The external economic and social environment undergoes persistent complex metamorphoses. Efficient management of these complexities brought by the fast-paced external environment is essential to have a market presence and dominance in the industry. An economic organisation must have the ability to acclimatize and adapt to the dynamics of the ever-changing market and open doors to new market opportunities. (Ghilic-micu, Stoica & Uscatu 2014)

Agility is the ability to recognize, rapidly react and cope with volatile changes to the environment. Organisations need to be agile in periods of unpredictable social-economic changes (Camarinha-Matos, Afsarmanesh & Rabelo 2003, p.235). Mthupha (2012) considers agility to be a characteristic that organisations should possess to survive in a volatile environment. Their research identifies that while agility gives organisations the ability to respond quickly to changing markets or other scenarios, it becomes essential during periods of uncertainty and volatility (Mthupha 2012, p.39). An overall coherent and adaptable enterprise architecture is crucial for organisations to maintain their competency in the market.

However, organisations are still using enterprise architecture that is incompatible with today's economic environment. There is a need for a more agile approach to developing an agile enterprise architecture.

3.1 Agile Enterprise Architecture

Prahalad (2009) describes how volatility in the market is here to stay but that organisations can handle change when they can address it within a clear strategic framework. This means there is a need to improve and develop organisational flexibility and responsiveness. Further, Mthupha (2012) illustrates that agile enterprises require capabilities to deal with uncertainty and that there are four principles that organisations should follow:

- **Responsiveness** – the ability to identify and respond to changes quickly
- **Competency** – the ability to reach an organisation's objectives and goals both effectively and efficiently
- **Flexibility/Adaptability** – the ability to handle different processes and achieve different goals
- **Quickness/Speed** – the ability to carry out an activity in the shortest possible time.

Agile enterprise architecture is an architecture that caters for future unknowns, enabling organisations to change rapidly without unnecessary resource utilisation but also in a controlled manner with minimal adverse impact (Mthupha 2012, p.1). An agile enterprise where an organisation can adapt quickly to changing circumstances is the solution to becoming an adaptive organisation (Mthupha 2012, p.39).

4. Developing an Agile Architecture

The main characteristic of an agile EA is that it helps companies improve their strategic IT planning by allowing them to assess the impact of changes on the existing IT landscape, allowing them to quickly adjust in the event of a change. Following are the recommended steps for developing an adaptable and dynamic architecture.

4.1 Build a Capability-Based Architecture

The first step in the development of an Agile Architecture is to understand and model the Capabilities of the business. To create a capability model, the organisation should be able to identify the varying possibilities of change in the market and thereby create a business continuity alternative, or in other words, a contingency plan. Fig. 1 below is an adaptation of a service unit from Cummins (2016, p.94). The degree of structure in the capability model is dependent on its repeatability and the level of detail in the model.

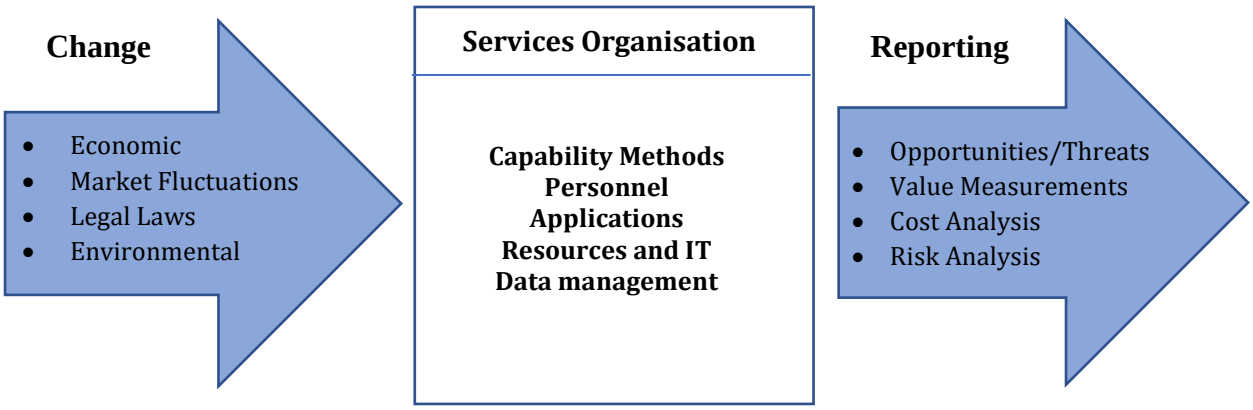


Figure. 1 Sense and Response to changes

Fig.1 illuminates only some of the impactful changes out of the plethora of other unprecedented dynamics an enterprise is exposed to in its lifetime.

Identifying the types of complexities and their impact is crucial to strategize a solution for the same capability. SWOT[1], Risk, Impact and Cost Analysis will help in strategizing an alternative mode of delivering value to the customers.

4.2 Value Delivery Mode

The value chain of an enterprise focuses on the overall sequence of the main operational phases which together lead to the delivery of value to an end customer (Cummins 2016). Each phase can be sub-divided to categorize the level of impact on the perceived value by the customer. Defining the mode of value delivery in the initial phases of EA development will help the organisation identify the:

- Flow of deliverables
- Roles of participants and organisations and
- Activities of each participant in the internal operations.

To execute the above two steps effectively, Enterprise Architects must interact with senior management and IT teams to map current organisation capabilities, and to realise the way to progress.

4.3 Conduct a Gap Analysis on the Technical Infrastructure

To achieve an agile enterprise, mapping out the existing IT environment is imperative, as business and technical leaders must have a common understanding of the technological needs and enhancements. This would also help the organisation identify the constraints in their current structure and the investments they need to support the business capabilities (Somane 2019).

The best result from the Gap analysis would be possible if the different domain architects, namely: Business, Solutions and Systems collaborate to form the desired architecture. This activity will further aid in identifying the disparate re-usable and alterable segments of the IT environment to bridge the identified gaps.

Tools that could be used to conduct the analysis are:

- PESTLE (Political, Economic, Sociological, Technological, Legal and Environment)
- Nadler-Tushman Congruence model
- SWOT

The N-T[2] Model and the PESTLE framework takes environmental changes and political disruptions into account as well when analysing the Organisation IT structure. The N-T Model elucidates the congruence of the different segments of an EA, and how they affect each other.

4.4 The Service-Oriented Architecture

The base foundation technology of a digitally abled Enterprise is the SOA[3] (Cummins 2016). The SOA forms the medium of communication between all the technical assets and service providing applications in the entire EA.

[1] Strength Weaknesses Opportunities and Threat
[2] Nadler-Tushman Congruence Model
[3] Service Oriented Architecture

Figure. 2 Illustration of the Service-Oriented Architecture

Modern-day technologies such as Virtualisation, Mobile/Cloud Computing and Teleworking are being adopted by organisations to provide a digital solution for the incoming complexities and further assist their internal operations to deliver value to their customers without additional lead time.

Implementing advanced virtual applications to provide services would require the adoption of a well-structured SOA. It would also facilitate seamless integration with the existing systems and technical infrastructure. Although an upfront investment would be needed to structure and integrate the newly acquired technology the benefits will cover the cost in the long run.

Benefits of adopting an SOA as stated by Cummins (2016) are:

- Minimisation of cost and complexity
- Enable sharing and flexibility
- Ensure scalability and security
- Integrate applications in diverse technologies
- Enhance speed, and reliability

4.5 Mobile and Cloud Computing

Given the remarkable growth of ICT[4] one of the solutions to ensure business flexibility and adaptability is mobile and cloud computing (Ghilic-micu, Stoica & Uscatu 2014). The path leading to an agile architecture requires constant monitoring of the dynamics of business processes, human resources, and information systems.

The table below addresses some principles and boundaries to acknowledge while adopting and integrating cloud and mobile services in the existing IT architecture in the organisation (Ghilic-micu, Stoica & Uscatu 2014).

[4] Information and Communication Technology

Table 1. Principles base for the digital transformation to cloud/mobile platforms

No.	Notion	Requirement Addressed
1.	**Architecture scalability**	Enable organisations to quickly add specific features with high compatibility in a cost-effective manner.
2.	**Architecture reconfiguration**	Assist the organisation in the reconfiguration of changing business requirements
3.	**Architecture unification**	Aid the organisation to create a coherent and structured network infrastructure
4.	**Comprehensive approach**	Aid the organisation to establish connections with stakeholders at remote locations
5.	**Business Expansion and Continuity Plans**	Expand and adapt to new markets and adapt quickly to their characteristics
6.	**Swift reaction to market and customer demands**	Introduce new services and products to the market in short durations to meet changing dynamics and requirements

4.6 Top Management Support and Governance

The management hierarchy focuses on overall enterprise management, operational optimisation, and proactive response to business threats (Cummins 2016).

With a strong IT strategy, senior management can have a holistic view of the current and future IT projects. This will help to curb the resulting resources and budget accordingly. It will also support the ability to quickly adapt to new business strategies.

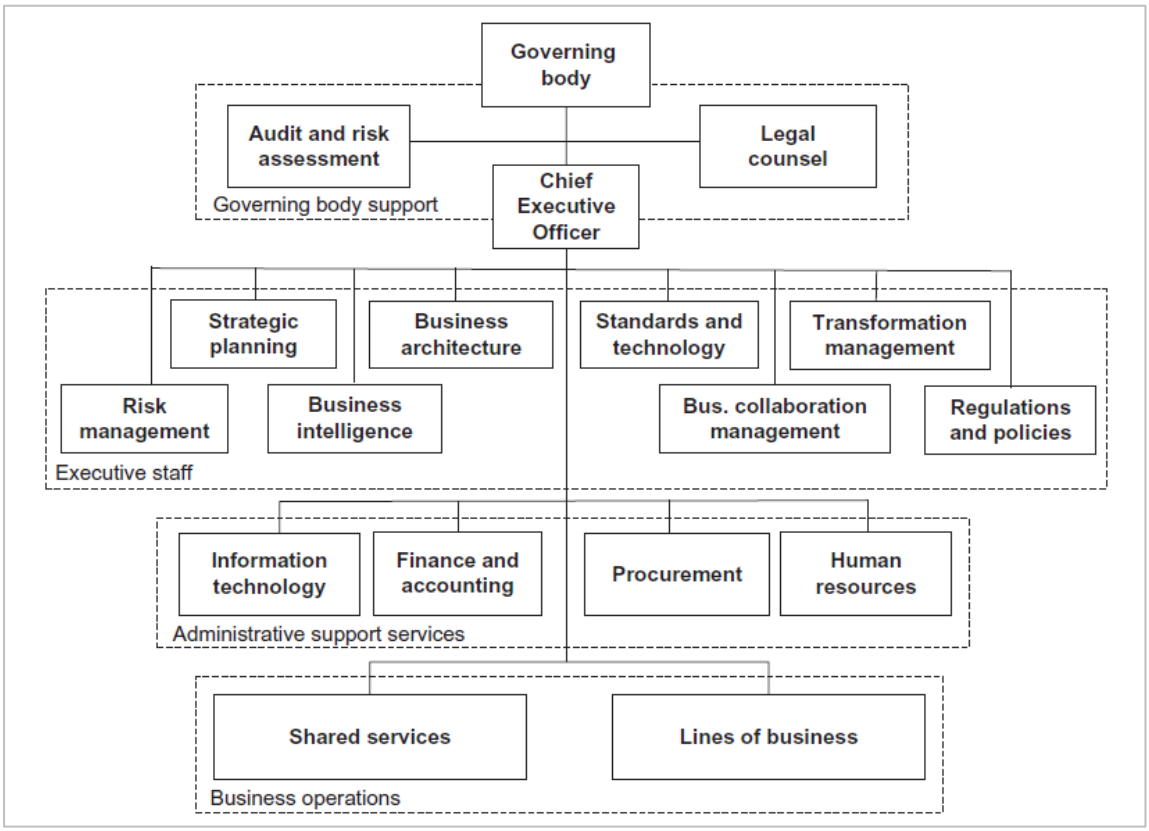


Figure 3 Management Hierarchy from (Cummins 2016)

Lastly, continuous measuring and monitoring the progress of implementing new processes and services with the help of KPIs[5] is imperative. Moreover, tracking the incoming risks and assessing their impact helps in modifying the business capability architecture (Somane 2019).

5. Key Issues and Considerations while developing an Agile EA

Digital transformation provides unparalleled capabilities to change the face of the organisation and enables innovation, although these new opportunities bring about newer unprecedented risks, which must be effectively managed by the organisation (Zimmermann et al. 2015).

Table 2 highlights the major risks and issues an Enterprise Architect must consider when developing an Enterprise Architecture. It also elucidates the impact of each emphasised risk along with a mitigation strategy. The risks featured in table 2 considers all the major components of an Enterprise Architecture namely: *People, Process, Technology and Vendors.*

[5] Key Performance Indicators

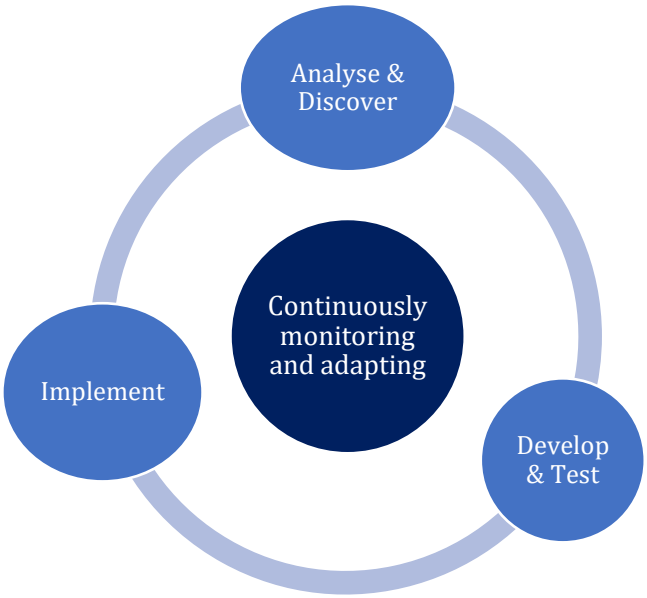
Table 2. EA Components and the area of concerns

Component of EA	Probable area of concern	Impact	Mitigation and Control
People	• Security controls • Privacy • IP disclosure • Strategic risk • Brand Reputation damage	In an event of unprecedented changes, employees who are not aware of the process become the most vulnerable link in the entire EA. The challenges include: • Skewed focus • Teams are unaware of EA in place • No liaising between architects and project teams • Managing dynamic workforce capability	Develop, educate and spread awareness covering all the security policies and secure use of systems. Drill employees by sending phishing emails and record how they react to it. Develop a home and mobile work policy and train staff to ensure the security of the system and data (Moore 2011).
Process	Change control	These comprise of operating systems and web servers. Moving to a virtualised world needs a higher level of attention as that of the physical environment. If the systems and software are not mounted properly, they jeopardise the security of systems involving confidentiality, integrity, and availability being compromised (Askarinejad 2012).	To observe how adversely operating systems are affected by rigorous testing in myriad staging environment should be conducted. The main challenge would be to replicate the impact of the unprecedented situation.
	Contingency Planning	An increased amount of remote working increases the computational load on the server which could cause it to crash.	The solution to this could be live migration of virtual machines which triggers administrator about spiked usage of the server.
	Financial hold	Inability to identify business-critical activities and capabilities to ensure cashflow	Huge investment in digital emerging technology OR adapting them as-a-service would help SMEs survive in such time. Although the initial investment is large which could overrun the budget, the ROI would be positively impacted.

Technology	Access to restricted systems	Most organisations store their IP on-premise, which means they can be accessed only in-house. These have multiple access control measures in place to ensure security (Baker McKenzie 2020).	Although multi-factor authentication is in place, accessing IP (Intellectual Property) pose high-security challenges, which could be an area of further research and development (Lankhorst 2019).
	BYOD[6] due to shortage of IT equipment	Using personal devices for official purpose could result in a data breach.	The same can be prevented using security patches, secured VPN and RSA token or application to authenticate.
Vendors	Data loss Compliance Resiliency	SOA, ERP or CRM needs proper E2E implementation to interact with the host organisation. This may add to implementation risk if the right digital technologies are not used for the business process. Identification of point of liaising of two systems could be time consuming and improper API usage could lead to a system outage.	Powerful and flexible API (Application Program Interface) should be identified based on the system requirement and engagement.

[6] Bring your own Device

5.1 Navigating/Mitigating digital transformation risks



5.1.1 Analyse and Discover

Digital risk management should be associated with the organisation's digital vision, digital enablers, and keeping in mind emerging technologies. Service-based organisations should analyse the environment to assess the digital footprint and its domino effect on the services (Deloitte 2018).

5.1.2 Develop and test

Use a defined digital risk framework, to develop a risk-based digital architecture tailored to the organisation's digital needs and operating environment. Further, test the framework on all possible environments by creating them virtually.

5.1.3 Implement

Under the umbrella of risk governance and policies, gradually deploy the newly framed digital architecture for chosen enablers of digitalisation.

5.1.4 Continuously monitoring and adapting

An automated surveillance system should continuously review processes. It should contain the whistle-blower functionality that would warn about any disruption and new changes across the social, legal and economic requirements.

5.2 Consideration to improve future security posture

Current legacy systems could become obsolete with the current rate of exponential digital growth. Therefore, SME's should promote technological innovations and should include emerging technology as part of their architecture (Lankhorst 2019).

- Check on **employee working conditions** (i.e. on-premise or remote working). The latter should be equipped properly to operate securely and swiftly. Further, define proper **roles and responsibility** for people as well as the system.
- **The performance** will be negatively impacted when running the operations virtually because of virtual machine (Askarinejad 2012).
- The architecture should be agile to promote **interoperability** seamlessly among different systems and processes.

- EA would require **huge investments upfront** and **money management** to run SMEs efficiently in tough times.
- Work along with suppliers and vendors to understand their systems, so that it can be aligned with the current system to enhance the performance of architecture altogether.
- Checking exponential penetration of smart devices and speed of the internet.
- Evolving customer expectations and changing demographics.

6. Conclusion

In the unfolding of dynamic situations, there is a need for organisations to adapt to changes to sustain their business and maintain their competitive advantage. With limited IT infrastructure capabilities, resources and unobliging strategies to approach unprecedented events, SMEs are the most vulnerable entities exposed to changing business environments.

Some of the potential challenges for these organisations that lack governance of their business ecosystem and application framework, involve:

- business continuity risks,
- inability to identify critical systems that could be difficult to access remotely,
- lack of risk and gap analysis of the building blocks of companies that are dependent on the business-critical capabilities for addressing information security risks.

As a result, incorporating agility in organisations can bolster mitigation of these challenges, allowing organisations to respond quickly to changing needs by easily customizing IT.

Incorporation of Agile EA for digital transformation provides exceptional control and capabilities for organisations, encourages innovation and preserves the business. However, there are associated risks and security concerns that impact on the people, process, technology and vendors of these organisations.

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