# Emerging Paradigms of Managing Digital Business: In Association with Factoring Incremental Risks

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Abstract—Consumer sector preceded and turned primary driven force for businesses to innovate as well as imply digital technologies. Changes that are materialized to institute digital business produce significant impact in consumerization. Hence, in recent years, it became necessary for enterprises to periodically reevaluate and redefine paradigms as well as their precedence to manage digital business. It has to be iterative process due to volatile characteristics of the influence of digital evolution on businesses. Traditional risk assessment and management methodologies are doomed when operating advancements in digital technologies with business strategy. This paper examines the relationship between the risk factors and the emerging paradigms that are needed in order to provide an adequate foundation for managing digital business. We proposed imperative incremental risk (IR) modeling framework in consideration of multifaceted unpredictable physiognomies of managing digital business. It empowers the imminent of digital technologies and enables businesses to focus less on vulnerability and more on competencies.

Index Terms—advancements in digital technologies, digital business operation (DBO), consumers, emerging paradigms, incremental risk (IR), modeling framework (MF)

#### I. INTRODUCTION

Today organizations are blurring digital technologies where different degrees of business operations are governed in different ways in order to improve competencies. The digital evolution of an enterprise is much more than seeking to increase flexibility. It requires enabling people (consumers, vendors and suppliers, partners, employees, managers, etc.) with digital technologies and corresponding infrastructure to succeed [1] and [2]. The enforced optimization of all business functions is to make the business more relevant to the recognized values of an enterprise connecting people and digital platform. Enterprises can't "manage" digital business functions without missing competitive benefits, if they are unable to exactly emulate the digital reality and its' impact on customer experiences in the broadest sense.

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Enterprise has to operate in the increasingly connected ecosystem. What matters is how digital technologies impact business in real life because they impact the behavior and attitudes of people across all their activities. The fundamental implication is clear, enterprises that fail to acknowledge in this context are underserving potential customers and at risk of losing mindshare and, ultimately, sales opportunities [3]. Many organizations have progressed toward consolidating and deepening expertise on key digital business tactics and responsibilities. Several performance gains are prominently visible due to the implications of digital business, however, new issues emerge due to the unidentified uncertainties in associated operations of digital businesses. This is characterized by the challenges of business integration at various aspects of an enterprise and anticipated operational changes due to the way of performing business using digital technologies as well as diversification in market competition.

One such example is the online credit card payment capability becoming norm in the industry. However, underneath complexities and uncertainties are often overlooked. To reduce the operative cost, large organizations are locating the data centers at other countries (or sometime to other continents). Either during the moving of data center or new initiative of digital business, enterprises are either unaware of international standards to send (or share) credit card information across the countries or the international standards are still evolving. Moreover, if the third-party is being utilized to verify and process the payment then neither customer nor the organization is aware of such issue. They are usually recognized during the later stages and subject to change or update. The example indicates that there is a need to recognize and address such issues before it occurs without impacting to the competitiveness of the digital business.

Available risk assessment and management methodologies focus on delivering the feature capabilities in adherence to marketplace [4], [5], and [6]. Due to the fact that the operative characteristics of digital businesses are always evolving, the perceptions to categorize and monitor individual risk have been changed. Moreover, they entail to maximize efficiency and effectiveness of business operations with the ability to scale and adapt

digital business. Vendors, offering digital transformation tools and technologies, have also proposed and developed digital capability framework and maturity models [7]. However, the layers of frameworks and maturity levels are derived based on digital transformation viewpoints. They failed to assess the concerns and impact to the ongoing business as well as risk factors that are necessary to be considered due to challenges of managing digital business.

We developed an approach of IR and consequently the corresponding modeling framework. It provides a platform for enterprises to rationalize individual risks to manage and update digital business. The primary constituting factor of digital business is integrating advancements of digital technologies and business strategy to remain competitive for the consumers. The categories of IRs are identified based on factors impacting primary constitute of digital business. The categories are the basis to derive IR modeling framework for managing digital business.

The rest of the paper is organized as follows. In Section II, we present the literature review to recognize the emerging paradigms of managing digital business and associative concerns to approach risk assessment criteria. Section III provides the approach to identify IRs and derives categories of IRs to manage digital business. Section IV describes the IR modeling framework and necessary steps to increase predictive characteristics of managing digital business. Section V enumerates evaluation criteria and correspondingly investigates effective mitigation and required actions. Section VI concludes the findings and future direction for the ongoing research efforts.

## II. LITERATURE REVIEWS AND EMERGING PARADIGMS OF DIGITAL BUSINESS

The study of 400 U.S.-based firms (by McKinsey) [8] indicated that digital business strategy is not solely a matter of optimizing firm operations internally or of responding to one or two focal competitors, but also arises strikingly from awareness and responsiveness to the diversity of demand and volatility of changes. According to the recent research and survey of 850 senior executives [9], the key activities involves analysis of the external environment and internal conditions to list potential digital business initiatives that aligns with business strategy and strategic growth objectives of an enterprise. It became mandatory to exploit opportunities and deal with external threads in light of identified strengths and weaknesses of the digital business initiatives.

To understand the scope of this issue in the business-to-business (B2B) context, Corporate Executive Board's Marketing Leadership Council (MLC) [10] surveyed more than 1,500 customer contacts (decision makers and influencers in a recent major business purchase) for 22 large B2B organizations. In a striking finding, the survey revealed that the average customer had completed more than one-half of the purchase decision-making process prior to engaging a supplier sales representative directly.

Digital spend among engineering, applied technology, telecommunications, and professional services companies often exceeds 15% of total budget, with some large organizations claiming to invest more than one-half of marketing budget in digital programs.

According to Gartner [11], survey encompasses the views of 2,053 CIOs (Chief Information Officers) from 36 industries across 41 countries, representing more than \$230 billion in corporate and public-sector IT spending, the top 10 global technology priorities reflect a greater emphasis on externally oriented digital technologies. CIOs see these technologies as disrupting business fundamentally over the next 10 years. They envision themselves with a range of digital innovation tools, all of which rely on tending existing platforms in support of hunting for new digital opportunities and harvesting value from products, services and operations.

Digital Economy Theme (DET) by the United Kingdom's Research Councils [12] reveals that the AHRC-funded (Art and Humanities Research Council) Brighton Fuse project is based on a survey of almost 500 firms and interviews with 77 local entrepreneurs in Brighton's creative digital cluster. It provides a clear picture of recent developments in the creative economy as it is transformed by new digital technologies. Fused businesses combine creative art and design skills with expertise, harnessing the competitive advantage of combining diverse skills and knowledge. The report found a significant correlation between higher levels of fusion and innovative outcomes (that is, launching products and services ahead of competitors) after controlling for size, sector, firm age, and even levels of growth. The organizations that integrated creative arts and humanities skills with creative technical skills, had superior economic performance compared to firms that didn't integrate as extensively.

As indicated in [1], [13], [14], and [15], following are the desperate aspects to assess the paradigms to manage digital business.

- The organizations, executives, teams and people use resources to improve the ways they serve their customers, collaborate, and operate
- The trade-off between cost, quality, and operational agility to attend changing characteristics of digital business drivers
- Metric five digital forces [16]: globalization, millennialization of consumer, prosumerization, business virtualization, and digital platform
- Increased need of effectively managing knowledge and technology advancements in terms of benefiting the consumerization as well as to remain competitive
- Precisely identifying and placing associations between development in life science and digital automation.

SAP Business Transformation Services and the Business Transformation Academy jointly developed the "Digital Capability Framework" (DCF) [7]. The aim of this framework is to help company managers analyze the potential of their company in order to leverage technical

innovations and to reach their stakeholders. The DCF consists of six dimensions, two digital transformation enabler dimensions and four digital transformation goal dimensions.

After extensive literature reviews and analysis, it was apparent that enterprises across the globe are eager to take advantages of combining digital technologies with their business strategy. Many digital transformation tools and frameworks are available (Example: Brighton Fuse and DCF) to instantiate the appropriate level of digital technology enablement. However, very few organizations realizes that it is a change in business strategy itself rather implications transformation or of technologies. The classic example is the innovation in video streaming changed the way of performing business of movie rentals. It is the primary reason that none to limited research methodologies, frameworks, rationalization available to consistently and effectively manage risks during digital business.

## III. INCREMENTAL RISKS: APPROACH AND CATEGORIES

Typically, risk is defined as a potential future harm that may arise from some present action. The loss is often considered in terms of direct financial loss, however, during the management of digital business, the loss can be in terms many other factors such as credibility, trust, prospects, and security. Risk management is a series of steps to identify, address, and eliminate risk items before they become threats to successfully managing digital business and a major source of expensive revision or investment. We define digital business operation (DBO) as the most granular level of functionality to incorporate specific accessible feature or business integration with digital technology (or platform). The IR is amount of uncertainty added to or degraded from a risks associated with managing digital business by either incorporating new and updated DBO or eliminating need of updating DBO. The update to DBO can be eliminated either third-party through involvement, validating conforming completeness of DBO, or strategic decision not to perform (or partially perform) specific business operation using digital technology.

### A. Steps to Identify Categories of Incremenal Risks

Fig. 1 represents our approach to identify categories of IRs for an enterprise in the form of state transition model. The primary consent to derive the states is the DBO and corresponding transitions from one state to another is in adherence to either constitute or assign the categories of IRs. DBOs can be associated with multiple categories of IRs. The process consists of 5 steps as described below.

**Determining type of DBO**: The first step is to determining the type of DBO. The type can be determined based on the enterprise involvements whether it is the consumer facing, vendor specific, internal to the employee, or automation to retrieve information from the database. The DBO identified to enter the credit card information for online payment is associated with consumer, however, DBO to validate the credit card

information is associated with bank. They both have different characteristics and responsibilities.

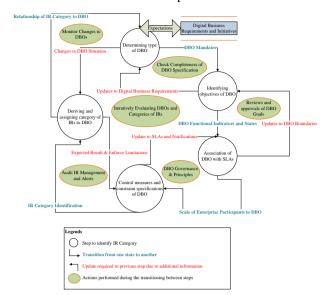


Figure 1. Steps to identify categories of IRs

Identifying objectives of DBO: The analysis to identify objective of DBO is performed during this step in adherence to the associated enterprise involvement identified in previous step. The objective is required to be reviewed and approved by corresponding stakeholders. As DBO is determined at the most granular level, the objective determined is extremely focused and within the boundaries of impact to an enterprise. The objective of DBO to validate credit card information is to receive the credit card information, verify the parameters of credit card, and present an approval message or an error. However, certain validations are responsibility of and can be performed at the consumer facing DBO, such as number of digits entered in the credit card number.

Association of DBO with Service Level Agreements (SLAs): The objective of the DBO is being associated with the SLAs in this step. The SLAs can be of numerous type and typical enterprise has predetermined SLAs for each business operation. However, any additional SLA with respective to the DBO objective if required then it is defined in this step. Usually, validation of the credit card has SLA of 3 seconds during online payment and it has to be associated as well as monitored with DBO.

Control measures and constraint specifications of DBO: Each industry has their own standards and in certain cases corresponding compliances are still evolving. Any control measures including industry segment specific standards and constraint should be specified as well as reviewed in association with DBO during this step. The encryption required to send and receive credit card information to and from consumer is the type of control measure for the DBO associated with online credit card payment by consumer. However, validating the credit card information can only be performed by bank is the type of constrained imposed to the corresponding DBO.

**Deriving and assigning category of IRs to DBO**: At this step, all the potential dependencies and associations

of DBO are known. This step is to determine the different types of risk to the DBO based on identified uncertainties. If the type already exist then it is assigned to the DBO and if the type doesn't exists then it is introduced to the enterprise. Each IR is allocated with severity as depicted in Section V. Risk of connectivity can be associated with consumer specific DBO in the example of credit card payment, however, risk of regulatory compliance can be associated with banking specific DBO for receiving credit card information.

#### B. Categories of Incremental Risks

As indicated in Fig. 1, the steps are iterative and they are consistently performed during each upgrade or corresponding deployment iteration. The categories of IRs are weighed and evaluated at each deployment iteration as described in Section V.

While iteratively executing the above steps to the case of online purchases of products pertaining to B2B electronic commerce (E-commerce), we identified following primary categories of IRs and their essential gradients. The categories can further be evaluated to derive subcategories based on numerous factors required to be considered for the DBOs.

Technology change IR (TCIR): Pace of digital technology change and upgrades required because of competition as well as changing dynamics of marketplace. The example of IRs that are being identified in this category includes any potential unknown technique to be introduced and lacking of appropriate resources to accommodate DBO using the correct level of technology feature.

Communication IR (CMIR): Advancements in connectivity and convergence due to potentials of newly introduced threats in communication channels and media. Most security concerns, trust, accessibility issues, roles, and unavailability of the network or enterprise resources are categorized in this type of IRs.

Governance IR (GVIR): Upcoming regulatory and legality of digital technologies in assertion of globalization. IRs associated with tax computation for specific state, unauthorized charges and adjudication, and unauthenticated access are the examples of GVIR. Part of the trust related risk factor also fall into this category.

Competitiveness IR (CPIR): Desired and recognized time-to-market versus the anticipated accuracies in products or services. Failure to deliver specific service on time, alterations required in reliability of SLAs, and customer needs to call support for online errors or unavailability are the outcomes of IRs categorized in this type. The primary impact is to the credibility.

Consumerization IR (CSIR): Compromise in consumer satisfaction due to preference in operational agility of delivering the digital business functionalities. The upgrade to infrastructure, scheduled maintenance, and flexibility to employee on deliverables are the examples of such IRs. It impacts the prospect and new business opportunities.

Performed correctly, the approach will precisely categorize the IRs associated with DBOs. However, the question remains open in term of how to identify, assure, and qualify the individual risk. Besides, one of the primary distinguishing feature between traditional risk and IR is the ability to add and degrade uncertainties of DBO. The modeling framework presented in Section IV enables characteristics of IRs.

## IV. INCREMENTAL RISKS MODELING FRAMEWORK (IRMF) FOR DIGITAL BUSINESS

IR modeling framework (IRMF) is the platform to correlate IRs and their categories to DBOs during deployment and consequently in runtime. It provides a feasibility for an enterprise to accurately model IRs and continuously monitor as well as update them based on the upgrades to the DBOs. The frequency and intensity of the updates to IRs are proportionate to the scope of DBOs that are either required to be updated or deployed in production. IRMF also establishes and provision to update policies for individual IR and qualification criteria for the categories of the IRs. Fig. 2 illustrates the constitution and aspects of IRMF to affectively accommodate iterative approach for evaluating and updating paradigms of digital business.

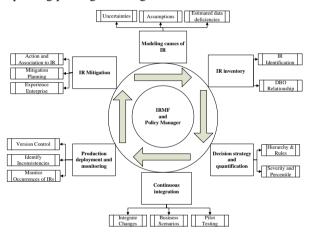


Figure 2. Phases of IRMF

Modeling causes of IRs: The first modeling criteria is to identify the possible causes of the IRs. It can be either due to the uncertainties, assumptions, or estimated data deficiencies. The state level causes relates to the unpredictability that represents whether or when a certain change may occur. Effect level causes relates to the inability to predict the nature of the impact of a change. The response level causes are defined as a lack of knowledge for the response options in specific DBO and/or an inability to predict the consequences of a response. Generally, the causes are modeled based on the situations associated with specific DBO.

IR inventory: The subsequent step is to identify individual IR based on the causes modeled and categorize them (as indicated in Section III). The IRs are registered, validated, and authorized in this step before actually added into the inventory. Multiple DBOs can be associated with single IR and vice versa is also possible. The inventory maintains the mapping between the individual risk and DBO. It is updated in each production deployment iteration and along with the cause models established in previous phase of IRMF.

**Decision strategy and quantification**: Qualitative and quantitative aspects of IRs are placed during this phase of the IRMF. Severity of the IRs are derived in the decision log based on the strategy of the particular DBO as well as overall goal of the digital business. The hierarchy of decision and decision rule are evolved. The weighing and percentile of IR categories are also computed (Section VI). They are revised in each of the production deployment iteration. The statistics can be generated and IRMF can be learned based on the analytical data provided during this phase.

Continuous integration: During this phase of the IRMF, the objective is to integrate changes from all the sources associated with updated or newly introduced DBOs such as customers, vendors, systems, and operations. If there is any need of additional DBO based on the emulated business scenario then it is also determined in this phase. It provides an environment to emulate business scenario in presence of identified, categorized, and evaluated IRs before actually production deployment. Pilot testing for high risk related DBOs is carried-out in this phase of the IRMF.

**Production deployment and monitoring**: It is responsible for the deployment of parameterization to production deployment environment. The version control of each DBO and corresponding IRs is maintained during this phase. Frequency of upgrades and validation is decided here. Any inconsistency in mapping and relationship between the business scenarios, DBOs, and IRs is captured along with the actual occurrences of the IRs.

**IR Mitigation**: It is the final stage of present cycle of IRMF before actually moving to the next cycle of IRMF. The actual occurrence of IRs are analyzed and corresponding actions are defined (at runtime). The identified action can be either accommodate to the intermediate releases or to the next production deployment iteration. Mitigations are associated with the IRs to generate experience for an enterprise and respective participants (including infrastructure or system elements).

## V. EVALUATING INCREMENTAL RISKS AND MITIGATION

#### A. Experiemental Setup for IRMF

The conceptual modeling of IRMF can be build using various different tools and techniques that supports risk analysis and management as the integral capabilities of production deployment iterations. Primarily, they are most effectively implied using project management (PM) [17], enterprise architecture (EA) [18], and business process management (BPM) [19]. Tools and technologies for PM, EA, and BPM facilitates automating risk identification, modeling, and management. We utilized Oracle BPM [20] to imply IRMF and model the IRs as it also has emulation capabilities as well as association with enterprises' business processes (BPs). The experimental evaluation is based on set of 6 diversified BPs and 62

DBOs. The DBOs are associated with one or more BPs listed below.

**BP# 1:** Online customer enrollment. The registration and account validation are the example DBOs pertaining to the BP.

**BP# 2:** Manage customer information, inquiry, and history. Customer payment history is the type of DBO within the arsenal of this BP.

**BP# 3:** Manage purchase order. Removal of the item from a purchase order is the DBO that can fall into this BP.

**BP# 4**: Online billing and invoicing. Generating invoices is an example DBO belongs to the BP.

**BP#** 5: Payment processing and account receivable. Credit card payment processing by the bank is the most prominent DBO of this BP.

**BP# 6:** Online notification and acceptance of terms. Updating payment term is the DBO that can be classified under this BP.

#### B. Evaluating Categories of IR

Any risk analysis method considers three paradigms to evaluate risk the quantity of potential impact, the probability of risk occurrence, and the timeframe. IR attempts to compute the worst case scenario for the identified timeframe. The production deployment iterations are typically set for 3 weeks to capture and iterate DBO (Fig. 1) and update IRs (using IRMF setup). 8 production deployment iterations are performed.

Severity levels are assigned to each identified IR. Although, every enterprise can define their levels and interpretation of severity levels (ISL), we have defined 4 levels of IR severity levels as listed below.

**ISL1** (**critical**): When IR is anticipated to be critical and interrupts continuity in day-to-day business then it is assigned ISL1 severity level.

**ISL2** (**high**): If the backend operational level failure is expected due to occurrence of an OR then the IR is assigned with ISL2.

**ISL3** (**medium**): An IR is estimated to violate one or more specified SLAs (service level agreements) then it is assigned with ISL3.

**ISL4** (low): If minor request an additional feature or addon capability from customer or vendor is anticipated to DBO then associated IR is assigned with ISL4 severity level

The assigned values for the severity levels (ISLV) are ISLV1 = 1, ISLV2 = 0.7, ISLV3 = 0.4, and ISLV4 = 0.2 to indicate finite value during the valuation of IR. The average weighing is being computed based on number of IRs identified in the category of IR (identified in Section III) and their severity level. Equation (1) presents the average weighing of the category of IR in consideration (AW<IR Category>).

In (1), "n" represents the number of levels defined for the severity in present iteration (that is, 4). #IR<IR Category> is the number of IRs identified for the specific category in present iteration. #IR<SL><IR Category> is the

number of IRs that falls into the specific severity level (in the context of particular IR category) for the present iteration. Finite value assigned to the specific severity level is presented by ISLV<SL>.

$$AW < IR Category >$$

$$= \frac{\sum_{i=1}^{n} [ISLV < i > J \times [IR < i > < IR Category >]}{\#IR < IR Category >}$$
(1)

The percentile for specific category of IR is being identified in (2) during each production deployment iteration and registered to IRMF. It also provides indicative number for the probability of IR occurrences (for the specific IR category). The percentile depends on the number average weighing of the IR category and number of DBO impacted due to the specific category of IR

In (2), #DBO represents total number of DBOs in present iteration (that is, 62 in iteration 8), #DBO <IR Category> is the number of DBOs associated with the IRs of the specific IR category in present iteration, #IRs represents total number of IRs in present iteration, #IR<IR Category> is the number of IRs identified for the specific category in present iteration, and AW<IR Category> is computed using (1) for the present iteration.

PEIR < IR Category > =
$$\frac{\left(AW < \text{IR Category} > \times IR < IRCategory} > \times DBOS < IRCategory > \right) \times 1000}{\# IR \times \# DBOS}$$
(2)

Table I represents the data for iteration 8 of the DBOs and associated IRs. It provides number of IRs identified for each category (#IRs), number of DBOs impacted by the specific IR category (#DBOs), computed average weighing for the specific IR category (AW), actual percentile of IR category (PEIR), and number of actual unique IR occurrence (#ACTIR) before instantiating next production deployment iteration (that is, iteration 9). If the DBO includes multiple risk categories then they are being considered in both the categories to provide accuracy during analyzing the impact.

TABLE I. CAPTURED IT CATEGORIES DATA IN ITERATION 9

IR Category	IR Category Paradigms				
	#IRs	#DBOs	AW	PEIR	#ACT IR
TCIR	14	18	0.72	68	5
CMIR	4	7	0.375	3.9	0
GVIR	8	12	0.56	20.2	3
CPIR	12	20	0.65	58.5	6
CSIR	5	5	0.48	4.5	1

#### C. Findings and Observations of IRs

Fig. 3 provides the total number of DBOs in each iterations and the percentile statistics pertaining to each category of IR for corresponding iterations.

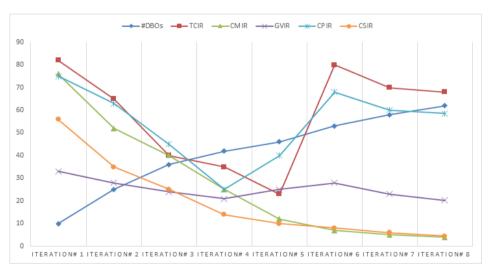


Figure 3. Statistics of percentile for each IR category (iteration 1 to 8)

It is apparent from the above presented analysis in Fig. 3 that each category of IR has different pace of percentile and respective probability. Percentile of technology change related IRs (TCIRs) and competitiveness IRs (CPIRs) decreases significantly before it actually starts increasing. Whereas, governance related IRs (GVIRs) are stable in characteristics indicating that the marketplace has always anticipating new regulatory events and concerns in pace. Impact of communication IRs (CMIRs) and consumerization IRs (CSIRs) are always decreasing due to consistent advancements in DBOs. The pace of

updates to DBOs and new DBOs (in the context of business processes in scope) are decreasing, however, stabilizes after certain iterations.

#### D. Categories of Mitigations

Based on the analysis and observations, 3 categories of mitigation are identified. Each category of mitigation is dedicated to either eliminate or reduce uncertainties of the DBOs.

Accuracy in estimating uncertainties and errors: The action includes inserting qualification and experience to introduce and effective validate uncertainties. It includes periodic measure, justified conservatism, and stress test in inputs and outputs of the DBOs introducing corresponding uncertainties.

Early resolution of deficiencies in DBOs: The primary goals are to establish governance to consistently resolve deficiencies in DBOs. The action item includes regular or frequent automated monitoring of DBOs to support an early warning system of deterioration to ensure the quality, integrity, traceability, and consistency.

Instituting inventory of IR in decision making process: The action includes market benchmark, when applicable, for the methodological decision adopted and use of alternative path to contrast result. Development of complementary analyzes that question the validity of the DBOs using additional information and provisioning of a delta factor to allowable impedance due to IRs.

#### VI. CONCLUSION AND FUTURE WORK

Despite the recently accredited research and available methodologies, the study indicates that enterprises facing significant challenges to correlate advancements in digital technologies and business activities before the realization of need for establishing or updating digital business strategy. The primary contributions in this paper is to specify emerging paradigms to manage digital business for provisioning upcoming digital technologies such as Internet-of-Things (IoT), Big Data, social media platform, online services, and mobile applications. It supports the enterprise in reaching more informed decisions about adapting, upgrading, and delivering digital technologies in the context of business strategy and organization's vision. Even then, however, enterprises will not be satisfied with digital technology-based assurances, and the paper consequently considers the extent to factor IR and corresponding mitigation can be offered through factorization.

There are different types of risks and each depends on type of paradigm associated to manage digital business. Severity of the risks can vary based on the characteristics of the upgrade necessary to introduce digital capabilities and corresponding features. The purpose of IRMF is to develop a granular aspect of managing digital business and to establish a comprehensive list of actions as well as mitigations. The framework assists enterprises by investigating the effects of external and internal interventions to efficiently operate digital businesses. It provides instrumental actions and evolves the enterprise based on rational problem solving to manage digital business. One of the primary avenues of the further research interest is to consider a series of issues in scenarios that requires attention in order for enterprises to establish IR governance processes across organization and corresponding operative digital businesses.

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