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A quantitative and qualitative study of the link between business process management and digital innovation

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ABSTRACT

The information revolution leaves its mark on businesses, resulting in organizations looking for digital innovation (DI) to apply to their business processes and anticipate competitors. Since the interplay between business process management (BPM) and DI has been underdeveloped, this mixed-methods article investigates the strength and nature of the relationship. We supplement the findings of an international survey (stage 1) with explanations from an expert panel (stage 2) to generalize a positive yet moderate link because of manifold contextual factors affecting strategic decision-making. We extend the technology–organization–environment (TOE) framework and profile organizations along their digital process innovation (DPI) mastery in a readiness matrix.

1. Introduction

Improving and automating business processes became a top priority for chief information officers (CIOs) and information technology (IT) executives throughout the 2000s [1,2]. Nowadays, business processes are increasingly prioritized in the context of digital innovation (DI) [3,4]. Business process management (BPM) has thus become a valuable field for many practitioners [5] by offering methods, techniques and management principles to strategically align business processes and achieve higher business results, compliance and long-term competitiveness [6,7]. Nonetheless, BPM is increasingly challenged by the (often disruptive) opportunities of DI using emerging technologies (e.g., social media, mobile and cloud solutions, big data analytics, radio-frequency identification (RFID), sensors, Internet of Things (IoT) and smart devices) [8]. Consequently, while BPM has traditionally focussed on continuous process improvements, automation and standardization, modern organizations also require process innovation, agility and flexibility [9]. Rosemann [10] positioned this shift by referring to organizational ambidexterity as a combination of exploitative BPM (i.e., the traditional focus) and explorative BPM (i.e., with a focus on process innovation) [10]. Alternatively, Recker [11] referred to a shift from an automation logic to an innovation logic, similar to the reengineering wave in the 1990s [12,13].

The business processes in many organizations experience pressure for DI [14,15] because the fast emergence of new technologies requires fast business transformations in today's work environment [15,16]. For organizations to survive and/or grow in current or other markets [16], incorporating new technologies in the corporate strategies and business processes becomes especially crucial when those technologies become user-friendly and competitive [15]. Moreover, while new technologies offer stronger insights into an organization's way of working, customers gain a louder voice by means of social media [17]. Hence, the BPM discipline should not only focus on internal business value (e.g., cost reductions), but also create customer value by aligning business processes with diverse customer requirements [8,14].

In response to calls for more process innovation, agility and flexibility [11,9], the BPM discipline has started recognizing new research streams, such as customer process management [10], value-driven BPM [7,10], intelligent or smart BPM [18,19], case-driven BPM [18], collaboration BPM [18] and agile BPM [20]. Such alternative streams build BPM solutions instead of digging for deeper explanations about the link between BPM and DI. Kerpedzhiev et al. [21] started by reinterpreting BPM's success factors from a DI perspective, but without presenting and explaining the current state of play. While the literature mainly acknowledges a link between BPM and DI [16], more research is needed for developing process innovation theories, models and applications that fit different business contexts [10]. This study will therefore address the following research questions (RQs):

- RQ1. To which degree is BPM linked to DI?

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- RQ2. How do organizations experience the role of BPM for DI?

This mixed-methods article presents explanatory research using an international survey (RQ1) and face-to-face interviews with practitioners who combine BPM with DI (RQ2). We provide insights into the strength and nature of the relationship between BPM and DI (gap 1), discuss the changing role of BPM (gap 2) and add knowledge about practical problems or complaints experienced by employees and BPM managers about their role for DI (gap 3). The results of RQ1 and RQ2 will be used to inductively develop a framework that supports organizations in their strategic decision-making for digital process innovation (DPI), as well as a matrix to show organizations their readiness for bringing DI into their business processes based on the studied contextual factors. This inductive approach serves for theory building and to drive BPM research. While the findings can be used to future-proof the BPM discipline in times of DI by new IT, organizations will acquire a general idea of the current situation and receive inspiration on how to overcome hurdles regarding the implementation of DI to enhance BPM adoption.

We proceed by positioning our research background in Section 2, and then, we provide a description of the applied research methods in Section 3. Subsequently, the quantitative (Section 4) and qualitative results (Section 5) are presented and discussed (Section 6).

2. Research background

2.1. Business process management

A generally accepted definition for BPM is "*the art and science of overseeing how work is performed in an organization to ensure consistent outcomes and to take advantage of improvement opportunities*" [22]: p. 1]. BPM typically works along a life cycle, assuming that each business process evolves through iterations. Process optimizations throughout the life cycle iterations range from smaller changes (e.g., total quality management) to radical improvements (e.g., process reengineering) [12, 13]. The latter was introduced due to IT opportunities and globalization in the late 1980s and early 1990s. In the 2000s, the same triggers grew stronger, resulting in a trend towards e-business/e-commerce. A similar wave has recently been caused by the emergence of new IT [23].

Organizations mainly apply BPM because of its positive link with performance and long-term competitive success [6,7,24]. Different ways, however, exist for applying BPM and an optimal BPM adoption depends on the organization's specific business context, thus requiring more contingent studies [25]. Rosemann et al. [26] defined the "business context" by external, internal and process layers. Despite the fact that DI and new IT trends are part of an organization's external business layer [26], only a few studies have investigated the link between BPM and DI [6,16]. Instead, a business context is generally examined in contingent or context-aware studies by empirically relating BPM maturity or the adoption of process-related success factors to an organization's size and sector [27,28]. In other approaches, success factors are made more case specific [29], or process improvement alternatives are prioritized based on milestones [30]. Such contingencies uncovered that public sector organizations generally have a lower BPM adoption than market-competitive organizations. The same reasoning does not apply for explaining the link between BPM and DI, because new technologies are also used in the public sector (e.g., smart cities). One may assume that higher innovativeness relates to lower BPM maturity because today's organizations increasingly require agility, flexibility and innovation, whereas BPM traditionally focusses on continuous improvements, automation and standardization [9]. Nonetheless, Dijkman et al. [6] showed empirical evidence for the contrary, albeit without digging deeper into different innovation types or focussing on DI. Alternatively, Bucher and Winter [31] asserted that organizations with more BPM adoption can choose between a standards-based approach and a custom-made approach. Hence, a paucity of information exists on the BPM–DI link and on alternative ways in which BPM can be applied in a digitalized economy.

2.2. Proxy for BPM

In our search for a validated measure for BPM, we scrutinized instruments that allow for a generic assessment of the BPM realization in a particular organization. We therefore looked at maturity models, which are diagnostic tools to assess a current situation (AS–IS) and support organizations with step-by-step guidance. In the context of BPM, maturity models measure the success factors to advance in BPM [32,33]. The choice for one or another AS–IS assessment model is, however, not evident since many process-centric maturity models exist with differences in scope. This means that different maturity types exist in the BPM domain [34]. For instance, maturity models may focus (1) on a different set of business processes (i.e., individual processes versus an entire process portfolio; e.g., Capability Maturity Model Integration (CMMI) versus [33]) and (2) on a different set of success factors (i.e., BPM life cycle versus organizational aspects such as culture and structure; e.g. [32], versus [33]). The latter refers to a difference in coverage and differentiates the narrow view on BPM from the more holistic view [25], which is also called business process orientation (BPO) [32,34]. In an attempt to summarize all BPM-related critical success factors, Van Looy et al. [34] have built and validated a conceptual framework that is based on a literature review, grounded in the BPM life cycle and organizational management theories, and empirically validated by 69 process-centric maturity models. Since this was the most comprehensive and validated instrument we observed, we considered their BPM index during our analysis.

2.3. Digital innovation

Innovation works by means of a "*multi-stage process whereby organizations transform ideas into new/improved products, services or processes in order to advance, compete and differentiate themselves successfully in their marketplace*" [35]: p. 1334]. Each innovation type (e.g., process innovation or product/service innovation) may vary on two dimensions [36]: (1) from incremental to radical and (2) from individual components to an entire system. Furthermore, innovation can have internal origins (e.g., for achieving efficiency gains or budget savings) or external origins (i.e., open innovation with stakeholders), with the latter being better motivators than the former [37]. The innovation process from idea generation to realization follows similar stages, independent of the innovation type or origins. Only the stage names vary depending on the author. For instance, Fichman et al. [15] labelled the overall innovation stages as (1) discovery, (2) development, (3) diffusion and (4) impact, whereas Birkinshaw et al. [38] labelled them as (1) motivation, (2) invention, (3) implementation and (4) theorization for legitimation.

A DI definition does not significantly differ from the innovation definition above, since DI is a specific type of innovation during which business transformations are supported by IT [39]. For instance, DI can be defined as "*a product, process, or business model that is perceived as new, requires some significant changes on the part of adopters, and is embodied in or enabled by IT*" [15: p. 330]. More specifically, IT can be used (1) during the innovation process (e.g., using 3D printers for product prototypes) and/or (2) to describe the innovation process outcomes (e.g., products/services or business processes) [40]. In our article, we focus on process innovations in the sense of creating novel business processes or substantially changing existing ones by means of IT. According to Kemsley [41], process innovations generally deal with: (1) digital changes in the way of working or (2) creations of more intelligent processes. Similarly, Kerpedzhiev et al. [21] referred to DI for making business processes faster, more efficient and innovative as well as to cope with data and unstructured business processes.

Since DI is more than using new technologies, a digital strategy helps with combining user desirability, business viability and technology feasibility [42]. Aspects to be considered in a digital strategy are earlier

Table 1
An overview of the surveyed variables.

Variable	Literature	Number of items	Operationalization	Measurement level
BPM	[34]	62	5-point-Likert scales	• Ordinal per item • Latent variable scores as index
BPM control variable	Self-developed	1	Score out of 10 (1 = not process-oriented; 10 = fully process-oriented)	Interval per item
Digital strategy types	[44]	4	5-point-Likert scales	Ordinal per item
DI	Self-developed	2	5-point-Likert scales	Ordinal per item
DI control variable	Self-developed	1	Score out of 10 (1 = no DI; 10 = fully digitally innovated)	Interval per item

business decisions, the expected opportunities in the future and the expected speed and impact of IT [43]. Additionally, a digital strategy is affected by an organization's business context, namely industry growth, concentration and turbulence [44]. Besides strategy and business context, Kane et al. [45] added that a successful DI is driven by culture and talent development. To better guide the previously mentioned factors, organizations are increasingly adopting user-driven innovation strategies (e.g., [42,46]): (1) a Lean startup using a business model canvas with testable hypotheses on multiple dimensions (e.g., customers, partners, value, costs, revenues) and (2) design thinking for solving a problem with ideation (e.g., user journeys or causal maps). Both approaches test prototypes in an agile way. The strategic considerations mentioned above are strongly organization dependent and therefore difficult to use for benchmarking purposes.

2.4. Proxy for DI

To our knowledge, one generally accepted measure for DI does not yet exist. We looked for alternative frameworks or measurement instruments that allow for a DI concretization. Given strategy's crucial role for DI, this study takes digital business strategies as a first proxy for DI. For instance, Sebastian et al. [47] presented two digital strategies for traditional organizations (i.e., customer engagement and data-driven solutions), albeit without offering a measurement instrument. Matt et al. [39] described a digital transformation framework containing four strategic dimensions: (1) use of technologies, (2) value creation, (3) structural changes and (4) financial aspects. These dimensions are based on preliminary works (i.e., including a literature analysis, multiple case studies and interviews), aiming at framework development without concrete measures. The same reasoning applies to the dimensions in a business model canvas [42]. Alternatively, Mithas et al. [44] differentiated between two digital strategy types: general IT investments and IT outsourcing investments. As per this strategy, it is observed whether the budget has increased (1) throughout the years and (2) relative to competitors. Since this approach can be translated into survey questions, we retained [44] for further analysis.

To find a second DI proxy, we scrutinized whether diagnostic tools like maturity models exist for DI. We uncovered the digital maturity model of Valdez-de-Leon [48], which was specifically built for telecommunications providers. Alternatively, we found a generic diagnostic tool in Nylén and Holmström [49] containing five items across three groups: (1) a product group with user experience and value proposition, (2) an environment group with digital evolution scanning and (3) an organization group with skills- and improvisation-related items. Since an established measure for DI is still missing, this generic index acted as our second proxy.

3. Research methods

3.1. Quantitative study

After completing a pilot study using an oral questionnaire with 131 West European managers [50], we collected data using a written questionnaire from 403 international top managers in spring 2017 (response rate: 20 %). The average survey duration was 15 min.

To ensure data quality, respondents could participate if they satisfied five conditions [51]: (1) fulfil a high managerial function (i.e., middle manager, senior manager, C-level manager), (2) have a total seniority of at least 8 years, (3) have a total seniority of at least 2 years in the current organization, (4) have an interest in BPM and (5) live in an English-speaking country to better compare survey comprehension. Additionally, for reasons of external validity and generalization, we strived for an equal spread across four continents (i.e., Australia/Oceania, India/Asia, UK/Europe and US/North America). We provide more details about the profiles of respondents and their current organization in Appendix A.

The main variables were related to BPM [34], digital strategy types [44] and DI. To increase internal validity, we based the operationalization on recognized measurement instruments or frameworks (Table 1). Since the DI variable [49] used in our pilot turned out to be too difficult to understand, this variable was replaced by two self-developed items, namely a "DI importance" statement (i.e., "Digital innovation is important to my organization") and a "BPM facilitator" statement ("Business process management facilitates digital innovation in my organization").

We calculated a Cronbach's alpha of above 0.7 ($\alpha = 0.985$) for the BPM variable, indicating data reliability. Afterwards, we used structural equation modelling partial least squares (SEM-PLS) to calculate one latent BPM score per respondent [51]. Correlations with the control variables were highly significant for both BPM and DI ($P = 0.000$), providing evidence for internal consistency and data reliability. More specifically, correlation coefficients indicated a moderate-to-strong linear relationship for the latent BPM variable and its control variable (Pearson's r=0.811; Spearman's rho=0.800; Kendall's tau_b=0.661; $P = 0.000$). We also observed moderate-to-strong linear relationships for the DI control variable and the DI importance variable (Pearson's r=0.561; Spearman's rho=0.560; Kendall's tau_b=0.472; $P = 0.000$), as well as for the DI control variable and the BPM facilitator variable (Pearson's r=0.646; Spearman's rho=0.640; Kendall's tau_b=0.545; $P = 0.000$).

After calculating correlations between the BPM index and all six DI variables, we verified the extent to which the data about DI and the digital strategy types can be explained by five contextual variables, namely the respondents' (1) position (3 categories: C-level, senior and middle manager) and (2) country/continent (4 categories: Australia, India, UK and US), as well as the organizations' (3) size (3 categories: large, medium and small), (4) sector (3 categories: products, services and government/social profit) and (5) perceived market competitiveness (3 categories: higher, about the same as average and lower).

We verified the assumption of homogeneity of variance by the nonparametric version of Levene's test, because our data were not normally distributed [52]. Since the nonparametric Kruskal–Wallis H rank test can deal with non-normality but requires homogeneity of variance ($P > 0.050$), we relied on the parametric Welch's ANOVA F test that does not require equal variances or equal group sizes and that is relatively robust for non-normality. Moreover, prior studies have shown that parametric tests can still be powerful for non-normal data [53,54]. If the Welch's ANOVA F test revealed that at least one subgroup differs from another subgroup [53], we identified those subgroups among which a difference is expected by performing the Games–Howell post hoc test (i.e., a test that can deal with unequal variances, unequal sample

Table 2
The experts' profile (N = 19).

Expert ID	Roles of experience	Years of experience in BPM	Years of experience in DI	Sectors of experience [NACE codes]
ExpA	BPM manager, DI manager	15	5	C
ExpB	BPM manager, IT consultant	4	4	E, J, Q
ExpC	BPM manager, IT consultant	10	3	C, G, H, J
ExpD	BPM manager, DI manager	20	5	C, M
ExpE	IT consultant	20	13	C, J, K
ExpF	IT consultant	10	5	J
ExpG	IT consultant	15	15	A, C, J, O, Q
ExpH	DI manager	12	6	C, H, O, R, S
ExpI	BPM manager	12	12	E, H, J, N
ExpJ	IT consultant	7	7	J
ExpK	DI manager	20	10	J
ExpL	BPM manager	8	3	G, N
ExpM	IT consultant	1	30	C, J
ExpN	BPM manager	10	10	E, K, O
ExpO	IT consultant	17	17	C, D, J, R
ExpP	CEO	20	6	C, G, J
ExpQ	CEO, founder	7	5	C, J, K
ExpR	BPM manager	5	3	C
ExpS	BPM manager	6	6	J, P

size and non-normality) [55].

3.2. Qualitative study

To better explain the quantitative findings, we continued by collecting data using semi-structured, face-to-face interviews with 19 West European experts in autumn 2017 (response rate: 22 %). The average duration per interview was 1 h.

Our expert panel approach [56] involved practitioners with relevant experience in both BPM and DI, who responded by relying on their entire career (i.e., as opposed to case studies) to enrich the data. Experts could only participate if they fulfilled the role of BPM manager, DI/transformation manager or IT consultant with experience in both BPM and DI. We obtained data triangulation [57] by composing a broad panel covering different perspectives from BPM and DI across different sectors and covering BPM/DI experience up to 30 years (Table 2).

We distributed the questions among two blocks, leaving room to add sub-questions for clarification and to ask for examples:

- **BLOCK 1. Role of BPM for DI** (RQ1)
  - o **[BPM–DI Relationship]** Previous research proved that a link exists between BPM and DI, albeit a moderate relationship. Why do you think this relationship is moderate (rather than strong)? [16,50]
  - o **[Causality]** How do you experience the nature of this relationship: Do you think that organizations apply BPM for better DI or vice versa (thus, that they apply DI for better BPM) or a different form? Can you give examples?
  - o **[Business Model]** What is the impact of DPIs on the so-called "business models" or governance of organizations? What do organizations hope to achieve? [42,46]
  - o **[IT investments]** Do you notice that organizations are investing more internally in IT or that organizations are outsourcing more IT than 5 or 10 years ago? Do you see a link to process innovations? Examples? [44]
- **BLOCK 2. Other factors** (RQ2) [21,49]
  - o **[Complaints of employees]** How do employees experience their role in the use of (new) IT for process innovations and their current BPM knowledge?
  - o **[Complaints of BPM owners]** How do BPM owners experience their role in the use of (new) IT for process innovations?
  - o **[Other problems]** Do you think of other practical problems, apart from the above BPM-related aspects, to realize DI?

Table 3
The correlation tests with respect to the BPM variable (N = 403).

Correlation	Spearman's rho	Kendall's tau_b
BPM * DI (DI importance)	0.422***	0.325***
BPM * DI (BPM facilitator)	0.623***	0.498***
BPM * IT investments (increasing budget)	0.480***	0.370***
BPM * IT investments (relative budget)	0.471***	0.356***
BPM * IT outsourcing (increasing budget)	0.601***	0.467***
BPM * IT outsourcing (relative budget)	0.500***	0.378***

(NS $P>0.100$; * $P<0.100$; ** $P<0.050$; *** $P<0.001$).

We used the Nvivo tool to apply the coding procedure of Saldaña [58]: We created initial nodes to represent the answered ideas, which we then aggregated into higher level categories or themes. The use of a coding tool (Nvivo) helped us in identifying and aggregating the coding nodes.

We addressed reliability by using investigator triangulation and an interview protocol. The research coordinator was supported by 59 master's students in IT management who were divided into groups of about five students. We followed an interview protocol to ensure that all interviews were conducted and analysed in a similar manner.

For reasons of measurement validity, we completed each interview using a group of students who helped each other in asking sub-questions and interpreting the experts' opinions. The research coordinator performed coding of all interview transcripts per group (in parallel), and then peer-reviewed and double-checked the data.

We increased internal validity by building on the literature and the quantitative study. Our panel size was varied enough to acquire data triangulation [57] and was large enough to exceed the minimum of 12 experts required for data saturation [59,60].

External validity of our qualitative findings is limited to the investigated sectors across Western Europe. While our quantitative study provided us worldwide data for generalization, our qualitative study aimed at explanations and insights into the role of BPM for DI without intending to be comprehensive. We deliberately made this choice to decrease bias within the expert panel and to provide a better understanding of the experts' opinions.

4. Quantitative results

Almost all (i.e., except for 17 out of 403) surveyed organizations used at least one new digital technology. In the top 5, we found cloud solutions (73.7 %), mobile technologies (65.5 %), social media (62.3 %), big data and business intelligence (50.9 %), IoT and smart devices (48.9 %).

4.1. Degree of the BPM–DI link

A minority of the respondents (strongly) disagreed (i.e., with a score of 1 or 2 on a 5-point Likert scale) with the variables regarding DI and digital strategy types. Only 5.5 % (strongly) disagreed that DI is important for their organization, and only 9.4 % (strongly) disagreed that BPM is a facilitator for DI in their organization. The disagreeing percentages were somewhat lower for the IT investment strategy (i.e., 8.8 % for increasing budget and 14.3 % for relative budget) than for the IT outsourcing strategy (i.e., 18.6 % for increasing budget and 19.1 % for relative budget). Although this finding confirms the overall importance of DI, it also implies non-normality for those variables and thus requires nonparametric correlation tests.

Similar to the pilot [50], Table 3 showed a moderate and positive relationship between BPM and DI, and this for both the DI importance variable ($P < 0.001$) and the BPM facilitator variable ($P < 0.001$). While the correlations for the digital strategy types with BPM were low to moderate in our pilot, we now provide stronger evidence for moderate

Table 4
The descriptive statistics for DI-related variables (N = 403).

DI-related variables	Median	Mean	Standard deviation
DI (DI importance)	4.00	4.08	0.861
DI (BPM facilitator)	4.00	3.81	0.940
IT investments (increasing budget)	4.00	3.98	0.931
IT investments (relative budget)	4.00	3.64	1.017
IT outsourcing (increasing budget)	4.00	3.66	1.090
IT outsourcing (relative budget)	4.00	3.50	1.121

Table 5
Post hoc testing for position.

Games–Howell	Position		
	C level vs senior manager	C level vs middle manager	Senior manager vs middle manager
DI (BPM facilitator)	NS	0.280*	NS
IT investments (relative budget)	0.325**	0.409**	NS
IT outsourcing (relative budget)	NS	0.375**	NS

(NS $P>0.100$; * $P<0.100$; ** $P<0.050$; *** $P<0.001$).

and positive relationships regarding all four digital strategy types ($P < 0.001$).

4.2. Contextual variables

Before we proceed, Table 4 presents the descriptive statistics for the DI-related variables as a reference to interpret the uncovered similarities or differences among the subgroups. More specifically, the estimated increases in units (i.e., on a 5-point Likert scale of the DI-related variables) given by the Games–Howell post hoc test are based on pairwise comparisons of the means. Appendix B shows details regarding the Welch's ANOVA F tests.

4.2.1. Differences according to the respondents' position (3 categories)

Table 5 shows that statistically significant differences were found for three out of six DI-related variables, and this is mainly between C-level and middle managers. The observed differences remained below 0.5 units on a 5-point Likert scale, namely with slightly higher values for C levels than middle managers for the BPM facilitator variable ($P < 0.100$) and for both the relative digital strategy types ($P < 0.050$).

4.2.2. Differences according to the respondents' country (4 categories)

Regarding the respondents' country and continent, Table 6 presents statistically significant differences for all DI-related variables, and this had higher values (i.e., ranging between 0.3 and 1.2 units on a 5-point scale) for India (Asia) compared with the other countries in the Western world ($P < 0.001$). We observed slight differences (i.e., between 0.2 and 0.4 units) between the UK and the US for the DI importance variable ($P < 0.100$) and BPM facilitator variable ($P < 0.050$), but not for the digital strategy types. We did not find any differences between Australia and UK.

4.2.3. Differences according to the organizations' size (3 categories)

As presented in Table 7, large organizations have statistically significant higher values for all DI-related variables ($P < 0.001$), and this ranges between 0.4 and 0.9 units on a 5-point Likert scale.

4.2.4. Differences according to the organizations' sector (3 categories)

Table 8 shows that service organizations have statistically significant higher values than product organizations for the DI importance variable

Table 7
Post hoc testing for size subgroups.

Games–Howell	Size		
	Large vs medium	Large vs small	Medium vs small
DI (DI importance)	0.405***	0.437**	NS
DI (BPM facilitator)	0.600***	0.841***	NS
IT investments (increasing budget)	0.448**	0.682***	NS
IT investments (relative budget)	0.618***	0.818***	NS
IT outsourcing (increasing budget)	0.403**	0.920***	0.517**
IT outsourcing (relative budget)	0.479**	0.764***	NS

(NS $P>0.100$; * $P<0.100$; ** $P<0.050$; *** $P<0.001$).

Table 8
Post hoc testing for sector subgroups.

Games–Howell	Sector		
	Products vs services	Products vs Gov./social profit	Services vs Gov./social profit
DI (DI importance)	–0.410***	NS	NS
IT investments (increasing budget)	–0.243*	NS	NS
IT investments (relative budget)	–0.359**	NS	0.382**

(NS $P>0.100$; * $P<0.100$; ** $P<0.050$; *** $P<0.001$).

Table 9
Post hoc testing for market competitiveness subgroups.

Games–Howell	Market competitiveness		
	Higher vs about the same	Higher vs lower	About the same vs lower
DI (DI importance)	NS	0.427**	NS
DI (BPM facilitator)	0.342**	0.397**	NS
IT investments (increasing budget)	0.283*	NS	NS
IT investments (relative budget)	0.466**	0.359*	NS

(NS $P>0.100$; * $P<0.100$; ** $P<0.050$; *** $P<0.001$).

Table 6
Post hoc testing for country subgroups.

Games–Howell	Country					
	Australia vs India	Australia vs UK	Australia vs US	India vs UK	India vs US	UK vs US
DI (DI importance)	–0.542***	NS	NS	0.372**	0.652***	0.280*
DI (BPM facilitator)	–0.687***	NS	0.544***	0.784***	1.231***	0.447**
IT investments (increasing budget)	–0.542***	NS	NS	0.635***	0.748***	NS
IT investments (relative budget)	–0.761***	NS	NS	0.805***	1.099***	NS
IT outsourcing (increasing budget)	–0.846***	NS	0.363*	1.113***	1.209***	NS
IT outsourcing (relative budget)	–0.657***	NS	0.510**	0.956***	1.167***	NS

(NS $P>0.100$; * $P<0.100$; ** $P<0.050$; *** $P<0.001$).

Table 10
Main findings for the "BPM–DI relationship" variable.

Node	Expert count	Expert IDs
(New) IT and business processes are intertwined	8	A, B, G, H, I, L, O, S
Also other factors can affect the BPM–DI relationship	7	F, I, J, L, N, P, R
Different focus or reasoning to start with	6	D, E, F, K, M, N
BPM is often nondisruptive or incremental DI (i.e., changing existing processes) while disruptive DI is out-of-the-box thinking	5	H, N, P, Q, S
BPM to anchor DI in the organization	4	A, F, N, S
BPM is negatively perceived as too bureaucratic (<> agile)	3	A, N, S
Stimulate reuse for simplification (internal, for suppliers/customers)	2	K, R
Focus on both customer experience and business value	1	K

Table 11
Main findings for the "causality" variable.

Node	Expert count	Expert IDs
First DI then BPM	8	A, D, E, I, K, N, O, S
First BPM then DI	3	G, Q, R
Synergies possible in both directions	7	A, C, D, H, I, L, S
DI is not the same as digitalization/ automation	5	H, N, P, Q, S
Organization dependent	2	B, P
Impact dependent on process types and IT types	1	M
Starting from end customer expectations	1	F

($P < 0.001$) and for both IT investment strategies ($P < 0.100$ and $P < 0.050$, respectively). Concerning the relative budget for IT investments, service organizations have statistically significant higher values than governments and social profit ($P < 0.050$). All differences remain below 0.5 units on a 5-point Likert scale.

4.2.5. Differences according to the organizations' market competitiveness (3 categories)

Table 9 shows statistically significant higher values for organizations experiencing higher market competitiveness (1) for the DI importance variable compared with organizations with lower market competitiveness ($P < 0.050$), (2) for the BPM facilitator variable compared with organizations with an average and lower market competitiveness ($P < 0.050$), (3) for the increasing IT investment budget compared to organizations with an average market competitiveness ($P < 0.100$) and (4) for the relative IT investment budget compared with organizations with an average ($P < 0.050$) and lower ($P < 0.100$) market competitiveness. The differences, however, remain below 0.5 units on a 5-point Likert scale.

4.2.6. Summary of the contextual variables

The five contextual variables refined our DI findings. The differences among the contextual subgroups mostly remained small and below 0.5 units on a 5-point Likert scale for the respondents' position, organizational sector and market competitiveness (i.e., with slightly higher values for C levels, service organizations and organizations with higher perceived market competitiveness). For organization size, the differences were somewhat higher (i.e., between 0.4 and 0.9 units) for larger organizations. For Indian (Asian) organizations, the differences were higher and varied between 0.3 up to 1.2 units, but were not drastically opposed to the other countries and continents.

5. Qualitative results

In order to gain a deeper understanding of DI and its link with BPM, our qualitative study narrowed the scope to Western Europe to minimize bias.

5.1. Explanations for the BPM–DI link

We start with the findings for the BPM–DI relationship variable (Table 10).

Eight out of 19 experts agreed that (new) IT and business processes are inherently intertwined and that most organizations have existing IT systems (i.e., an IT legacy) to integrate with. They explained that process changers should look at "people-process-systems" (PPS), namely (1) who does what and which talents are needed, (2) how we work and organize and (3) IT systems as instruments. "*IT has always helped BPM to achieve efficiency and customer experience, but with robotic process automation and artificial intelligence, organizations can now leverage data to achieve more advanced process improvements by collecting data to predict (e.g., maintenance issues in machines) and proactively enhance*" (ExpG). The focus turns from internal to external communication (ExpO), and DI can lead to leverage (e.g., efficiency gains) (ExpG).

Seven experts asserted that other contextual factors could affect the BPM–DI relationship, such as culture (e.g., regarding customer differentiation), stakeholders, market, competitors, sector, organizational age and size or legislation (e.g., General Data Protection Regulation (GDPR)). Disruptive changes in older organizations are more difficult because they take more time to realize what IT can do for their products, services and business processes (ExpI). New IT may not yet be embedded in large organizations because it is more complex to integrate with existing tools (ExpL). ExpN mentioned that sectors such as insurance do not necessarily need cutting-edge DI. Hence, DI should be dependent on the business case and is not necessarily the best option (ExpJ).

While BPM and DI focus on customer experience and business value (ExpK) and stimulate reuse for internal simplification, customers and suppliers (ExpK and ExpR), six out of 19 experts claimed that BPM and DI start with different focusses. While BPM often targets existing processes, products or services, DI usually starts from a technological innovation and reflects on its optimal use for customers (ExpE and ExpN). DI is typically fast and works with agility (e.g., with experiments and proofs of concept), while many business processes follow a more rigid approach. Similarly, five experts made an explicit distinction between nondisruptive DI (i.e., for incrementally changing existing business processes) and disruptive DI (i.e., for defining new or drastically changing existing business processes). The latter requires more out-of-the-box thinking, experimentation and new business models. Nonetheless, four experts asserted that BPM could anchor DI in the organization. Although managers can push strategies (e.g., for customer segmentation), an organization should know its business processes to estimate what new IT can support (ExpF). BPM experts and process owners are better able to estimate how innovative ideas can be translated into practice (ExpS). BPM is needed to continue with a realized innovation (ExpN).

On the other hand, three experts admitted that BPM is often negatively perceived as too bureaucratic (i.e., involving many stakeholders and requiring time to design process diagrams), which contrasts with the agile approach of DI. ExpA explained that business processes are sometimes outdated by the time the process diagrams are designed and that process diagrams are not necessarily used in practice. Instead of involving many stakeholders, ExpN argued that "*innovation ideas can come from one or a few free spirits who talk to a strategy manager, innovation manager or project leader with charisma and who have connections in the organization*".

Table 12
Main findings for the "business model" variable.

Node	Expert count	Expert IDs
Disruptive or nondisruptive impact	9	D, E, I, N, O, P, Q, R, S
Customers are key	5	D, E, F, O, S
Efficiency is key	5	C, G, O, R, S
Data are key	3	D, F, L
Job contents will change	3	B, O, Q
Servitization	2	H, K
Business model canvas: different perspectives to be considered	1	J
Short-time trials for long-term success	1	D
Impact more relevant for certain departments (e.g., R&D, business units)	1	A

5.2. Explanations for causality in the BPM–DI link

We continue with the causality variable (Table 11).

Eight out of 19 experts mentioned that DI usually precedes BPM initiatives, while three experts were convinced that BPM usually comes before DI. The eight experts who favoured causality from DI to BPM stated that IT trends should be a starting point and BPM is needed to make a successful DI efficient and anchor it in the organization. They stipulated that DI is faster, more experimental and creative, while BPM is more rigid and bureaucratic. On the other hand, the three experts who favoured causality from BPM to DI argued that process bottlenecks should be a starting point to avoid suboptimization and spaghetti solutions if an end-to-end view is not taken. Seven experts instead positioned that synergies exist in both directions. For instance, DI is built into the corporate flows (ExpC), and a bridge is needed between IT, BPM and quality management (ExpI). Organizations are free to start from a business problem (i.e., process bottlenecks) and then search for IT solutions or to start from new IT possibilities and search for potential business applications or translation into pilots (ExpA, ExpH and ExpS). ExpL referred to "*a chicken-or-the-egg causality dilemma, because process awareness and an external view are key, but big innovations come rather from an IT trend*".

As with the previous variable, the experts made a differentiation between (1) disruptive DI (i.e., from DI to BPM) and (2) incremental DI (i.e., from BPM to DI). ExpB and ExpP also referred to organization dependency, namely with larger and older organizations being less flexible. ExpP clarified that disruptive DI is more realistic in smaller startups. ExpB explained that DI is typically faster than BPM, while multinationals experience more difficulties to change. ExpM argued that the impact of DI and BPM depends on the process types and IT types, including a higher impact for new IT (e.g., IoT, 3D printing) and core processes (e.g., supply chains; ExpM).

5.3. Explanations for an impact of the BPM–DI link on business models

This section presents the business model findings (Table 12).

Nine out of 19 experts agreed that the impact of DI and BPM on business models can be disruptive or nondisruptive. Nondisruptive business models focus on automation and internal advantages (e.g., efficiency) (ExpP, ExpR, ExpS). Disruptive business models are more flexible and dynamic to respond to changing market needs (ExpI), with new ways of working replacing old ones (e.g., Uber for taxi services or bitcoin and crowdfunding for banking) (ExpE, ExpN). To succeed in the long term, short-term business actions and trials are required (ExpD), possibly with shorter periods for an organization to exist (ExpO). According to ExpP, business processes can limit the creativity required for disruptive innovation.

Business models combine internal advantages (e.g., efficiency gains for faster business processes) with external ones (e.g., new communication channels to improve customer service). ExpS illustrated that DI can stimulate reuse across departments and organizations to make products or services (e.g., online payment services) more generic for customers. Furthermore, data have become an asset or "*power element to create a better service, more sales or a higher market share*" (ExpD). Data can change the inputs for communication and data processes (e.g., product tracking from start to destination; ExpF). ExpL was critical by stating that data can be sold to suppliers or third parties, namely by selling insights. This means that business intelligence techniques help create new business models.

ExpH and ExpK referred to the increasing relevance of servitization to solve customer problems by renting fees instead of product sales. For instance, an organization such as Philips can sell light instead of lamps by using IoT technology (i.e., from a distance) for a better customization and handling of customer needs. With servitization, employees are put in the right place as a service.

Table 13
Main findings for the "IT investments" variable.

Node	Expert count	Expert IDs
More focus on core business	8	D, H, J, K, O, P, Q, R
Investment reasons (e.g., economic recovery, reuse of standards, competition, reputation management, generation gap)	7	B, C, E, J, K, L, O
Besides offshoring, more onshoring and also nearshoring	6	A, B, F, I, N, R
IT dependent (hardware vs software and all-in solutions vs data analytics vs architecture)	5	B, D, J, N, O
Cloud solutions	4	E, G, I, P
More renting than buying (cloud, servitization)	3	B, D, H
Expertise on fast evolving IT is difficult, and thus possibly external	3	F, G, M
Finding a fit with the corporate strategy to assess potential solutions	1	B
Knowledge loss vs internal knowledge transfer	1	S

5.4. Explanations for IT investments

The IT investment findings are shown in Table 13.

Seven experts mentioned that different IT investment reasons are valid for innovating business processes (e.g., new IT opportunities, economic recovery, younger business leaders being more familiar with IT, reuse of standards, interfaces with social media feeds). ExpB warned that, because too many IT opportunities exist, a strategic focus is needed based on an organization's budget and product portfolio (i.e., to focus on the best of the breed). ExpE illustrated that small fintech companies stimulate entrepreneurship for only a small market segment, but can become big competitors of large and older organizations.

Eight out of 19 experts explained that outsourcing of noncore business processes (e.g., support processes) allows for focusing more on an organization's core business, which is its "*differentiator of tomorrow*" (ExpD). ExpJ stipulated that outsourcing decisions depend on weighting cost-driven versus value-driven strategies. If an organization wants to differentiate based on a specific business process, then outsourcing that process is not the best option. A trend exists to complement offshoring with onshoring and also nearshoring (six experts), for which two reasons were given: (1) communication problems and cultural differences between continents may kill creativity and (2) the fast evolution of IT requires a location close to customers.

Five experts noticed that outsourcing decisions are IT dependent (i.e., with different approaches for hardware, software, all-in solutions, data analytics, architecture). Outsourcing is typically used for cloud solutions, hardware and upgrades, while important data analyses or IT architecture can be insourced due to the crucial role of a business context and privacy concerns (e.g., GDPR legislation). Four experts stated that process outsourcing is increasingly done by means of cloud

Table 14
Main findings for the "complaints of employees" variable.

Node	Expert count	Expert IDs
Bad business-IT alignment	9	C, F, G, I, J, M, N, O, P
Cultural resistance to change (from employees, stakeholders)	8	D, C,F, I, J, M, N, O
Insufficient training and communication about personal benefits	7	C, D, F, H, O, Q, S
People dependent (generation issues)	5	A, B, C, D, R
No employee involvement nor empowerment	4	B, K, L, S
Lack of IT literacy	3	A, E, R
Top management resistance	2	B, L
Too many or fast changes, resulting in stress	2	B, E
Afraid for job content changes or job losses	2	F, K
Work overload, resulting in stress	1	B
Lack of flexibility	1	D
Slow legislation	1	B

solutions (e.g., offered by Amazon, Google, MS), because they are direct in use and therefore cheaper and faster to bring products and services to the market. Alternatively, three experts (ExpB, ExpD and ExpH) broadened the notion of cloud solutions to the idea of servitization, by which organizations rely more on renting (e.g., with monthly fees) noncore business aspects to keep pace with new technologies (e.g., IoT; ExpD).

Similarly, three experts (ExpF, ExpG and ExpM) argued that process outsourcing can be a useful option, since building in-house expertise on fast evolving IT is difficult. Hence, "*fast changing IT requires expertise that is not easy to manage in an IT department, while different specialties can be found in IT consultancy to support organizations*" (ExpF). ExpB stated that internal IT experts will be needed to challenge external partners, assess potential solutions and find fits with corporate strategy.

5.5. Employee complaints

We now describe the main employee complaints (Table 14).

Nine experts mentioned that employees frequently complain about business–IT alignment issues. ExpG clarified that many organizations work with IT solutions that do not fit their business realities because of power battles. Eight experts linked these complaints to resistance to change. Resistance complaints also involved (top) management, indicating that managers should become more open to bottom-up innovation ideas (ExpL). ExpB added that top managers sometimes prefer a slower pace in DI because of failed projects in the past. Another type of employee complaint dealt with the need for more BPM knowledge and training on specific business processes (ExpD, ExpF, ExpS) and the need for better communication on personal benefits for employees and value for end customers (ExpC, ExpF, ExpH, ExpO and ExpQ).

Four experts referred to a lack of employee involvement or empowerment. Early employee involvement can be realized in the DI testing phases. ExpA, ExpE and ExpR added that more IT literacy is needed because many employees experience difficulties when working with standard IT tools. Five experts, however, admitted that employee complaints remain people dependent. Older employees are often less open to DI, while young employees know more about new IT, but are less able to think conceptually.

Furthermore, ExpB and ExpE warned that many and/or fast changes result in stress. For instance, work-related stress can increase because of changing work practices or incidents due to immature IT. Similarly, stress can be caused if employees fear for job losses (ExpF and ExpK). BPM and DI take knowledge away from employees due to automation, resulting in employees realizing that their job content will change (ExpF) and in knowledge workers fearing they will no longer be recognized as experts (ExpK). ExpB explained that work overloads can also trigger stress and that some organizations hire a so-called "energy manager" (i.e., responsible for social well-being) or allow for fitness at work.

Other minor employee complaints dealt with a lack of flexibility (ExpD), as efficiency gains do not necessarily provide flexibility and legislation can slow down organizations when compliance is required (ExpB).

Table 15
Main findings for the "complaints of BPM owners" variable.

Node	Expert count	Expert IDs
Eagerness to learn about new IT is people dependent	7	E, H, K, M, O, R, S
Too much working as a change manager and reputation manager	6	A, C, E, I, J, O
Too dependent on the IT department, external consultants, vendors	5	A, C, G, K, M
Resistance to change from others, and also from process owners	3	A, N, O
Top management resistance	2	A, B
Work overload	1	I
Bad business–IT alignment	1	O
BPM experience is dependent on seniority	1	I

Table 16
Main findings for the "other problems" variable.

Node	Expert count	Expert IDs
Need for a learning organization (both training and business models)	7	B, I, J, K, L, N, Q
Early adopter vs following the sector or competitors	4	C, L, N, O
Limited resources, budget, time	3	N, P, R
Bad business–IT alignment, need for a good IT architecture	3	F, I, S
Too many IT possibilities require focus, an integrated approach	2	B, L
New vs existing applications; systems integration and maintenance issues	2	A, D
Other top management preferences	2	P, R
People dependent (generation gap)	1	P
Disappointments due to too high expectations about new IT	1	H
Different ways to manage fully/semi/nondigitalized processes	1	E
Not fully understanding customer needs by being too fast	1	P
Staff turnover; skilled people leave the organization	1	K

5.6. Complaints of BPM owners

After the employee complaints, we turn to those of BPM owners (Table 15).

The most frequently cited complaint for process owners was related to eagerness to learn, which remains people dependent (seven experts) and concerns a drive for new opportunities to improve business processes and learn about new IT by means of seminars or conversations with IT vendors. Some BPM experts are more IT-minded, while others are more people-minded (ExpS). It also takes effort to keep up to date on new and fast-changing IT (ExpE and ExpO).

Six experts mentioned that process owners work too much as change or reputation managers, requiring extra time and effort. Additionally, ExpJ mentioned that process owners often act as coaches or facilitators for employees when there are not enough resources to do so. ExpI referred to work overloads for many process owners due to extra tasks.

Five experts added that process owners frequently feel too dependent on internal IT departments, vendors and consultants. IT remains abstract and the outcomes of new IT are still unsure. Process owners get frustrated when they cannot initiate process changes themselves. Another

recurrent complaint was related to business–IT alignment. ExpO clarified that process owners sometimes do not understand why their requirements cannot be covered correctly by IT or that process owners do not necessarily want to go as far as what IT can offer.

Although process owners and process analysts complain about resistance from employees and stakeholders, three experts mentioned that some process owners are also resistant to change (e.g., when the organizational culture in not in line with BPM and DI changes). Complaints about top management resistance especially occur when there is a lack of sponsorship or vision (two experts). Finally, ExpI warned about seniority issues, since process owners sometimes lack sufficient BPM experience themselves.

5.7. Other problems related to BPM and DI

We close the qualitative findings by examining additional problems (Table 16).

Experts strongly emphasized the need for a learning organization. ExpQ referred to a lack of experience and skills to innovate. ExpK added that new IT evolves so fast that organizations need to change frequently and invest in training. According to ExpJ, organizations need to be open to business model changes to cope with new or changing markets (e.g., Nokia can sell both smartphones and tires, and Amazon has streaming services in addition to web shopping). Finally, three experts (ExpB, ExpL and ExpN) expressed an increasing need for expertise and training in new IT (e.g., via seminars or sales pitches of IT vendors). Nonetheless, four experts argued that organizations should decide whether they want to be early adopters or follow their competitors. Learning experiments cost money to undertake, but waiting too long involves risks. Sometimes, sector-dependent trends should be followed.

Three experts repeated the need for an IT architecture and better business–IT alignment. For instance, ExpS suggested that the business–IT gap can be closed by making conceptual models more concrete, translating them into work practices, giving examples to employees and explaining conceptual thinking in terms of personal net benefits. Similarly, ExpB and ExpL emphasized that too many IT possibilities require focus and an integrated approach across departments. Next, ExpA and ExpD stressed that a balance should be found (i.e., in terms of energy and efforts) between new and existing applications, which also affects systems integration and maintenance issues.

ExpP elaborated on people dependency because "*organizations need young people to create novel ideas and older people to complete those ideas. Young people can have cool ideas, but the customers are not necessarily waiting for those changes. Thus, an organization needs diverse employee profiles (*e.g.*, backgrounds, ages), which is difficult to manage*". According to ExpP and ExpR, other problems occur when top managers have preferences other than BPM and DI or when CEOs postpone changes and innovation strategies for personal reasons (e.g., bonus, retirement).

Finally, problems can be related to (1) disappointments due to excessively high expectations about new IT (ExpH), (2) different ways and tools to manage fully automated, semiautomated and nondigitalized processes (ExpE), (3) not fully understanding customer needs by going too fast (ExpP) and (4) staff turnover in the form of skilled people leaving the organization (ExpK). While three experts referred to limited resources, budget and time (e.g., for IT projects or training) as obstacles to employee efficiency, ExpP was of the opinion that if employees can work more efficiently with new IT, they can also save time to reflect on innovative ideas.

5.8. Linking qualitative to quantitative findings

In sum, the qualitative data helped describe the statistically observed role of five contextual factors, as follows:

- (1) The surveyed C-level managers were somewhat more positive towards DI compared with middle managers. Our expert panel explained this on the basis of strategic decisions being made on the C-level.
- (2) The surveyed Indian (Asian) managers tended to be more positive about DI than those of Western countries (UK, US and Australia). The interviews suggested that such attitude is mainly culture dependent. Western countries can still rely on India for outsourcing more labour-intensive processes, while DI also requires more nearshoring and onshoring.
- (3) The quantitative and qualitative results for organization size seemed to contradict each other. While the survey suggested that large organizations are more positive about DI, the experts explained that large organizations are typically less flexible on DI (e.g., due to their IT legacy, multiple departments or international character). The experts positioned large organizations against Lean startups, whereas the survey covered traditional organizations.
- (4) Service organizations were somewhat more positive about DI than product or public organizations. Although product innovation is highly relevant and the public sector also benefits from new IT (e.g., smart cities), the experts referred to servitization as a new business model whereby organizations focus on renting service fees instead of buying products.
- (5) The perceived level of market competitiveness may also explain why organizations feel more positive about DI because of stronger drivers or triggers.

6. Discussion

This study has generalized the positive yet moderate relationship between BPM and DI based on five contextual factors (RQ1), which concerns a link without causality because organizations can choose the dynamics of the BPM–DI interplay and combinations are required for a long-term vision (RQ2). Both RQs have shown that process innovation (i.e., disruptive and nondisruptive changes) is based on strategic decisions that remain organization dependent. Therefore, the discussion elaborates on how such digital strategies [42–45] can be made more contingent upon the internal and external contextual factors.

To inductively generate a theory based on the uncovered results, the findings of RQ1 and RQ2 are now mapped to related management theories to come up with a descriptive decision-making framework and a prescriptive readiness matrix for DPI.

6.1. Framework to support strategic decisions on digital process innovation

In order to find a potential framework for deciding on DPI strategies, we started from the PPS idea mentioned by eight experts in Section 5.1. More specifically, by providing evidence for the complex relationship between BPM and DI, our study has highlighted drivers and critical aspects that depend on multiple contextual factors in an interplay of "people-process-systems". This PPS notion emphasizes that business processes are intertwined with technologies (e.g., to change and support an organization's way of working on a strategic and also operational level) and involve people as process participants or actors (e.g., employees, customers and suppliers).

From the "process" perspective, our study gives evidence for the new BPM research streams mentioned in Section 1 [7,10,18–20]. Regarding the "people" part, organizations can rely on change management theories [61,62] to avoid or reduce (internal and external) resistance, while business–IT alignment models help improve the "systems" part [63–65]. The richness of our data also showed that strategic decision-making on DPI cannot be simplified as an independent factor that merely linearly depends on the identified business contexts. Hence, PPS has guided us to take a descriptive and explanatory framework approach to position the theoretical and practical implications of strategic DPI decision-making after accounting for such contextual factors.

The notion of PPS adheres to what DePietro et al. [66] called

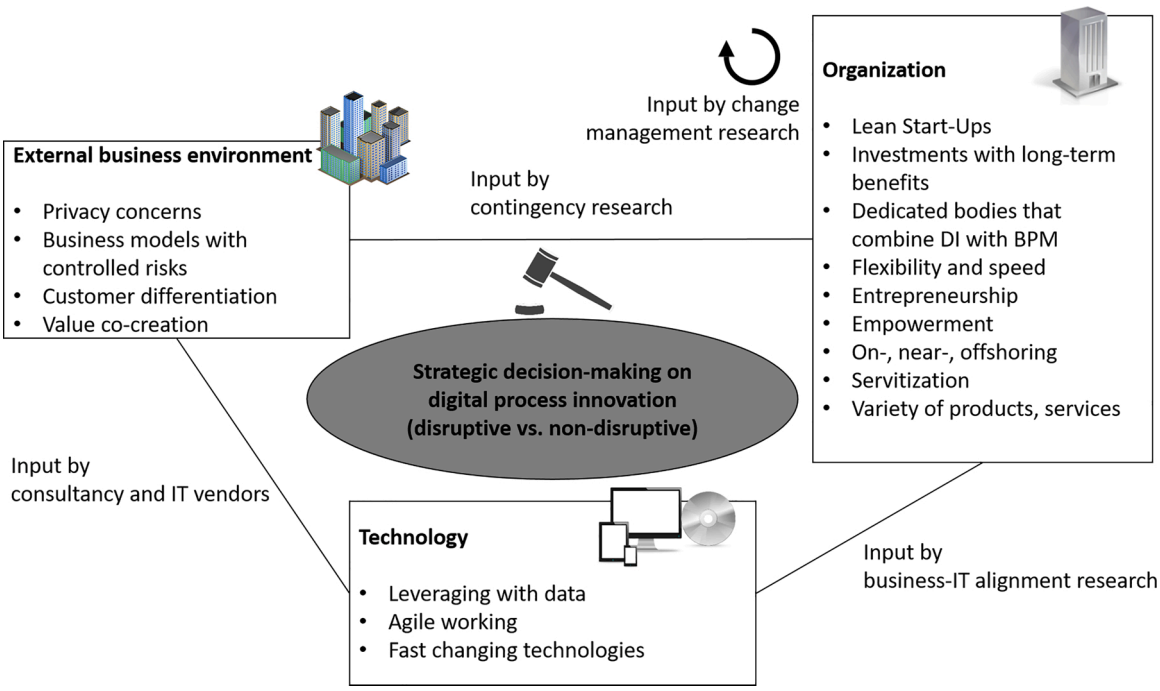

Fig. 1. Our proposed "technology–organization–environment" (TOE) framework for DPI, adapted from the work of DePietro et al. [66].

"technology–organization–environment" (TOE), which helps explain which information system or technology best suits a particular business process by better positioning contextual considerations to PPS. TOE is a framework from the 1990s that claims that innovation decisions should be dependent on technological, organizational and environmental contexts. This framework shows similarities with our work, namely with "technology" referring to "systems", with "organization" combining "people" and "process", and with "environment" covering the contextual factors.

We translate and extend the TOE framework [66] from technology innovation to DPI (Fig. 1) by keeping the three main categories and adding the subcategories derived from this study with related theories and explanations. For this purpose, Appendix C shows how we start from the initial TOE categories and group them along the contextual factors of RQ1. Then, we add refinements based on the analysis results from RQ2 (i.e., with Appendix C referring to specific subsections). As such, we are able to re-structure the explanations and differences for new IT compared to the initial TOE, as shown in the rectangles of Fig. 1.

Subsequently, we convert the TOE extension into a more practical instrument for utilizing the findings.

6.2. *Towards more prescriptive implications*

Our findings have shown that DPI often suffers from different types of resistance that impede a DPI adoption, such as employees lacking skills or corporate values (RQ2). Although Fig. 1 describes some solutions, the current section intends to make the TOE framework more prescriptive in nature. We therefore differentiate between organization types from the perspective of DPI and start from two theoretical underpinnings related to adoption needs:

- We rely on the diffusion of innovation theory [67] and orient the theory to the diffusion of DPI. This theory indicates that innovations are first adopted by innovators and early adopters, who influence the majority of early users. Only once an innovation proves successful will the late majority and laggards follow. Otherwise, an unsuccessful innovation will disappear.
- We also focus on the five-stage model of adult skill acquisition [68] in order to apply this approach to employee skills for DPI and then extrapolate it to employees' organizations. This model shows how employees typically acquire skills, starting as novices and then evolving into advanced beginners and competent employees. Afterwards, they may become proficient in applying the skills and ultimately be recognized are experts.

Table 17 represents the DPI mastery of organizations based on their gradual approaches of innovation diffusion and skill acquisition. We have differentiated five organization types along the corresponding

Table 17
DPI mastery.

An organization's DPI mastery		Strategic decision-making on DPI		
Diffusion of DPI, based on the work of Rogers [67]	Acquisition of DPI skills, based on the work of Dreyfus [68]	Our animal metaphors	Characteristic motivation	Our advice on the number of incremental vs disruptive process innovations
0/ Laggards	0/ Novice	0/ Dinosaur	Extinction of major groups	Keep up in order not to be destroyed or disappear in a digital economy
1/ Late majority	1/ Advanced beginner	1/ Turtle	Slow pace, but with a protection shield to survive	Incremental >> Disruptive
2/ Early majority	2/ Competent	2/ Horse	Sense of balance and a strong fight-or-flight response, use of speed to escape possible predators	Incremental > Disruptive
3/ Early adopters	3/ Proficient	3/ Lion	King of the wild, and a fast runner	Incremental < Disruptive
4/ Innovators	4/ Expert	4/ Chameleon	Agile to change and fit its environment	Incremental << Disruptive

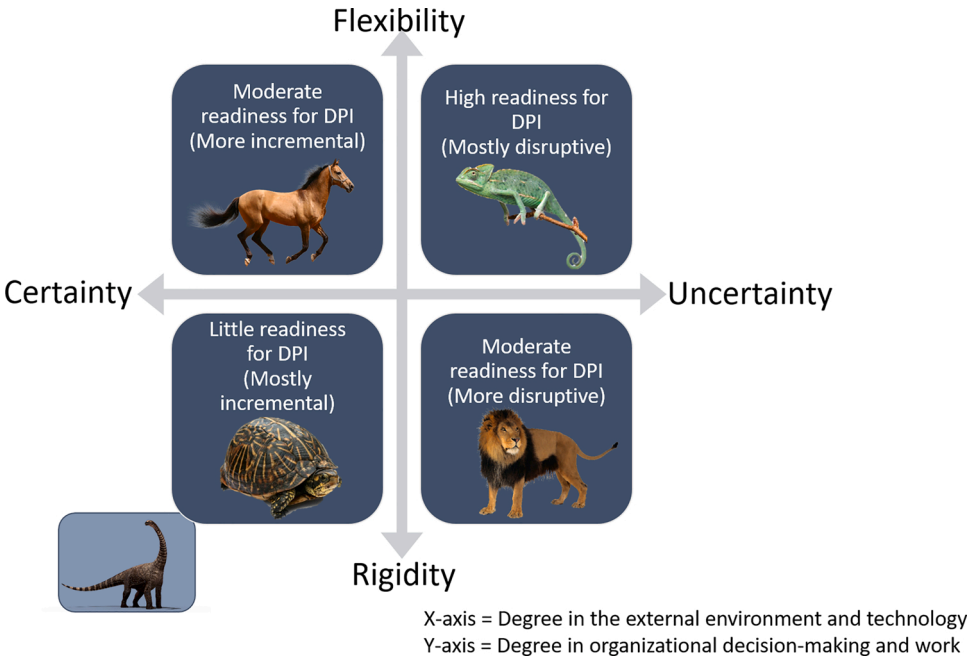

Fig. 2. The readiness matrix regarding DPI.

theoretical stages and assigned animal metaphors that describe their respective characteristics with regard to DPI.

- The **chameleons** are exemplary innovators and experts in DPI skills.
- The **lions**, as early adopters, are proficient in DPI skills.
- The **horses,** symbolizing the early majority, are competent in performing DPIs.
- The **turtles,** representing the late majority for adopting DPIs, are less advanced on the required skills.
- The **dinosaurs**, seen as laggards for diffusing DPIs, have not yet sufficiently acquired DPI skills.

Based on the underlying adoption pattern, we are able to provide preliminary advice ranging from more incremental (or nondisruptive) to more disruptive process innovations (Table 17). The latter is especially crucial since RQ2 showed that both options are valid DPI solutions, and depend on the organization's business context.

The advice in Table 17 supplements our findings that DPI depends on a complex interplay of contextual factors. It also recognizes the fact that organizations should strive for a positive return on investment (ROI) per DPI by balancing costs and benefits, and thus by carefully considering trade-offs.

We then combine our findings from the TOE framework and the DPI mastery in a DPI readiness matrix (Fig. 2), considering the degrees of certainty/uncertainty (i.e., in the "external business environment" and in "technology") and of rigidity/flexibility (i.e., in the "organization", including decision-making and its business processes). The x-axis considers turbulence in markets and technology, while the y-axis focusses on how corporate decision-making and work are usually organized per organization type.

In sum, each organization type should deal with DPI depending on its specific business context.

- The **chameleons** are most open to disruptive process changes, possibly by experimenting, and are thus best prepared to perform in a digital economy. Examples are organizations, such as Philips, Amazon or Nokia (as illustrated in Section 5).
- The **lions** can be forced to become disruptive due to turbulence, but they will be more hesitant than the chameleons because their way of working is less entrepreneurial. Such organizations may be situated in sectors like those for automobiles, pharmaceuticals or chemicals.
- The **horses** are prepared for a digital economy in the sense that they particularly need incremental process changes, but they are able and willing to be disruptive from time to time. Section 5 referred to insurance companies.
- The **turtles** benefit most from incremental process changes given their less turbulent environments and will shift to a more disruptive technology once it has gained more common ground, rather than when it is too immature. One can likely find examples in social profit organizations.
- The **dinosaurs** risk being too old-fashioned and rigid in mindset to function in a digital economy, and are less likely to survive unless they reincarnate into another type.

If an organization wishes to transform its DPI readiness (e.g., from dinosaurs to turtles, from turtles to horses or from lions to chameleons), the TOE framework in Fig. 1 advises how to become more flexible in terms of organizational decision-making and work processes (e.g., by changing resource allocation as well as informal and formal relationships). For instance, in TOE terms, if a small and medium enterprise has a rather small budget for process innovations ("organization"), it may invest only in those digital technologies ("technology") that have become mainstream in its sector or that its end customers most demand ("external business environment"). Providing training in DPI skills to stimulate faster adoption of process innovations can encourage flexibility and speed. Customers can become more involved by cocreation or differentiation can be realized by collecting more commercial data.

Alternatively, an organization may switch to another external business environment (e.g., to become a lion) by providing other products or services (e.g., servitization or scaling up to a variety of products and services). For instance, in TOE terms, if a large organization decides to become an early adopter of an emerging technology ("technology") in order to strengthen its market position ("external business environment"), it needs to invest in training and involve employees early ("organization"). Dedicated governance bodies may be launched to promote values such as entrepreneurship and empowerment. On the other hand, the organization may create a spin-off (i.e., a Lean startup) to experiment as a chameleon.

Table A1
The distribution of our sample for country/continent (N = 403).

Continent	Country	Frequency
Oceania	Australia	100
Asia	India	102
Europe	UK	100
North-America	US	101

6.3. Limitations and future research avenues

While we acknowledge limitations regarding our data collection (i.e., based on opinions and with cautious generalization to all sectors worldwide), organizations can already benefit from our DPI findings as stipulated in Section 6.2. The extended TOE framework as well as the related DPI mastery and readiness matrix would benefit from further validation efforts given DPI's complexity and variety. Follow-up research can best be conducted by case studies to dig deeper into organizational settings. Alternatively, organizations can benefit more when the insights are turned into a practical decision tool, which can be built and tested using design-science research. Another limitation is related to the fact that TOE typically contains sometimes opposing aspects relevant when drawing up a strategic business model. Likewise, our extension offers essential considerations and refers to research opportunities for DPI decisions by including inputs from contingency research, business-IT alignment and change management. Finally, we acknowledge that the animal metaphors merely act as simplified visualizations based on established theories supporting a gradual adoption of innovations and skills, for manager to better grasp the essential DPI drivers.

7. Conclusion

This study sheds light on the strength and nature of the relationship between BPM and DI based on an international survey (RQ1) and an expert panel (RQ2). The novelty of our work lies in looking at the BPM–DI relationship from the unique perspectives of 403 managers across four continents, which enabled us to formulate statements about different contextual factors affecting this relationship. By replicating our pilot findings on the positive yet moderate BPM–DI relationship, we provided strong statistical evidence that can be generalized (RQ1). Furthermore, by interviewing 19 subject matter experts from Western Europe, we uncovered deeper explanations for the rationale behind this relationship and the identified contextual factors (RQ2). We then combined our findings in an extended TOE framework and suggested a typology to categorize organizations by their DPI mastery in a readiness matrix for reasons of theory-building and helping organizations strategically decide how to change their business processes (e.g., as an aid to reflect on which business processes are to be changed and whether the required changes are more disruptive or nondisruptive). Since our proposed TOE framework builds on an accepted framework for technology innovation (and refines it into a 2.0 version for DPI), the current article aims at framework development. We call for more empirical research to come up with practical guidelines on how the extended TOE framework and five metaphorical animal types regarding DPI readiness can be applied, possibly supported by an online decision tool.

CRediT authorship contribution statement

Amy Van Looy: Conceptualization, Methodology, Formal analysis, Supervision, Visualization, Writing - original draft, Writing - review & editing.

Appendix A. the profile of organizations and respondents in the quantitative study

Table A1–A7

Table A2
The distribution of our sample for organization sector, using NACE codes (N = 403).

Sector	Frequency	Sector	Frequency
A – Agriculture, forestry, fishing	4	K-Financial, insurance	33
B – Mining, quarrying	3	L-Real estate	6
C – Manufacturing of products	76	M-Professional, scientific, technical	32
D – Construction	14	N-Administrative/ support service	8
E – Electricity, gas, air conditioning	10	O-Public, defence, social security	10
F – Water, sewerage, waste	6	P-Education	16
G – Wholesale, retail, vehicle repair	33	Q-Human health, social work	23
H – Transportation, storage	23	R-Arts, entertainment, recreation	9
I – Accommodation, food service	6	S-Other services	6
J – ICT	62	Other	23

Table A3
The distribution of our sample for organization sector, recoded from the NACE codes (N = 403).

Sector	Frequency
Products	130
Services	176
Government and social profit	74
I do not know	23

Table A4
The distribution of our sample for the organization's sector market competitiveness (N = 403).

Degree of the organization's sector market competitiveness compared to an average organization	Frequency
Lower	65
About the same	74
Higher	261
I do not know	3

Table A5
The distribution of our sample for organization size (N = 403).

Number of employees	Frequency	Number of employees	Frequency
11–50	45	Small-sized (11–50)	45
51–250	66	Medium-sized (51–250)	66
251–500	49	Large-sized (>250)	292
501–1000	61		
1001–-5000	87		
5001–10,000	36		
> 10,000	59		

Table A6
The distribution of our sample for respondent's position (N = 403).

Years	Frequency
Middle manager (e.g., department head of IT, operations/production, purchasing/ procurement, quality)	118
Senior manager	194
C-level	91

Appendix B. the Welch's ANOVA F tests

Table B1–B5

Table A7
The distribution of our sample for respondent's seniority (N = 403).

Years	Total seniority	Seniority in current organization	BPM involvement in current organization
0–5	0	91	204
>5–10	65	144	133
>10–20	141	120	61
>20–30	118	38	5
>30	79	10	0

Table B1
The Welch's F test for DI-related variables among position subgroups (N = 403).

DI-related variables	F	df1	df2	Result
DI (DI importance)	0.618^{NS}	2	221.368	No difference
DI (BPM facilitator)	2.435*	2	214.181	At least one subgroup differs
IT investments (increasing budget)	0.775^{NS}	2	212.753	No difference
IT investments (relative budget)	4.817**	2	214.217	At least one subgroup differs
IT outsourcing (increasing budget)	0.330^{NS}	2	217.496	No difference
IT outsourcing (relative budget)	2.909*	2	207.979	At least one subgroup differs

(NS P>0.100; * P<0.100; ** P<0.050; *** P<0.001).

Table B2
The Welch's F test for DI-related variables among country subgroups (N = 403).

DI-related variables	F	df1	df2	Result
DI (DI importance)	12.274***	3	219.747	At least one subgroup differs
DI (BPM facilitator)	44.895***	3	213.432	At least one subgroup differs
IT investments (increasing budget)	16.960***	3	216.144	At least one subgroup differs
IT investments (relative budget)	27.523***	3	203.428	At least one subgroup differs
IT outsourcing (increasing budget)	43.157***	3	210.801	At least one subgroup differs
IT outsourcing (relative budget)	27.370***	3	200.423	At least one subgroup differs

(NS P>0.100; * P<0.100; ** P<0.050; *** P<0.001).

Table B3
The Welch's F test for DI-related variables among size subgroups (N = 403).

DI-related variables	F	df1	df2	Result
DI (DI importance)	9.363***	2	91.019	At least one subgroup differs
DI (BPM facilitator)	26.031***	2	89.708	At least one subgroup differs
IT investments (increasing budget)	14.363***	2	87.319	At least one subgroup differs
IT investments (relative budget)	22.912***	2	89.622	At least one subgroup differs
IT outsourcing (increasing budget)	17.233***	2	92.883	At least one subgroup differs
IT outsourcing (relative budget)	14.845***	2	88.573	At least one subgroup differs

(NS P>0.100; * P<0.100; ** P<0.050; *** P<0.001).

Table B4
The Welch's F test for DI-related variables among sector subgroups (N = 403).

DI-related variables	F	df1	df2	Result
DI (DI importance)	8.478***	2	189.989	At least one subgroup differs
DI (BPM facilitator)	1.477^{NS}	2	180.347	No difference
IT investments (increasing budget)	2.625*	2	198.729	At least one subgroup differs
IT investments (relative budget)	5.944**	2	174.537	At least one subgroup differs
IT outsourcing (increasing budget)	0.425^{NS}	2	193.697	No difference
IT outsourcing (relative budget)	2.282^{NS}	2	181.871	No difference

(NS P>0.100; * P<0.100; ** P<0.050; *** P<0.001).

Table B5
The Welch's F test for DI-related variables among market competitiveness subgroups (N = 403).

DI-related variables	F	df1	df2	Result
DI (DI importance)	5.162**	2	120.354	At least one subgroup differs
DI (BPM facilitator)	6.442**	2	117.831	At least one subgroup differs
IT investments (increasing budget)	3.809**	2	0.025	At least one subgroup differs
IT investments (relative budget)	7.214***	2	114.895	At least one subgroup differs
IT outsourcing (increasing budget)	2.273^{NS}	2	130.916	No difference
IT outsourcing (relative budget)	1.343^{NS}	2	115.572	No difference

(NS P>0.100; * P<0.100; ** P<0.050; *** P<0.001).

Appendix C. our refinements to the TOE framework

Table C1

Table C1
Describing and explaining our findings to extend the "Technology–Organization–Environment" (TOE) framework (DePietro et al., 1990).

Initial TOE categories		Context factors (§ 4)	Refinements from §5	Explanations and differences for new IT
External business environment		Country (Continent) (§4.2.2)	Imposed government regulation/legislation (§5.1–§5.4–§5.5)	More privacy concerns due to data-driven insights
		Sector (§4.2.4)	Sector-related trends (§5.1–§5.7)	High importance of a business model with more room for controlled risks and experiments with immature technologies
		Market competitiveness (§4.2.5)	Customer demands (§5.1–§5.3)	More customer differentiation/segmentation due to varied pressures to change More value cocreation
	Other	Size (§4.2.3)	Small vs larger/older organizations (§5.2–§5.4)	More Lean startups; Need for more flexibility and speed; More entrepreneurship
			Constraints in budget and resources (§5.7)	Higher risks involve higher investments on the short-term but also more long-term benefits
Organization	People	Position (§4.2.1)	Formal relationships (organogram) (§5.1–§5.3)	More strategic decisions based on a business model; Need for dedicated bodies that combine DI with BPM for a long-term vision
			Informal relationships (communication, top management support, human resources for recruitment and training) (§5.4–§5.7)	A growing generation gap regarding IT literacy due to more digitalized work; More value cocreation; More focus on customer experiences; More empowerment
	Process	–	Core vs noncore processes (§5.2–§5.4–§5.7)	More onshoring/nearshoring; More servitization and scaling up to a variety of alternative products and services
Technology	Systems	–	New IT vs integration with existing technologies and systems (§5.1–§5.3–§5.6–§5.7)	More leveraging with data (e.g., to predict); More agile working (e.g., to change the order of routines); More difficulties to keep up-to-date of fast changing technologies

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