Innovating with enterprise systems and digital platforms: A contingent resource-based theory view

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ABSTRACT

In an era of new technological advances and hyper-competition, it is no surprise that organizational innovation enabled through information systems in order to achieve competitive parity will remain a core topic of interest for both scholars and practitioners. Understanding the process of innovation through enterprise systems (ES) is especially critical, given the contradictory beliefs surrounding the role of ES in organizational innovation. Conversely, recent anecdotal commentary suggests a substantial growth in digital platforms, purportedly energizing innovation. This study seeks to address our limited understanding of how digital and ES platforms attain innovation, through a study involving 189 organizations.

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1. Introduction

The relationship between information technology (IT) and innovation has been a much discussed topic in academia [116,29] and practice [48,111], with many studies resorting to a highly positive view of technology's role in assisting innovation [112]. In the current competitive and aggressive corporate environments, organizations are increasingly under pressure to maximize their resources [123], especially to maximize the values and benefits embedded in their existing technology infrastructure such as enterprise systems (ES) [129]. Despite their continuing dominance as the most salient corporate information systems (IS) since the mid-1990s [47], the role of ES in innovation is yet to be comprehensively understood [165,166]. The advent of ES provided the much-needed IT functional capabilities for organizations to innovate through process orientation, integration, and standardization [154,13].

The majority of past studies discussed the influence and importance of the features and functions of an ES that bring forth operational flexibility [85], business process improvements [73], productivity [140], transparency [5], innovation [145], and profitability [134,146]. However, there is a growing recognition that ES is now evolving to play a more salient role as a technology platform. The literature provides the characteristics of a technology platform such as providing the basis for further actions, changes, and evolves but in a stable manner, not providing value itself, and the actions conducted on the platform are restricted by its nature [64,150]. Gawer [64] recognized that ES acts as a building block, providing an essential function to a technological system that acts as a foundation upon which other complementary products, technologies, or services can be developed (for further details, refer Appendix A). The widespread adoption of ES across industry sectors and geographical locations and the emergence of unrestricted platform architectures (e.g., the NetWeaver platform interface by SAP) further recognize ES as a dominant corporate technology platform [66]. Moreover, adhering to the fundamentals of a “platform” [64,150], the “ES technology platform” (henceforth referred to as an ES-platform) facilitates an ecosystem of third-party software products, services, and suppliers [28]. Gawer and Cusumano [66] observed that reducing the restrictions in an ES platform assists organizations in innovation. Other studies have observed that an ES platform may hinder innovation [91]. Practitioners have also likened installing an ES to “pouring cement” [91,45], and an ES is not, in general, designed with flexibility in mind. Gable and Sedera [60] and Sedera and Gable [139] suggested that the lack of flexibility in an ES platform hinders growth opportunities. However, with contrary views of Swanson and Dans [147] on systems being upgraded or replaced periodically to minimize deterioration, Eden et al. [52] noted that ES is rarely replaced or retired.

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Moreover, since the mid-2000s, corporate IT has been presented with a plethora of technology options. The advent and massive proliferation of mobile computing, cloud computing, in-memory technologies, and social media, collectively referred to as digital platforms [120,161], fueled by the consumerization of IT [75] have presented organizations with other opportunities to innovate, signifying an era of technology that epitomizes flexible, easy-to-deploy, and cost-effective IT solutions [152]. Here, the study makes a distinction between “functional” capabilities and the capabilities of a digital platform. Although it is acknowledged that the functionality of such technologies may have differences, as digital platforms they possess very similar characteristics. A digital platform in this research is defined as a technology architecture that allows development of its own computing functionalities and allows the integration of information, computing, and connectivity technology platforms available to an organization. The common characteristics of digital platforms represent newer technology ecosystems that can be interconnected to provide creative solutions to organizational problems. Therefore, the use of the umbrella term “digital platform” is appropriate. While we acknowledge the functional differences in digital platforms, this compromise was made to focus on the ability of these technologies to foster innovation.

For organizations, the growth of digital platforms has provided an ecosystem of providers and suppliers of tools, techniques, and practices, beyond the conventional boundaries of traditional corporate IT [161,75,3]. As Yoo and Boland Jr [161] identified, digital platforms denote broad and evolving models of highly distributed computing and related solutions that rely on heterogeneous, ubiquitous network services, and associated protocols [32,113]. Researchers also indicated that digital platforms have the potential to trigger innovation in organizations [120], facilitated by their trialability, cost-effectiveness, and ease of use [26,108].

This research is driven by the following research question: “Does the ES-platform moderate the impact of digital platforms in attaining innovation?” It allows both researchers and practitioners to observe the changing role of ES as a platform as well as the impact it has on novel technologies cloud, mobile, in-memory, and social media platforms. Here, although the digital platforms are associated with innovation, the role of ES as a platform, particularly when embedded in the IT portfolio, is yet to be determined.

The surging changes to the corporate IT landscape [137] of cloud, mobile, in-memory, and social media platforms were evident in the sample of this study. Fig. 1 summarizes the platform composition of our study sample of 189 large organizations. The study inquired the organizations to denote the percentages of spending in relation to the complete IT portfolio 3 years ago and now (in 2014). Overall, Fig. 1 highlights the dramatic changes in the corporate technology landscape from 2011 to 2014. For example, in 2014, the emphasis on ES dramatically reduced (with a drop of 36%) and the footprint of all digital platforms increased.

Fig. 1 reflects how the modern organization is transforming from a single, monolithic ES-centric technology landscape into a portfolio of IT with an eclectic collection of platforms. The observation drawn from Fig. 1 concurs with the predictions by practitioner outlets (e.g., [22]), where they argue that contemporary organizations are much eager to integrate digital platforms with traditional ES technology platforms to innovate and augment the functions of the existing business processes, thereby suggesting an interacting role of ES and digital platforms in fostering innovation.

The conceptual view of the interaction of digital platforms with ES platforms for innovation is illustrated in Fig. 2. Fig. 2 alludes to two possible scenarios of the business processes involving both internal and external parties (i.e., customers and/or suppliers) posed by the advent of digital platforms: (i) the coexistence of an ES platform and digital platforms in a single business process or (ii) the replacement or substitution of platforms. In both scenarios, the digital platforms have the potential to provide an augmented, value-adding, and innovative option for completing a business process (the dotted line in Fig. 2), compared to the default ES process (the straight line in Fig. 2). The focus here shifts to functional orientation, as opposed to process orientation. The engagement focus of digital platforms is not on providing a platform to automate the entire business process, but rather on innovating through exposing a selected platform component/s to build function/s that would provide maximum innovation capacity to the organization.

Nambisan ([120], p.216) highlighted that the inclusion of digital platforms plays an imperative role in modern innovation, whereby digital platforms “are being embedded to an ever increasing range of products and services...thereby expanding the role and relevance of IT in any innovation.” Such technologies epitomize the role of IT “as an operant resource [that] underscores how digitalization can unleash generativity and create novel opportunities for resource integration” ([105], p.28). Digital platforms purport to provide organizations with an unprecedented potential for innovation through their affordability, ease of adoption, and ease of connection with customers and suppliers [161,160]. Such platforms have disrupted the traditional linear equation, so that IT
sophistication is no longer proportionate to resource availability (e.g., finance and human capital), thus providing organizations with low capital the opportunity to innovate in the same fashion as their resourceful counterparts. As shown in Fig. 2, for the traditional ES custodians, digital platforms also provide alternative approaches as well as the opportunity to synchronize such platforms with their ES platform. However, digital platforms have the potential to act on their own and do not necessarily have to rely on the ES platform [161]. Although digital platforms have the option to be deployed and managed in isolation, they have the potential to deliver better value by integrating or synchronizing with a high-quality ES platform [101]. For instance, the Sybase Unwired Platform – a market-leading mobile platform – has the potential to operate alone, as well as to integrate and extract the relevant master data and business rules embedded in an ES platform. Similarly, cloud computing, in-memory technologies, and social media can also be integrated with the ES platform, potentially delivering greater benefits than if they were to be operated as individual platforms [161,149]. The quality of a platform has been observed through data [138], stability of the business processes [13], resource dedication [18], and the ease of connectivity [161,149].

Given the low-cost, easy-to-access, and easy-to-deploy nature of digital platforms [99,132], a reasonable assumption in the research question is that all organizations have equitable access to such digital resources (e.g., Fig. 1 evidenced the substantial footprint of digital platforms in our study sample). Further, an operational boundary of this research is that the notion of “digital platforms” herein is limited to mobile, cloud, in-memory, and social media. Although these technologies denote the types of digital platforms at the point of writing, an alternative classification based on finer or broader associations of technologies can be derived in future studies. Moreover, the term “social media” in this research does not pertain to the simple use a Facebook page for a company, but rather observes how social media is used as a corporate platform (e.g., Delta Airlines allowing passengers to complete the entire ticketing process through Facebook).

The remainder of the paper proceeds in the following manner. The next section introduces the contingent resource-based theory as the theoretical basis of this study, followed by the research framework and hypotheses development. Then, we present the research methodology, highlighting sub-constructs and scale development. The data analysis and findings are then presented. The paper concludes with an overview of the study’s contributions for research and practice, limitations, and recommended directions for future research.

2. The contingent resource-based theory

The resource-based theory (RBT) explains that the diverse resources owned by each organization differentiate an organization’s performance levels and provide competitive advantage to the organization [11]. Even though RBT provides the much-needed theoretical understanding of how resources can be employed for higher outcomes, it falls short in explaining the conditional aspect of organizational resources [30]. Brush and Artz ([23], p. 223) critiqued this core deficiency of the RBT stating that Barney’s [11] four criteria for resources, namely value, rarity, immutability, and substitutability “are limited in their practical usefulness for this problem because they are context insensitive.” They further explained that “while context specificity is incorporated in the theory by requiring that resources be “valuable,” the theory is not instructive in identifying the contingencies that might make the same resource valuable in some contexts and not in others.” Other researchers concur with the views of Brush and Artz [23]. For example, after reviewing IS research using RBT, Wade and Hulland ([153], p. 123) noted that “resources rarely act alone in creating or sustaining competitive advantage.” This gives rise to the need to pay attention to the role of other resources or complementary resources, which are linked to the resource under consideration in creating sustainable business value. It is expected that there are synergies from primary and complementary resources [30], highlighting that some resources rarely act alone in creating competitive advantage. Research extensions of RBT also suggest that while resources can either be given exogenously or created by activities within the organization, capabilities emerge from the integration and combination of these resources [30,23]. Furthermore, studies investigating the interrelationship of resources have found that the primary resources and secondary/complementary resources are aligned to yield superior organizational performance [30,23]. Thus, as an extension to RBT, contingent resource-based theory (CRBT) explains that the value of resources can be contingent upon the context and the linkages between the primary and complementary resources [8].

The delineation of a resource as a primary resource is also context dependent. In CRBT studies, the resource under consideration is often called the “primary,” while the other interacting resources are referred to as “complementary/secondary.” However, the theory does not purport the literal meaning of primary (i.e., main, chief) in its theoretical view when describing a resource. Conversely, complementary resources are those that are expected to interact with and increase the value of the primary resources [54]. In the IS literature, for example, technology platforms are treated as primary resources (e.g., [30,104]), while in the context of
analytics, data are discussed as a primary resource [49,125], which
is per CRBT, complementary resources have a moderating
effect on the primary resources [153]. In this line of enquiry, Luo
and Fan [104] considered IT infrastructure, enterprise IS, and
financial resources as organizations’ resources for improving
organizational capabilities, including operational efficiency. Here,
they argued that the impact of IT assets (IT infrastructure and
enterprise IS) on organizational capabilities is moderated by
financial resources: the positive impact of IT assets on organiza-
tional capabilities is stronger when organizations possess greater
financial assets. In applying CRBT, this study considers digital
platforms as the main resource under investigation (thus consid-
ered primary) and ES platform as the complementary resource in
delivering innovation to the organization [76,46,33].

However, the ability of digital and ES platforms to support
innovation is not a foregone conclusion. It requires much debate,
investigation, and empirical evidence. Employing CRBT, this study
argues that, although resources can be operational in isolation to
create competitive advantage [23], the synergistic complementar-
ity application of resources (in our case, digital platforms and ES
platforms) is purported to deliver greater benefits.

Fig. 3 depicts the a priori research model of this study, with
three constructs (Digital platforms, ES platform, and Innovation).
Consistent with the CRBT, the digital platform construct is
conceptualized as the primary resource, while the ES platform
serves as the contingent resource, which moderates the relation-
ship between digital platforms and innovation. The a priori
research model addresses the recent calls for empirical research on
the ability of digital platforms to trigger innovation [120].

In defining the ES-platform construct as a moderating resource,
this study subscribes to the definition provided by Baron and
Kenny ([12], p. 1174) of a moderator as a variable that “affects
the direction and/or strength of the relationship between an indepen-
dent or predictor variable and a dependent or criterion variable.”
The idea of the moderating effect is related to the premise in
contingency theory that the effect of X variable on Y variable can be
stronger or weaker, depending on other factors that are moderators.
A moderator influences the strength of the impact of X on Y [77].
The discussion herein introduces the key hypotheses relevant to
this research. The development of a theoretical understanding
begins with identifying the critical concepts in the phenomenon of
interest and considering the theoretical boundaries [51]. Thus, the
hypotheses herein are based on the theoretical foundations of the
CRBT [23] and are influenced by the multidisciplinary literature on
ES/digital platforms and innovation.

2.1. Innovation and technology

The role of IT in innovation has been studied for several decades
[84,15]. The advancements in the technology landscape, the rising
market demands, and globalization have necessitated innovation
for the survival of the contemporary organizations [30,6,71]. Thus,
novation is considered the lifeblood of corporate survival and
growth [163,143]. The technology advancements made during the
past few years have assisted organizations in innovation through
(i) improved decision-making capabilities [81,24], (ii) increased
customer connectedness [97,20], (iii) increased the number of
channels for reaching customers/suppliers [19,94], and (iv)
enhanced communication facilities [126,162].

As Crossan and Apaydin [40] stated, innovation is a “production
or adoption, assimilation, and exploitation of a value-added
novelty in economic and social spheres; renewal and enlargement
of products, services, and markets; development of new methods
of production; and establishment of new management systems”
([40], p. 1155) This definition provides a generalized view of
innovation taking into account innovation that occurs in “every-
day organizations.” It goes beyond the definitions that ideated
innovation as “new to the world” (e.g., [62]). This definition
captures internally initiated innovations, as well as adopted
(imitated) innovations. For the majority of common organizations
dealing with common products or services, the term “innovation”
does not resonate with the new-to-the-world concept, as it would
for technology or manufacturing innovators such as Google, Apple
Inc., or BMW. As such, Lai and Riezman [98] also agreed that
innovation need not be a totally new concept to the world and
could even be considered an imitation of something already used
elsewhere, but new to the unit of adoption.

2.2. Impact of digital platforms on innovation

The digital platforms have been considered an important
resource into the corporate IT landscape in the past several years
[161,93]. IS scholars have studied this emergence and the impact
of digital platforms as a resource having the potential to influence
organizational strategies, structures, and processes [136,135]. In
particular, there is strong avocation that these digital resources can
deliver and trigger innovation [94,96,121]. Researchers attribute
the ability of digital platforms to trigger innovation to its innate
characteristics such as its ease of maintenance [31], ease of
connectivity with other technologies, [130], trialability [26,108],
need for less-specialized skills [103], flexibility [120], higher
processing capability, low cost [103,124], and reusability for
different purposes [161,160]. Further, the ease of use of digital
platforms increases the likelihood of user innovation [124]. How-
ever, the ease of development and deployment enable the
organizations to augment and replace the existing business
functions [9]. These innate characteristics of digital platforms
enable a new way of attaining innovation in an organization, and
the innovation processes enabled through digital platforms are
known to be “rapid and difficult to control and predict” ([124], p.
58). These characteristics are the epitome of innovation-favoring
technologies, where the innovation barriers such as access to
financial and human resources (e.g., specialized skills) are required
at a minimal level. Minimizing such barriers to digital resources
has disrupted the traditional linear equation of technology and
innovation, whereby innovation is no longer proportionate to
the resource availability, thus providing organizations with an
opportunity to innovate in the same way regardless of one’s
resource availability. Further, the digital platforms provide
organizations with an opportunity to innovate, facilitated by the
growing ecosystem of providers and suppliers of tools, techniques,
and practices, beyond the conventional boundaries of traditional
corporate IT [161,75,3]. Such characteristics have been recognized
as highly favorable for innovation [34]. Further, the use of digital
platforms provides a rich user experience; as such, the innate
characteristics such as the ease of use and ease of learning enhance
the innovation adoption and diffusion [124]. This in turn increases
the probability of achieving innovation through the digital
platforms [64,65]. Furthermore, Yoo and Boland Jr [161] stated
that digital platforms are “dynamic” and “malleable,” purportedly
facilitating innovation [161] by reproducing the same resource for
different outcomes and accommodating rapid changes for enhancing value [164]. Moreover, the investment risk is also low in digital platforms [161,124]. Fundamentally, the risk – the potential of losing value due to uncertainty [95] – of an investment increases with the cost, level of uncertainty, and in general the resources available to execute an idea. As such, for digital platforms, the economic, innovation, and scaling risks are much lower due to their characteristics as mentioned earlier.

Considering the implications of this discussion, we develop our first hypothesis:

**H1.** Digital platforms have a significant and positive impact on innovation.

### 2.3. Contingent nature of digital platforms

Contesting the argument in Hypothesis 1, following Floyd and Wooldridge [57] and Powell and Dent-Micallef [129], it is worthwhile to investigate whether the commonly available IT resources alone could drive innovation. Chae and Yang [30] suggested a contingent view of resources and argued that resources are contingent and that they are more effective in yielding organizational performance when synergistically combined (rather than any individual resource acting alone). Past studies have observed that IT delivering value is contingent upon the availability of financial and human resources [19]. However, as argued in Hypothesis 1, past research summarized earlier showed that digital platforms are rarely contingent upon such resources. If so, what are the contingent factors of digital platforms delivering value to the organization?

Tiwana and Konzynski [150], for example, described that creativity, innovation, and growth are contingent upon the existing platforms. Given that digital platforms extract and write back data from the existing ES platforms [28], it is logical to investigate the ES platform as a contingent resource for digital platforms. The literature also suggests that there is a natural tendency to build digital applications on ES platforms [161]. ES platforms demonstrate a strong prevalence in the corporate system landscape with their high proliferation among businesses as the preferred technology platform to digitally engrave corporate data and business processes [28]. The use and continued growth of ES have facilitated notions of big data, data warehousing, and business intelligence, where the ES platform allows additional IS to be deployed on the existing platform [123]. Researchers have identified this notion as the “technology-enabled adoption,” which allows organizations to make strategic investments to enhance the value of initially adopted technologies [85,56]. Organizations that do not consider the evolving changes can potentially limit the inherent benefits that such underlying technologies can offer [123].

Reducing proprietary restrictions in an ES platform encourages complementary third-party technology integrations [28]. This is a substantial departure from the “end-to-end” business process approach of ES [127] advocated by past studies [46], and marks the dawn of a new era of corporate computing. Similarly, the digital platforms also have a stronger value proposition by connecting to an ES platform. For example, the corporate use of mobile technology enables organizations to extract the frequently used functions of a business process and set up the functions to be completed on a mobile device (see Fig. 2). Herein, organizations could employ mobile technologies that rely on the master data and business rules embedded in an ES platform, while returning the updates to the ES platform. Similarly, an ES platform can be utilized as a foundational platform for business intelligence, cloud computing, and social media [161].

Even though digital platforms have the potential to achieve organizational goals independently, following CRBT, this study argues that such technologies are more effective if they are used synergistically with traditional IT platforms such as ES. As such, in line with past CRBT studies [153], the study hypothesizes that digital platform-led innovation is moderated by the ES platform. As such, the second hypothesis of the study is as follows:

**H2.** ES platform has a moderating effect on digital platform-led innovation.

### 2.4. ES platforms and innovation

Davenport ([44], p. 122) highlighted the innovation potential of an ES stating that the embrace of ES “may in fact be the most important development in the corporate use of information technology in the 1990s.” The change cascades through the introduction of an ES platform mirror the characteristics that Damanpour [41] described for radical innovation [118,80] through (i) technological uncertainty [72], (ii) technical inexperience, (iii) business inexperience, (iv) technology cost [69], (v) high risk [114,87], and (vi) high initial resources consumption in ES implementations [43,102]. Yet, anecdotal commentary and scholarly studies are still opaque of the continuing innovation potential of an ES platform. Proponents argue that an ES platform fosters innovation through its stable platform, buoys client–consultant–vendor ecosystem, and through its dominance as the leading corporate technology platform in an organization [161,28]. To the contrary, some argue that an ES platform is unlikely to support innovation for two reasons: (i) the best practices embedded in an ES are available and obtainable to all organizations, including their competitors [57,129], and (ii) the high degree of formalization of the business processes [83,16] may hinder innovation [83] by reducing the flexibility required to respond to change and discouraging the generation of new ideas [42].

As Swanson and Dans [147] advocated, all systems deteriorate over time and eventually must be retired or upgraded. Yet, since the ES platform is rarely replaced or retired, Eden and Sedera [53] suggested that organizations must actively update and maintain ES platforms for them to remain current [37]. Thus, once introduced, the organization must devote adequate resources to maintain the ES platform to foster innovation [37]. Consistent with the discussion in Appendix A, the ES platform manifests to support business requirements [154], and process standardization [144], and has the capacity to provide real-time information. This discussion highlights the imperative role of ES platform in attaining innovation through ES and thus leads to our third hypothesis:

**H3.** ES platform has a significant and positive impact on innovation.

### 3. Research methodology

A survey was used to gather data to test the model described earlier. The survey method is appropriate for this study design for several reasons. First, the nature of the research question investigated through the CRBT lens requires a quantitative approach for the theoretical consistency and then to enhance the cumulative practice of research. Second, the phenomenon of interest required analyzing data from a large sample of organizations, which can best be done using a survey approach. The survey approach followed herein fails to understand “how” a portfolio facilitates innovation. Such an investigation can best be carried out using a qualitative study approach.

The survey instrument was circulated among 350 companies represented by their chief information officer (CIO) or chief technology officer (CTO). The data collection was held at an International CIO Forum in the second quarter of 2014. The event
participation organization registration indicated that all participating organizations were large and were representative of all industry sectors. Further, the survey instrument captured demographic details to assert that the organizations considered for the analysis possessed the following criteria: (i) the organization had a dedicated CIO/CTO (henceforth referred only as the CIO to minimize repetition) and a team of IT staff that managed the organization’s IT portfolio, including a packaged ES; (ii) the organization had used an ES for the past 5 years and documentation of the IT roadmap since the implementation of the ES was available; and (iii) at the time of the data collection, the CIO had been in the position for at least 6 months, was not in the last 6 months of their appointment, and was participating in regular meetings with the executive leadership team (e.g., chief executive officer and chief financial officer).

The targeted CIO sample was appropriate for the study objectives, as these personnel would be able to comment knowledgeably on behalf of the organization in relation to innovation, ES, and digital platforms. As Grover and Jeong [74] explained, a CIO manages the information resources that influence organizational strategy and has the direct responsibility for the planning of the IT framework necessary to cope with an organization’s competitive environment. A total of 189 CIOs responded on behalf of their organizations, thereby yielding a response rate of 55%.

4. Sub-constructs and scale development

The dependent construct “innovation” is a subjective measure. Two types of measurement approaches are prevalent in past innovation studies [2,39]: (i) absolute indicators such as the number of patents [159] or the number of new products/services or new market segments [107], and (ii) proxy measures of innovation such as research and development fund allocation or market changes to investment decisions through Tobin’s-Q. Such studies observe the inputs (e.g., research and development funds) and outputs of innovation (e.g., new patents). These two approaches have been criticized for lacking relevance for the day-to-day innovation as the common business practices would rarely engage in creating patents or even allocating dedicated research and development funds [39,1]. As such, this paper addresses calls of Adams and Bassant [2] to study innovation in relation to common business practices. Thus, for an organization to be considered innovative under the present market conditions, it demands consideration of how the organization faces challenging environments swiftly, effectively, and mindfully [148]. Furthermore, being innovative also means how organizations move quickly out of political and social turbulences [116]. Such measurement of innovation in the IS discipline is lacking. The measures of innovation in this study were based largely on the studies of Wong and Tjosvold [158] and Burpitt and Bignoness [25]. However, new measures were deemed necessary and an inductive method was followed to derive new and appropriate measures. First, using six semi-structured interviews with CIOs lasting 30–40 min, all participants were asked to state how they use IT to support innovation. Next, two researchers synthesized and mapped the CIO comments to the measures of Wong and Tjosvold [158] and Burpitt and Bignoness [25]. The process validated the existing measures and introduced several new measures as well. Finally, seven measures were identified to measure innovation (see Appendix B).

Next, the study employs measures to understand the role of the two platforms under three distinct technological capabilities [153]: (i) the platform’s ability to meet the current business requirements [36,63], (ii) the quality of the platform infrastructure [19,31], and (iii) the platform’s ability to meet future expansions [160,55,109]. The three sub-constructs that help recognize the individual ability of both ES and digital platforms facilitating innovation, while providing theoretical space to understand the contingent nature of digital platforms. Further, consistent with the objectives of the study, the theoretical notions of CRBT, and operational considerations (as the sample included 189 organizations), the three sub-constructs are treated as formative at the organizational level.

The sub-construct measuring the platform’s ability to support the current business requirements (the sub-construct henceforth referred to as “support for business requirements”) attempts to gauge how the ES and digital platforms assist in supporting the current business requirements [17]. Past research has suggested that supporting business requirements is a salient characteristic of a stable IT platform [36]. The ability of ES to support business requirements is a well-established discussion in the literature [21]. Furthermore, studies related to “system quality” have also observed the extent to which an ES platform supports the business requirements [61]. Similarly, evidence suggests that digital platforms also support business requirements through reliability and the ability to support and manage current and future business functions of the organization [161,99].

The second sub-construct measures the quality of the infrastructure. Here, the sub-construct is intended to observe whether or not the platforms are up to date and current in terms of their technical abilities [19]. The platform infrastructure construct also observes whether or not the platform can be easily maintained [31], the awareness of the shortcomings of the existing platforms, the awareness of the forthcoming updates [19], and whether or not appropriate resources are being allocated to maintain it [19,31]. Importantly, the ES platform has the ability to allow easy connectivity with other technologies [130]. More specific to digital platforms, the term “infrastructure” can be understood by aspects such as trialability, flexibility, ability to control risk, ability to orchestrate dependencies, and the ability to reuse the same infrastructure for different purposes [161,160].

The third sub-construct attempts to gauge how the platforms facilitate and support future business expansion. The expansion capability of a platform is equally important to both ES and digital platforms. Especially for ES platforms, as Eden and Sedera [53] observed, they must have a long-term expansion capability to support future business needs [138,130]. Similarly, although digital platforms can be easily acquired, they too must have the expansion capabilities, interoperability, scalability, and the ability to extend business functionalities. Such characteristics are evident in mobile, cloud, in-memory, and social platforms. Furthermore, digital platforms accommodate the growing organizational requirements through storage, communication, and geographical expansions. Yet, Tiwana and Konsynski [150] suggested that IS scholars have paid very little attention to understand the future expansion capabilities of a platform.

The operational model conceives both ES and digital platform sub-constructs as formative: (i) support for business requirements, (ii) infrastructure, and (iii) expansion capability. The items of the sub-constructs are measured as reflective (Appendix B presents the items employed in the study with the corresponding literature lineage). The conception of the three sub-constructs as formative is particularly useful so that they provide the “specific and actionable attributes” of a concept [110]. Particularly interesting from a practical viewpoint would be the weights of the sub-constructs and how they form ES and digital platforms (see details in [59]). Fig. 4 presents the research model.

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1 This was essential in order to determine that the present IT leadership was not “in transit.” This is an important consideration because it has been argued that companies with in-transit CIOs do not embark on strategic initiatives.
The survey designed to operationalize the three constructs, their sub-constructs, and measures employed a seven-point Likert scale with the end values of (1) “Strongly Disagree” and (7) “Strongly Agree” and the middle value of (4) “Neutral.” The survey instrument included a cover page, which stipulated the code of conduct and ethics of data collection. It also included a clear description of the constructs, where each digital platform was described using a common, easy-to-understand definition as well as an example relating to the participatory companies. Furthermore, the umbrella term “digital platforms” was defined in the survey instrument; hence, the respondents knew that they needed to consider all the emerging digital platforms. In addition, the survey instrument included four criterion items as global measures for ES and digital platform constructs that are necessary for formative construct validation and model testing. In order to reduce the common method variance, the items for all three constructs were not grouped under their construct headings [70,141].

5. Measurement scales and validation of the research instrument

The model and construct validation in this research are reported under four headings: (i) content validity (tested using the content validity ratio (CVR)), (ii) construct validity (tested using the composite reliability, average variance extracted (AVE), and factor analysis), (iii) the outer model (tested using the partial least squares technique), and (iv) the structural model and moderation effect (tested to determine the relationship between the independent, moderating, and dependent variable).

5.1. Content validity

As the sub-constructs were derived specifically for the study, the establishment of content validity was a priority. The current study followed the guidelines of McKenzie and Wood [115] for establishing content validity, which entailed four steps: (i) using the guidelines of Lynn [106], an initial draft of the survey instrument was created by canvassing the related literature in order to derive its measures; (ii) following the guidelines of the American Educational Research Association [7], a panel of 10 CIOs was established to review and evaluate the possible survey questions, ensuring that the panel had the necessary training, experience, and qualifications; (iii) the panel critiqued the survey constructs; and (iv) the panel conducted a review of the questionnaire, assessing how well each item was represented as a reflective measure of each sub-construct. In this fourth step, a quantitative assessment was made, establishing the CVR for each item/question based on the formula by Lawshe [100]. Based on 10 pilot tests, the minimum CVR value of 0.87 was observed at a statistical significance of \( p < 0.05 \). Feedback from the pilot round respondents resulted in minor modifications to the wording of the survey items [115,106,100], and endorsement of the research model, its sub-constructs, and measures.

5.2. Construct validity

Construct validity for each sub-construct was established using factor analysis, composite reliability, and AVE. As mentioned earlier, each of the three formative sub-constructs (support for business requirements, infrastructure, and expansion capability) was measured using reflective items qualified through content validity.

In establishing construct validity, we first determined the discriminant and convergent validity through factor analysis, whereby the individual item loadings of the sub-constructs were all above 0.5 on their assigned factor and that the loadings within the sub-constructs were higher than those across the sub-constructs. The measures demonstrated satisfactory reliability as the reflective factor loadings were all above 0.64, which is well above the proposed threshold level of 0.5 [82]. Further, there were no substantial cross-factor loadings.

Second, two measurement models (one for each platform) were assessed by estimating the internal consistency, as well as the discriminant and convergent validity, following similar studies (e.g., [156]). Strong and significant composite reliability was observed for all the sub-constructs of ES platform, reporting above 0.85 [122], with alpha values of 0.917 for support for business requirements, 0.931 for infrastructure, and 0.967 for expansion capability. Similarly, the composite reliability of the measures of digital platforms too demonstrated similarly high alpha values, significant at 0.001 levels, with values of 0.917 for business requirements, 0.931 for infrastructure, and 0.867 for expansion capability. The measures of innovation reported an alpha value of 0.912 significant at 0.001 levels.
Finally, convergent validity was established through the AVE. All the sub-constructs demonstrated satisfactory convergent and discriminant validity, with the AVE for all the sub-constructs measuring above 0.5 [58], and the AVE of each sub-construct is greater than the variance shared between the sub-construct and other sub-constructs in the model [35], thus indicating strong discriminant validity. The AVE for ES-platform sub-constructs was 0.76 for support for business requirements, 0.89 for infrastructure, and 0.93 for expansion capability. The AVE for digital platform was 0.82 for support for business requirements, 0.75 for infrastructure, and 0.92 for expansion capability.

5.3. Testing the structural model

For the testing of the outer and inner models, the study employed the partial least squares technique using SmartPLS software [133]. The partial least squares test [157] is a structural equation modeling technique that is well suited for highly complex predictive models and that supports the mapping of formative observed variables [35,157,14,78]. SmartPLS was used together with the bootstrap resampling method (5000 resamples) to determine the significance of the paths within the structural model [68,128].

As suggested by Diamantopoulos and Winklhofer ([50], p. 272), the test of the outer model employs global items that “summarize the essence of the construct that the index purports to measure” and examine the extent to which the items associated with the index correlate with these global items. For this purpose, the two criterion measures of ES and digital platform constructs were included in a separate section of the survey instrument as stated below. Smart PLS cross-item loadings indicated that there were no major cross-factor loadings, thus confirming our earlier observations. Correlating the measurement items with the two global measures demonstrated significant correlation coefficients at the 0.001 level.

Next, using SmartPLS software and following structural equation modeling techniques, two measurement models were established separately with sub-constructs of the ES and digital platforms. Table 1 presents the results. Collectively, the three constructs accounted for 96% variance of an ES platform and 90% of the variance of digital platforms, thus demonstrating strong external validity.

The convergent validity of the sub-constructs (see Table 1) conform to the heuristics of Gefen and Straub [67], whereby all the t-values of the outer model loadings exceeded the one-sided cutoff of 1.645 levels, significant at the 0.05 alpha protection level.

5.4. Investigating the moderation effect

Next, the study employs the CRBT to examine whether there is a moderation effect of ES platform on the relationship between digital platform and innovation. The measurement of moderation follows the procedures outlined by Aiken and West [4] and Cohen and Cohen [38], wherein the simple argument is that the nature and/or strength of two variables change as a function of a third variable. Table 2 presents the analysis of Fig. 4 (the research model), where the dependent variable – innovation – is predicted by the quality of the two platforms with an adjusted $R^2$ of 0.854 (significance level at 0.001). The results indicate that the ES platform alone influences innovation (standardized beta of 0.487, significant at 0.001). Yet, the digital platform does not make a direct statistically significant contribution to the dependent variable (standardized beta of 0.803 and nonsignificant). However, the interaction effect of ES platform and digital platforms on innovation demonstrates a significant relationship with a standardized beta of 0.660 (significant at 0.001) outlining the moderation effect of the ES platform.

Finally, having understood the moderation effect of an ES platform, further insights were sought by observing whether the high, medium, or low levels of the moderating variable change the nature of the relationship between digital platforms and innovation. Such an approach is essential to understand how a continuum of the moderator variable influences the relationship between independent and dependent variables, as outlined by Aiken and West [4].6 The scatterplot regression analysis using the three groups (i.e., high, medium, and low quality) of ES platforms revealed that digital platforms had a negative relationship (correlation at –0.8, significant at 0.001) with innovation, when the ES platform quality is low. When the quality of the ES platform is high, the correlation between digital platforms and innovation is near perfect at 0.98 (significant at 0.001), while medium levels of ES platform yielded a correlation of 0.63 (significant at 0.001).

Table 3 presents the results of the testing of the three hypotheses. In summary, the ES platform influences the relationship between digital platforms and innovation. Yet, the moderation is not straightforward, with the high, medium, and low qualities yielding substantially different influences (H2). Similarly, as noted in past studies [145], the ES platform has a direct influence on innovation (H3). Conversely, digital platforms do not have a direct influence on innovation (H1). Table 3 summarizes the results.

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4 A one-sided test is appropriate because we only hypothesize a positive contribution of the formative components. A two-sided cutoff of 1.96 is used otherwise.

5 The t-values of the loadings are, in essence, equivalent to those in least-squares regressions. Each measurement item is explained by the linear regression of its latent construct and measurement error [50].

6 First, the scores of ES platforms were arranged in ascending order, creating three mutually exclusive groups (in this case, three groups of equal size n [(low/medium/high) x 63]; next, creating a scatterplot regression between digital platforms and innovation for the three groups of ES platforms.
6. Summary and discussion

This research observed how the advent of digital platforms potentially influences innovation in an organization. Digital platforms, a collective term associated with technologies such as mobile technology, cloud computing, in-memory technologies, and social media, have been widely recognized as “revolutionary” [79], “innovative” [142], and at the same time being “cost-effective” [103]. As such, research forecasting by Gartner [27] makes strong suggestions regarding how organizations could derive innovation capabilities through digital platforms. The shift toward digital platforms suggested in both academic and practitioner literature was also observed in the data sample employed in this study (Fig. 1).

The wide proliferation of digital platforms arguably provides organizations with an opportunity to engage, synergize, replace, and add value [120,161,160] to the existing monolithic ES, thus possibly yielding greater potential to trigger innovation (Fig. 2). Yet, empirical evidence on how digital platforms contribute to innovation has been scarce. As such, Nambisan [120] identified this area of study as a critical research area for future studies on innovation.

Against this background, this study observed how digital platforms and ES platforms contribute to innovation. The study employed the CRBT [23] to conceptualize the ability of digital platforms to create innovation, when the ES platform acts as the contingent variable. The research model includes three sub-constructs to measure digital platforms and ES platform quality: support for business requirements, infrastructure, and expansion capabilities.

The three sub-constructs defined ES platforms and digital platforms adequately, explaining nearly 90% of the variance of each. The measurement model demonstrates that the way in which the three formative sub-constructs defined ES platform and digital platforms is substantially different in each measurement model, thereby highlighting possible strengths and weaknesses of each technology platform. For example, while the infrastructure sub-construct predicted the most amount of variance in ES platform (as the dominant sub-construct), the same sub-construct was the weakest in defining digital platforms. Similarly, the supporting business requirements sub-construct was dominant in defining digital platforms, but it was identified as the weakest in defining ES platforms. The findings are contrary to the popularly accepted views that ES platforms provide support for business requirements (e.g., [47,61,139]). As an explanation, we argue that although an ES platform would have provided support for business requirements when first introduced, it is difficult for modern (and perhaps dynamic) business requirements to be supported through an ES due to the system’s complexity [92]. However, the study results highlight the importance of the ES platform as a valuable IT infrastructure, thus demonstrating the maturity of the technology, reflecting the notions of a “technology backbone” [119].

Most significantly, this study highlighted that digital platforms can yield innovation, only through the moderation of the ES platform. Moreover, when placed in a continuum, while the existence of high or medium levels of ES-platform quality ultimately lead the digital platform to innovate, the low levels of ES-platform quality lead to a negative relationship between digital platforms and innovation (Fig. 4).

6.1. Academic contributions

We herein discuss three specific academic contributions from this study. Firstly, this study observed how two types of technology platforms work together to deliver innovation. The study highlighted the role of digital and ES platforms in deriving innovation. Contrary to popular commentary, we witnessed that digital platforms alone do not yield innovation and that they need a strong ES platform to derive innovation. Furthermore, the study revealed that a weak ES platform may lead the digital platform to hinder innovation. From another viewpoint, this study observed how the role of ES has changed to become a strong enabler as a platform. A trigger of innovation maturing into an enabler of innovation is an interesting observation that has potential for future research. For example, it obliges IS researchers to understand IT as a long-term investment with morphing roles, rather than as a sunk cost. This research applies CRBT foundations to suggest that while resources can be either given exogenously or created by activities within the organization, capabilities emerge from the integration and combination of these resources.

Secondly, this study provides a useful view of the emerging IT portfolio. In the past, studies have attempted to understand the notion of an IT portfolio as a collection of systems [155]. As such, rarely did studies employ the notion of a portfolio in relation to a collection of different types of platforms. When studying a collection of different types of platforms, interdependencies, synergies, and connectivity become important. The view presented in this study of digital and ES platforms is a useful initial step toward a greater understanding of a portfolio of multiple technologies.

This study provides an improved understanding of the role of technology in facilitating innovation. Specifically, studies offering an empirical evidence of the role of IT in innovation in “common” organizations are rare. For example, most past studies have focused on how IT may lead to new patents, products, and services [159,107] – making innovation seem out of bounds for common organizations. The conceptualization, derivation, and operationalization of common organization innovation are a valid contribution of this study. Particularly, at present, when organizations hope to innovate through a selection of technologies, these first insights into how innovation can be attained through technology platforms will provide a useful foundation.

6.2. Practitioner contributions

This study makes several practical contributions as well. First, this study provides an early empirical evidence of how an IT portfolio assists organizations with innovation. The encouraging study results demonstrating a positive value of ES and digital platforms for innovation provides evidence-based confidence to IT practitioners. Second, the study observed the quality of the ES and digital platforms using three formative constructs. The study results demonstrate that while infrastructure capabilities dominate the ES platform, support for business requirements dominates the digital platforms. Such observations will make it easier for the practitioners to plan for future technology investments. Third, the study demonstrated the morphing role of an ES as a technology platform. Evidenced through the analysis of the hypotheses, the study findings demonstrate that the ES is not only evolving, but a stable platform is essential for an organization to seek value through digital platforms. Therefore, for the practitioners, contrary to what this study observed (Fig. 1), continuing investment into ES platforms is essential.

6.3. Limitations and future research directions

The current study has several limitations. First, the study does not distinguish the type of digital platform. Instead, it bundles all
the available contemporary digital platform types as one. While various digital platforms were considered collectively for convenience, we recognize that they may each have distinctive characteristics that could benefit from independent study. Second, the homogeneous selection of organizations in the study sample may add some biasness to the study findings. For example, the inclusion of variables associated with organizational size (e.g., medium-sized organizations), IT maturity, governance, and regulations may provide deeper insights. The consideration of such aspects is highly recommended in a future study. Third, innovation is measured in this study as a snapshot, without reflecting its dynamic, contextual nature. The snapshot approach may also be identified as a methodological weakness. Thus, a longitudinal study of innovation, perhaps following the case method, would provide a deeper understanding of the true nature of innovation and its independent and moderating variables.

In ways that may assist future research, the study adequately describes the role of digital and the ES platforms in facilitating innovation. The high $r^2$ values (0.660 for ES platforms moderating the influence of digital platforms on innovation and 0.487 for ES platforms having a direct influence on innovation) imply that a further investigation into their role is not essential. Thus, it is proposed that future studies could gainfully focus on the approach and the method proposed in order to better understand the relationship between IT and innovation.

Four research directions for future research are herein identified. A natural extension would lead to a deeper understanding of each of the digital platforms (e.g., mobile) to better understand how each platform yields innovation. Perhaps one would employ the same research model with the ES platform as a moderating variable, while including specific technology platforms as independent variables. The second research direction relates to a better examination of organizational/technology maturity and their role on digital and ES platforms in delivering innovation. Relating such contextual variables in a future study would provide unique insights. Thirdly, a future study could embark on developing a “platform index.” An index would determine how much of each technology platform has been employed in the IT portfolio. Such indexes are commonplace in analogous disciplines of economics and finance to understand the risk and returns of investments and would provide similar value IS discipline as well. Finally, another stream of future research could focus on the interconnectedness and contingencies amongst the digital platforms. While the connectivity between mobile technology, cloud computing, in-memory technologies, and social media is obvious and evidently complex, such a study would add further insights into the role of IT in innovation.

Appendix A. What is a platform?

The first known use of the word platform, which originates from the Middle French word “plate-forme,” was in 1535. Since then, the term “platform” has been employed in multiple disciplines, especially to those with continuance and growth [65]. In biology, the human genome database has become a platform upon which many companies and laboratories build complementary products and services. Although the term “platform” appears in the IS/IT literature abundantly, much less conceptual and fundamental thinking has been devoted to understand it. In general, we develop the following five fundamental characteristics to define a platform: (i) a platform itself does not provide value; (ii) it provides the basis for further action, for example, to build, debate, and connect; (iii) the actions conducted upon a platform are restricted by the very nature of a platform; (iv) it provides a basis to make a comparison with another platform or actions built upon another platform; and (v) platforms change and evolve, but in a stable manner. Radical changes will disrupt an existing platform and will emerge as a new platform.

Taking the five fundamental characteristics, a “technology” platform is a term for technology that enables the development and/or delivery software services. While some technology platforms provide tools and techniques to develop software applications, other technology platforms only provide the delivery mechanism of a software service. In either case, the platform will provide either a conceptual or practical boundary on the software being developed or delivered. Competing platforms too have emerged with the growth of proprietary software that competes with other technology platforms in a marketplace. In most cases, technology platforms evolve in a manner that allows higher capabilities.

Over a period of time, if the platform attracts enough adopters, it has the potential to create an ecosystem. With the growth of the ecosystem, the number of applications and the services offered on the platform will increase. This also affects the rate of evolution of a platform, as more products and services will provide new ideas to evolve a platform.

From a technical standpoint, it is important to distinguish three related terms presented in the IS literature to clarify the role of a platform: platform, module, and ecosystem. Gawer [64] defined a platform as “a building block, providing an essential function to a technological system – which acts as a foundation upon which other organizations, loosely organized in an innovation ecosystem, can develop complementary products, technologies, or services.” Meyer and Lehnerd [117] defined a platform as a set of subsystems and interfaces that form a common structure from which a stream of derivative products can be efficiently developed and produced. Katz [86] provides a technical viewpoint to the notion of a platform stating that a platform specifies the design rules that describe how the platform and modules interact and exchange information. The SAP’s NetWeaver is an ideal example for a platform.

A module, according to Baldwin [10] is an add-on software subsystem that connects to the platform to add functionality to the platform. Such modules will include system features and functions that business end-users engage for daily business processes. The term ecosystem, as described earlier refers to a collection of the platforms, with their specific modules and those who offer services and products to support the platform as well as its modules [66, 28]. A conceptual view of IT platforms is also available on Tiwana and Konsynski [150].

Appendix B. Survey items and lineage

Instructions to the respondent

1. Please answer all questions. If you are unable to answer a particular question, please leave it blank.
2. The term “Enterprise System” in this study refers to corporate-wide IT system in your organization that does Financials, Materials Management, Human Capital Management, and Sales. Some examples of such systems include SAP, Oracle Business Suite, and Microsoft NAV.
3. The term “Digital Platforms” refers to modern technologies such as Cloud, Mobile, and In-memory applications. Such technologies would be new to your organization and may not be employed across all divisions and departments.

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7 Online Etymology Dictionary, Retrieved 2014-12-07.
ES platform: Platform to meet business requirements

Our organizational business processes are running smoothly without much issues.
Our ES platform is adequately supporting our business requirements (e.g., AS400 mainframe is not a supported distributed network).

Our Enterprise System is regularly maintained and upgraded to meet our business requirements.
Our Enterprise System meets the current business expectations of the organization.

ES platform: IT Infrastructure

Our ongoing investments into Enterprise System platform are substantial.
We are aware of the forthcoming updates relating to the Enterprise System platform.
Our Enterprise Systems platform has the ability to connect with almost all new technologies.
The Enterprise Systems platform has made it easier for us to bring in new technologies to the organization.

ES platform: Business Expansion Capability

Our Enterprise System is adequate to meet our future business expectations for innovation.
Having our Enterprise System is hindering the business growth and innovation.
ES development, deployment time, and resources are not a challenge in meeting our expectations of responding to environmental changes.
Any improvements to Enterprise System functionalities will require substantial resources (time, people, and funds).
We do not make much changes to our Enterprise System functionalities.
I regularly receive directives to change the Enterprise System functionalities as per business requirements.

As per [138] items were developed

Digital platforms: Platform to meet business requirements

Digital platforms help us supplement the existing business processes or functions in our organization.
Our business processes or functions run smoothly with digital platforms.
Our digital platforms meet the current business expectations of the organization.

Digital platforms: IT Infrastructure

We are well aware of the forthcoming updates relating to available digital platforms.
Our IT projects regularly trial new technologies seeking business opportunities.
We have the ability to reuse the same digital platforms for multiple purposes.
Our IT projects using digital platforms require less resources (time, money) to develop and deploy.

Digital platforms: Business Expansion Capability

We employ new technologies to make our IT landscape much more agile for dynamic business requirements.
Digital platforms provided business expansion opportunities to our organization.
Digital platform development, deployment time, and resources are not a challenge in meeting our expectations of responding to environmental changes.

Innovation

Developed

Digital platforms help us supplement the existing business processes or functions in our organization.
Our business processes or functions run smoothly with digital platforms.
Our digital platforms meet the current business expectations of the organization.

Developed

We respond to market and customer needs swiftly and effectively by orchestrating multiple technologies.
Using corporate IT, we address unique business needs swiftly and effectively.
Where possible, we experiment and trial IT in new ways to develop new products that can help attract and serve new markets.

Using corporate IT, we integrate and build internal and external capabilities in our organization.
Using corporate IT, we seek out information about new markets, products, and technologies from sources outside our organization.

Using corporate IT, we continuously try to discover additional needs of our customers (and potential customers) of which they are unaware.

Using IT, we manage political and economic risks by promptly responding proactively to them.

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