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Abstract. Due to the advancements in digital technologies and their characteristics to impact existing business models, enterprises have to capture risks in association with the pace of increasing competitiveness and capabilities of corresponding digital business. Traditional approaches for handling uncertainties and assumptions, typically, require enterprises to engage in severe risk management that involves systematic analysis of all possible pervasive inter, intra, and external scenarios. A number of vendors and institutes address it through risk governance frameworks that provide models, procedures, and tools for streamlining risk management across enterprise. Many of these frameworks are general purpose. While architecting for a digital businesses, existing risk governance frameworks tend to be narrowly focused to work with the specific business aspect. A critical problem for an enterprise when implementing risk governance for digital business is to assess and evolve incremental risks (IRs) in alliance with digital technology management. The paper examines the primary concerns of digital businesses and notion to capture associated incremental risks. The emphasis is to devise incremental risk governance framework (IRGF) and its phases in consideration of multifaceted and unpredictable physiognomies of managing digital business. A lightweight and extensible technique is proposed, one that employs scenarios to stabilize and continuously evaluate inductivity and also improve the dynamic sustainability of digital business operations (DBOs).

Keywords: digital business operation (DBO), governance framework, incremental risk (IR), processes, scenarios (SRs).

1. Introduction

The rise of digital business is rapidly changing how enterprises operate and communicate. Enterprises are looking for ways to seize advantages of emerging DBOs by evolutionary way of establishing interactivity, agility, and transparency [1]. The pace of advancements in upcoming digital technologies are rapid and it makes it imperative for enterprises to embrace digital technology features at all levels of day-to-day business. Many enterprises that considers digital technologies adaptation are at least somewhat aware of the desired changes to various enterprises entities and corresponding business operations. However, the impact of these changes in an enterprise vary across a wide spectrum. On one end, enterprises where extreme agility in producing new online applications and services is essential. On the other end, implementations in the regulatory related industry including financial services provider that involves continuous monitoring and updates based on upcoming compliances where there is a high need for control.

It is evident that digital businesses have flourished and failed at a scale and pace never seen before by any other traditional business sector [2]. While costs of managing enterprise’s ecosystem and servicing of clients have increases over time for traditional businesses, these costs have been falling rapidly in the case of DBOs. It is the primary reason, despite numerous failures, the phenomenal success of new ventures such as Amazon, Google, and Facebook have shown that disruptive business models have the potential to exponentially gain market share and expand virally. In recent years, many enterprises 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 scenarios of digital businesses. They are characterized by the challenges of business integration at various aspects of an enterprise and anticipated operational changes because of the newly introduced scenarios that never existed in traditional way of performing businesses.

One such example is the online movie rental, it is becoming norm in the industry. Additional scenarios are being introduced that weren’t even existed during the traditional way of renting movies from the store or actual site. The specific scenario in this case is to validate and restrict the number of simultaneous logins and devices to stream the video of rented movie for the specific customer. The other scenario is to introduce capabilities of pause and fast forward online streaming content. These scenarios are usually recognized during the later stages after deployment of digital technologies or corresponding products and services. The example indicates that there is a need to recognize, address, and capture such scenario oriented IRs to remain competitive in the offerings.

Many current risk issues of digital business are complex, uncertain, or even ambiguous [3]. In most scenarios, the potential benefits and IRs are interconnected. It raises the need of risk governance that essentially accelerates iteratively tuned risk-related decisions and maximizes DBOs’ trust in organization’s risk management processes, structures, and decisions. The volatility of scenarios are dependent on many factors such as industry segment, line of business, types of target customers, and vendors or suppliers of specific set of services (or products). Clearly, same risk governance solution or framework is not appropriate for every enterprise, besides there is a need to introduce DBO specific IRs into the adapted risk governance solution. It is neither desirable nor possible for organizations implying digital technologies to directly leverage risk governance from a single vendor [4], [5], and [6]. In some cases, organizations are considering building their own risk governance implementation [7], [8], and [9]. Organizations probably understands the need for risk governance, but they do not understand how to implement risk governance within their identified DBO specific scenarios.

We established an approach of classifying and specifying IR associated with DBOs in pervasive scenarios. Consequently, the paper proposes and implies IRGF based on the identified categories of scenarios to continuously and consistently govern existing or upcoming IRs in the context of enterprise’s DBOs. It provides a platform for enterprises to rationalize individual DBOs to trace the IRs, reduce the impact of IRs, and increase the response time in adherence to the occurrence of IR in a pervasive scenario. The categories of pervasive scenarios are identified based on factors impacting primary constitute of IRs associated with DBOs, that is, the changes due to advancements as well as implication of digital technologies during the product or service offerings to consumers. The categories are the basis to derive IRGF and evaluate inductivity of specific DBO. The vendor neutral scenario-based technique proposed here takes into account risk governance perspectives without going into specific roles. Each scenario category provides the context and requirements for a specific situation related to technical aspects in DBOs.

The rest of the paper is organized as follows. In Section 2, we present the literature review to recognize the principal concerns of IR association with DBO and pervasive scenario based approach to derive IRGF. Section 3 provides the approach to identify pervasive scenarios based on characteristics of essential DBOs that are required to be deployed by an enterprise. Subsequently, Section 3 provides the analysis and initial categories of pervasive scenarios. Section 4 describes the IRGF and necessary steps to govern risks for set of DBOs that are either in development or deployed in production. Section 5 enumerates methodology to iteratively assess inductivity of DBOs and correspondingly investigates key perspective to mature an enterprise during the incorporation of numerous types of DBOs. Section 6 concludes the findings and presents future direction for the ongoing research efforts.

2. Literature Reviews and Primary Concerns of DBOs

The Based on Gartner [10] survey that 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 in emerging market and harvesting value from products, services, and operations.

Emerging markets have been neglected by the literature in terms of risk metric assessment and improvements during the advancement of digital technologies. Most emerging markets are basically characterized by heavy tails in their distribution, particularly those of extreme value, making emerging markets more volatile and riskier compared to developed markets [4] and [11]. The study of 400 U.S.-based firms (by McKinsey) [1] 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. Although there is no consensus in the literatures on the best means of disaggregating uncertainties, the following categories appear to be an appropriate means of distinguishing between the key components of uncertainty [12] in digital businesses.

- **Variability** refers to different vulnerability of targets such as the divergence of individual responses to identical stimuli among individual targets within a relevant enterprise entities.
- **Inferential effects** relate to systematic and random errors in modeling including problems of extrapolating or deducing inferences from small statistical samples, from consumer data or experimental data onto actual business operations.
- **Indeterminacy** results from genuine stochastic relationship between cause and effects, apparently non-causal or non-cyclical random events, or badly understood non-linear, chaotic relationships.
- **Enterprise boundaries** allude to uncertainties stemming from restricted models and the need for focusing on a limited amount of variables and parameters.
- **Ignorance** means the lack of knowledge about the probability of occurrence of a damaging event and about its possible consequences.

International Risk Governance Council (IRGC) released a guideline [13] and approach of proactive governance for emerging risks that aims to enhance anticipation and forward-looking capabilities. The abstract level of steps assist projecting managers into their possible future operating context and highlights decision opportunities and provides them with additional lead time to prevent risks from emerging or to manage their consequences. It is also necessary to go beyond the usual Bayesian approach of eliciting and calibrating expert judgments. According to the RIM (Risk Maturity Model) [14], implementation of an effective enterprise-wide risk management program is incomplete without determining and defining an effective risk governance framework.

SAP Business Transformation Services and the Business Transformation Academy jointly developed the “Digital Capability Framework” (DCF) [15]. 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.

Various articles and literatures review indicates that enterprises across the globe are investigating means of identifying new scenarios in the context of DBOs that can impact existing business models as well as necessary variability to the organization’s strategy. Many abstract risk management tools and corresponding governance guidelines are available to instantiate the appropriate level of digital technology enablement. However, very few enterprises realizes that it is a change in business strategy itself due to newly introduced pervasive scenarios rather than transformation to digital technologies project. The most prominent example is the innovation in digital wallet where it requires storing and associating loyalty programs, gift cards, and credit cards. It eliminates the needs of producing the plastic cards, however, generates additional scenario to incorporate various formats in which the digital numbers and barcodes are saved and scanned.

3. Characteristics of DBOs and IRs: Foundation to Generate Pervasive Scenarios
Essentially, governance refers to the actions, processes, traditions, and institutionalization by which authority is exercised and decisions are taken and implemented. Risk governance deals with the identification, assessment, management and communication of risks in a broad context. However, during the applicability of DBOs, the risk governance also needs to consider paradigms of effective pricing models, deriving online marketing strategies, impact on creditability, and accompanying changes based on innovations in digital technologies [16] and [17]. We define 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, complexity, and ambiguity 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. Pervasive scenarios are associated with the DBOs and correlates sets of IRs with DBOs. Scenarios provides explicit relationship between DBOs and IRs, they can be either incorporated and automated into the DBOs or managed manually through the specific business unit.

3.1. Processes to identify categories of pervasive scenarios

Fig. 1 represents our approach to identify categories and policies of pervasive scenarios for an enterprise in the form of process model. The primary consent to derive the process is the DBO and correlate the IRs in scenarios. DBOs can be associated with multiple IRs and correspondingly multiple categories of scenarios. Corporate processes, governance, and objectives are required to be reviewed and formal approval is mandatory before moving forward with subsequent process or stage. The technique employs six sequential processes as described below.

-establish context of DBO
-develop classification schemes
-create affinity groups by IRs
-customize policies for the category of scenarios
-consolidate scenarios in categories
-create and refine scenarios

Fig. 1: Process model to identify categories of pervasive scenarios.

Establish context of DBO: The goal of establishing context is to collect and record information that will guide the DBO and activities to accommodate it in the enterprise. One part of establishing context is determining the business drivers or justification for DBO. Another part of establishing context is identifying the scope of the DBO. The context of the DBO activities should be scaled to assure that all participant enterprise entities are responding to consistent drivers and in adherence to objective of DBO. In the example of facilitating online movie rental with streaming videos through internet, the initial driver and granular scope for a DBO can be “registering an online account”.

Develop classification schemes: Classification schemes are used to categorize scenarios and the policies designed to address problems they raise. The schemes can often be simply based on the identified IR associated with DBO in consideration. Common classification schemes group scenarios according to goals (example, consumer certification), life-cycle phase (Example, invoicing), focus of activity (example, payment), or usage (example, check account balance). Classification schemes also provide a shorthand for
discussing groups of scenarios and policies and support efficient communication among participant enterprise entities. Classification schemes is developed as input to scenario generation.

Create affinity groups by IRs: The first two processes are best accomplished by employing a top-down approach. However, the insight is limited by the differing objective of DBOs. These different needs are driven by varying views of the dynamic characteristics of digital business and corresponding IR. Groups with similar and related IRs (affinity groups) are created and tasked with creating scenarios to capture these different viewpoints at this stage. The example is IR associated with the consumer security at various levels of digital business, it can be at transaction or application level, corresponding affinity group remains intact, however, the severity of IR differs.

Create and refine scenarios: Scenarios are generated independently by each of the affinity groups established in previous process. Generating appropriate scenarios that provides broad coverage of IRs is performed in this stage. The initial round is intended to elicit broad coverage of granular elements of scenarios. It considers a set of scenarios that address as many affinity groups within the classification scheme as possible by situational analysis that could lead to concerns. The issues could be alleviated if there are existing corporate policy or control in place. For example, a concern under administrative privilege could be access of the unauthorized third-party data and a concern under payment technology could be inconsistent use of a particular technology by third-party vendor providing payment authorization.

Consolidate scenarios in categories: The goal of consolidation is to reconcile and merge the work of the various affinity groups in order to identify pervasive scenario policies for the enterprise. Several dilemma may arise during consolidation of scenarios generated by different affinity groups and they are required to be considered at this stage to identify categories. The potential situations can be a scenario is consistently included by multiple groups, a scenario is in conflict with another scenario in a group, scenario is unique and doesn’t belong to any category, several scenarios across groups appear to be similar, although, they are actually different, and elements of a scenario from one affinity group are in conflict with one or more scenarios from other affinity groups.

The example of scenario that generate conflicting policies or mechanisms to address the same situation is consumer under age 16 are prohibited to access and purchase certain products. In this case, it is absolutely necessary to know the age of consumer. The example indicates that it needs through reconciliation on a case-by-case basis when deriving categories of pervasive scenarios (as described in Section 3.2).

Customize policies for the category of scenarios: The result of this process is a single set of consistent policies across the enterprise that have been fully validated against DBO drivers. The primary goal is to present a single set of implementable policies and other scenario elements, back into the enterprise-wide IR governance approach. It is mandatory and responsibility of this step to ensure that the policies provide complete coverage of the identified pervasive scenarios, map to the IRGF, and updating the policies or the respective paradigms in the proposed IRGF. In the example of accessibility of particular product and service can be restrained for consumers over age 16, however, the consumer application is required to access and process consumer information during the policy validation.

3.2. Categories of pervasive scenarios

All Scenarios represent combinations of formal models and plausible narratives [5] and [13]. Depending on the topic and the available knowledge, scenarios differ in the composition of formal modelling. Some scenarios pursue well-known causal or functional relationships and vary primarily in their assumptions. In contrast, others develop imaginative futures based on basic knowledge, formal logic, and plausibility. Almost all scenarios include methods to involve multiple actors and factors in the description of what the future could look like. While iteratively executing the above processes to the case of online shopping experience of set of consumers in electronic commerce (E-commerce), we identified following primary categories of scenarios and their essential gradients.

Cognitive scenario (CSR): When there is a cognitive diversity in the DBO is mandatory to intricate and react to the particular affinity group of IRs then the scenario is categorized at cognitive scenario. Parallel
variant of the specific DBO can be classified in CSR. Most applications that need to accommodate diversified types of consumers and geography falls in this category of scenarios.

**Explorative scenario (ESR):** ESRs describe how the future might unfold for DBOs, according to known processes of change or as extrapolations of past trends. They involve no major interventions or paradigm shifts in the enterprise. ESRs also can describe futures that bifurcate at some point (an example might be uptake or rejection of a new digital technology capability) or that make some assumptions about regulation and/or adaptation of a system. The simplest model is a direct extrapolation of past trends.

**Predictive scenario (PSR):** PSRs give a relatively detailed and quantitative indication of how the enterprise react to the change under a set of DBOs. It is based on a statistical extrapolation of trends, or some form of deterministic model of reality. When scenario is utilized to predict either ambient environmental conditions or human exposures then it in categorized as PSR. Predicting the increase or decrease in price due to the associated IRs is the capabilities offered through the set of PSRs.

**Normative scenario (NSR):** NSR takes values and interests in account. NSR depicts the alternative futures of DBOs or contrasting trends that might be very different from the present. They allow decision-makers to anticipate their reactions to different future possibilities, to anticipate time-frames beyond the immediate future, and to make choices. They should include a description of the present situation, a number of alternative futures, and possible path ways connecting the present with images of the future. NSRs are useful when digital technologies are not matured enough to establish automation of the DBOs.

**Interceptive scenario (ISR):** Adding responsibilities to individual DBO and avoiding a static occurrence of IRs, ISR is utilized to forward requests to the intra, inter, or extra enterprise entities and enables enterprise to perform additional actions before or after forwarding the request. ISR intercepts the usual characteristic of DBO and dynamically adds behaviors without affecting any other DBO. This can be useful in managing crosscutting concerns that access common features such as logging or validation.

**Substantive scenario (SSR):** SSR focuses to deliver essential functional expectations of DBOs. It is primarily to deliberate extensibility and maintainability of the DBO to facilitate additional functional and non-functional requirements of the specific business aspect associated with the DBO. It is to sustain the high priority investment to capture market share and specific set of consumers. It determines the paradigms during the actual occurrence of the IR such as how long will the damage last? Or can the damage be reversed? The most prominent example is the fraud prevention and protection approaches of an online business.

**Procedural scenario (RSR):** RSR is to ensure the sequential execution of the functionalities of DBO and resolution to the interdependencies within the specification of the DBO. RSR is utilized to estimate relative frequency of IR occurrence with respective to the DBO, which can be discrete or continuous. Classical example of the RSR is reaction and procedure to follow during fraud inducement scenario.

Performed correctly, the approach will precisely categorize the scenarios interlinking DBOs and groups of IRs. However, the question remains open in term of how to continuously identify or update, assure, qualify, and govern the upcoming situations in terms of pervasive scenarios of digital business. Besides, one of the primary distinguishing feature between traditional risk governance and scenario based IRGF is the ability to add and degrade uncertainties of DBOs in pervasive scenarios. The IRGF presented in Section 4 enables characteristics of IRs associated with DBOs in pervasive scenarios.

### 4. Establishing IR Governance Framework using Categories of Scenarios

IRGF provides the solution to modeling of pervasive scenarios and associate them with corresponding paradigms of an enterprise during the deployment of DBOs and consequently in runtime. It provides a feasibility for an enterprise to accurately model scenarios and continuously monitor as well as update them based on the upgrades necessary to the DBOs. The frequency and intensity of the updates to scenarios are proportionate to the scope of DBOs that are either required to be updated or deployed in production. IRGF also establishes and provision to update policies for individual scenario and qualification criteria for the categories of the scenarios. Fig. 2 illustrates the constitution and identified paradigms of IRGF to affectively accommodate iterative approach for evaluating inductivity of DBO in association with IRs.
Modeling of pervasive scenarios: The primary reasons to introduce pervasive scenarios is the existence of complexities, uncertainties, and ambiguities in DBOs. The initial IRGF criteria is to model individual scenario specifying the niche level of anticipated unpredictability of DBO. It is based on situation analysis and type of assumption incorporated due to IRs. The modeling specification includes the category it belongs to, customized policies associated with it, perspective of scenario, concerns, and any identified exception.

Fig. 2: IRGF based on categories of pervasive scenarios.

Association of IRs: The subsequent step is to identify set of IRs based on the analysis performed. The IRs are registered, validated, and authorized before actually associated with the scenario model. Multiple scenarios can be associated with single IR and vice versa is also possible. The association maintains the mapping between the individual scenario and associated IRs. The essential parameters to specify in this phase are the severity of IR, tolerance level, acceptability, and risk reduction measures as well as any known option. It is updated in each production deployment iteration and along with the scenario model.

Alliance of consuming applications (CAs): The alliance between the scenario model and various consuming applications is specified and traced in this phase of the IRGF. The alliances are basically in terms of specific functionalities and/or feature capabilities of the application. The navigation model can be represented to identify the impacted applications and corresponding online features due to pervasive scenario.

Integration of business processes (BPs): In more stringent enterprises, it is necessary for a scenario to participate in BPs before proving its legitimacy. This phase of IRGF is responsible for communicating qualitative and quantitative measures of scenarios across enterprise. BP activities that invokes the scenario is mapped to the scenario model and corresponding roles are derived or placed. The service level agreements (SLAs) are specified with the parametric aspects of scenarios in association with the enterprise entities. Any diversification to BP activity, role, or SLA is registered to the subsequent version of the scenario model.

Collaboration map of operative enterprise entities (EEs): The EEs including participating systems, platforms, infrastructure element, network, and third-party components that are involved in scenario should be specified during this phase of IRGF. The phase ensures the severity identified for the IRs associated with scenario is appropriate as certain EE are more crucial and has critical impact to the DBO over others. If necessary, severity must be revised and iterated depending on the upcoming changes.

Continuous deployment of DBOs: Each deployment of DBO is registered and corresponding version of the scenario models are maintained in this phase of the IRGF. Intense competition, pricing model, and marketing strategy are the primary impact areas as well as driving factors to continuously deploy the DBOs in due diligence of pervasive scenarios. They are monitored and observed to update scenarios.

5. Methodology to Evaluate Inductivity of DBOs
5.1. Experimental setup for IRGF

The conceptual modeling of IRGF can be build using various different tools and techniques that supports risk analysis and scenario modeling as the integral capabilities of production deployment iterations. Primarily, they are most effectively implied using project management (PM) [18], enterprise architecture (EA) [19], and business process management (BPM) [20]. Tools and technologies for PM, EA, and BPM facilitates automating risk identification, modeling, and management. We utilized Oracle BPM [21] to imply IRGF and model the scenarios as it also has emulation capabilities as well as association with service oriented architecture (SOA) to dynamically deploy DBOs. The experimental evaluation is based on set of 9 BPs of online shopping experience. It consists of 84 DBOs and 12 diversified consuming applications including customer portal, call center agent portal, database administrative application, and vendor specific application. The DBOs and corresponding identified scenarios are associated with one or more BPs.

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

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

BP# 3: Manage purchase order. Removal of the item from a purchase order is the example DBO.

BP# 4: Delivery of product and service. Assigning vendor to deliver specific product is the DBO in this BP.

BP# 5: Manage inventory. Removing number of items from inventory after delivery is an example of DBO.

BP# 6: Online billing and invoicing. Generating invoices is an example DBO belongs to the BP.

BP# 7: Payment processing and account receivable. Credit card payment processing by the bank is type of DBO of this BP.

BP# 8: Online notification and acceptance of terms. Updating payment term is the DBO.

BP# 9: Online support and resolution. Request to deliver at different address is an example of the DBO.

5.2. Computing inductivity of scenario based DBOs

Any scenario based risk analysis method considers three paradigms to evaluate scenarios, that is, the quantity of potential impact, the rationality of the business case, and the timeframe for the anticipated resolution. Scenarios attempt to compute the worst case possibility considering all the participants of an enterprise in the provided timeframe. The production deployment iterations are typically set for 4 to 5 weeks to capture and iterate categories of scenarios (Fig. 1) and update scenario policies as well as models (using IRGF setup). 8 production deployment iterations are performed.

Severity levels (SLs) are assigned to each identified IR. Although, every enterprise can define their levels and interpretation of severity levels, we have defined 5 levels of IR severity as described below.

ISL1 (catastrophic): When IR is anticipated to be critical and interrupts continuity in day-to-day business.

ISL2 (significant): If the operational level of one or more EEs failure is expected due to occurrence of an IR.

ISL3 (moderate): An IR is estimated to violate one or more specified SLAs then it is ISL3.

ISL4 (low): If there is an anticipation of request for an additional feature or add-on capability.

ISL5 (negligible): If certain extension is expected to include monitory help for consumers.

The assigned values for the severity levels (ISLV) are ISLV1 = 1, ISLV2 = 0.8, ISLV3 = 0.6, ISLV4 = 0.4, and ISLV5 = 0.2 to indicate finite value during the valuation of IR. The average weighing is computed based on number of DBOs, corresponding number of IRs associated with the specific category of scenario (identified in Section 3.2), and severity level determined for the respective IRs. Equation 1 presents average weighing (AW) of the scenario category (SRCA) in consideration.

In Equation 1, “n” represents the number of levels defined for the severity in present iteration (that is, 5). #IR<SRCA> is the number of IRs associated with the scenario category in present iteration. #IR<SRCA><SL> is the number of IRs that falls into the specific severity level (in the context of particular scenario category) for the present iteration. Finite value assigned to the specific severity level is presented by ISLV<SL>.

\[
AW < SRCA > = \frac{\sum_{i=1}^{n} [ISLV < i > ] \times [ #IR < i > < SRCA > ]}{#IR < SRCA >}
\]  \hspace{1cm} (1)
The inductivity of DBOs pertaining to specific category of scenarios (IND<SRCA>) is identified in Equation 2 during each production deployment iteration and registered to IRGF. It also provides indicative number for the probability of scenario occurrences (for the specific affinity group). The inductivity depends on the average weighing (AW) of the scenario category, number of impacted DBOs, involved consumer applications (CAs), corresponding business processes (BPs), and participant enterprise entities (EEs).

In Equation 2, #DBO represents total number of DBOs in present iteration (that is, 84 in iteration 8), #BPs represents total number of BPs in present iteration (that is 9, in iteration 8), #CAs is the total number of CAs in present iteration (that is, 12 iteration 8), and #EEs is the total number of EEs in present iteration (that is, 22 in iteration 8). Correspondingly, #DBOs<SRCA>, #BPs<SRCA>, #CAs<SRCA>, and #EEs<SRCA> are the paradigms and number associated with the specific category of scenario in context during present iteration.

AW<SRCA> is computed using Equation 1 for the specific category of scenario in present iteration and “p” presents number of paradigms in considerations (that is, 4 in present iteration of IRGF).

\[
\text{IND}_{<\text{SRCA}>} = \frac{(\text{AW}_{<\text{SRCA}>} \times \#\text{DBO}_{<\text{SRCA}>} \times \#\text{BPs}_{<\text{SRCA}>} \times \#\text{CAs}_{<\text{SRCA}>} \times \#\text{EEs}_{<\text{SRCA}>}) \times 10^{p-1}}{\#\text{DBOs} \times \#\text{BPs} \times \#\text{CAs} \times \#\text{EEs}}
\]  \tag{2}

Table 1 represents the data for iteration 8 of the categories of scenarios and associated DBOs. It provides number of IRs associated for each category (#IRs), number of DBOs impacted by the specific category (#DBOs), computed average weighing for the specific scenario category (AW), corresponding number of BPs associated with scenario category (#BP), involved number of consumer applications in the context of scenario category (#CAs), participant number of EEs to the scenario category (#EEs), and actual inductivity for the category (IND). If the DBO participate in multiple categories of scenarios then they are being considered in both the categories to provide accuracy during analyzing the impact. Similarly, if same IR is present in multiple DBOs for a single scenario then it is consider multiple time to compute the weighing of the scenario category.

<table>
<thead>
<tr>
<th>Scenario Category</th>
<th>#IRs</th>
<th>AW</th>
<th>#DBOs</th>
<th>#BPs</th>
<th>#CAs</th>
<th>#EEs</th>
<th>IND</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSR</td>
<td>12</td>
<td>0.6</td>
<td>18</td>
<td>5</td>
<td>7</td>
<td>10</td>
<td>18.93</td>
</tr>
<tr>
<td>ESR</td>
<td>14</td>
<td>0.7</td>
<td>23</td>
<td>6</td>
<td>8</td>
<td>12</td>
<td>46.46</td>
</tr>
<tr>
<td>PSR</td>
<td>18</td>
<td>0.65</td>
<td>20</td>
<td>7</td>
<td>9</td>
<td>16</td>
<td>65.65</td>
</tr>
<tr>
<td>NSR</td>
<td>10</td>
<td>0.48</td>
<td>14</td>
<td>9</td>
<td>8</td>
<td>8</td>
<td>21.82</td>
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<tr>
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<td>5</td>
<td>15</td>
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</tr>
<tr>
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<td>8</td>
<td>4</td>
<td>9</td>
<td>9</td>
<td>2.3</td>
</tr>
<tr>
<td>RSR</td>
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<td>0.34</td>
<td>12</td>
<td>6</td>
<td>7</td>
<td>13</td>
<td>11.16</td>
</tr>
</tbody>
</table>

5.3. Finding and observations of production deployment iterations

Fig. 3 provides the total number of DBOs in each iterations and the inductivity statistics pertaining to each category of scenarios for corresponding iterations. It is apparent from the presented analysis in Fig. 3 that each category of scenarios has different pace of inductivity and respective probability of occurrences.
Inductivity of predictive scenarios (PSRs) and normative scenario (NSRs) decreases significantly before it actually starts increasing. Explorative scenarios (ESRs) are stable in characteristics indicating that the digital marketplace has always anticipating new regulatory events and concerns in pace. Impact of substantive scenarios (SSRs) and procedural scenarios (RSRs) are always decreasing due to consistent advancements in DBOs. The characteristics of cognitive scenarios (CSRs) are unpredictable as they fluctuate dramatically during the deployment of DBOs in various iterations due to impact of geographical culture diversities and needs of global changes (including environmental changes). Whereas, the pace of decreasing inductivity of interceptive scenarios (ISRs) is gradual and in correlations with the advancements in DBOs. The pace of updates to DBOs and new DBOs in the context of consuming applications and business process in scope are decreasing, however, it stabilizes after certain iterations.

5.4. Improving maturity of an enterprise

Based on the analysis and observations, 3 categories of improvement opportunities are identified for an enterprise to be matured in terms of IRGF. Each category of maturity improvements is related to the envision accuracy in DBO and corresponding scenarios.

Precision in business integration to digital technologies: Scenario specific SLAs association and roles to the BP activities provides in-depth view of the consequences as well as threshold level to tolerate corresponding IRs. Precision in enumerating interdependencies and correlation with stages of BP activities to specific scenario decreases vulnerability introduced due to digitalization in the form of DBOs.

Streamlining detection and realization of emerging market trends: The action includes market benchmark within the scenario models, when applicable, for the methodological decision adapted. Advancement in capabilities of an enterprise to introduce scenarios with augmented temporal properties in adherence of identified emerging market’s hierarchy of conditions is necessary.

Continuously evolve enterprise to rationalize decision making process: The enterprise implying IRGF has to evolve and additional scenario categories and respective custom policies are required to be introduced and parametrized. On the other hand, obsolete scenario categories are required to be removed and noted for future decisions. It is due to the changing dynamics of digital businesses, corporate governance, and upcoming regulatory and ethical standards towards operating digital businesses.

6. Conclusion

The study illustrates that existing risk governance frameworks and offerings of the risk management by various vendors are a useful starting point for an enterprise adapting, leveraging, and advancing organization’s digital business goals. However, mandating an existing framework without considering the unique needs of the DBOs may result in inefficiencies, overkill, or, even worse, complete failure due to pervasive scenarios of digital businesses. Abstract level of guidelines and frameworks are available to recognize DBO specific scenarios and they are unable to accurately measure the impact of associative risk. This paper proposes an IRGF that can be applied to a variety of online business to analyze, evaluate, and predict pervasive scenarios. The framework captures the way that online users are organized and communicate with respective to the identified DBOs and in the BP propagation to adopt product or a service.
Secondarily, the framework also considers other novel elements of digital businesses such as digital technology inventions, pricing models, and marketing strategies.

The scenario-based technique presented in this paper provides a mechanism that is vendor neutral, compatible with existing risk governance frameworks, simple, and easily scalable. There are different types of pervasive scenarios and each determines the inductivity of set of DBOs depending on the severity of associated IRs, BPs, EEs, and CA utilization. The methodology to determine types of scenarios assists enterprises by investigating the effects of external and internal interventions to efficiently operate DBOs. It provides instrumental actions and evolves the enterprise based on rational problem solving to manage IRs. The results are encouraging and direct benefits are visible in terms of revenue as well as increasing market share for the specific line-of-business. Moving forward, the primary research interest is to define maturity levels of an enterprise considering dynamics between deterministic behavior of the scenarios and accuracy in the DBOs for early detection of the IRs or for rapid turnaround time in the DBOs.

7. References

