

Context Change Archetypes: Understanding the Impact of Context Change on Business Processes

Karsten Ploesser, Christian Janiesch
SAP Research CEC Brisbane
SAP Australia Pty Ltd
South Brisbane, Australia
Email: {karsten.ploesser, c.janiesch}@sap.com

Jan Recker, Michael Rosemann
Business Process Management Group
Queensland University of Technology
Brisbane, Queensland
Email: {j.recker, m.rosemann}@qut.edu.au

Abstract

The emergence of Enterprise Resource Planning systems and Business Process Management have led to improvements in the design, implementation, and overall management of business processes. However, the typical focus of these initiatives has been on internal business operations, assuming a defined and stable context in which the processes are designed to operate. Yet, a lack of context-awareness for external change leads to processes and supporting information systems that are unable to react appropriately and timely enough to change. To increase the alignment of processes with environmental change, we propose a conceptual framework that facilitates the identification of context change. Based on a secondary data analysis of published case studies about process adaptation, we exemplify the framework and identify four general archetypes of context-awareness. The framework, in combination with the learning from the case analysis, provides a first understanding of what, where, how, and when processes are subjected to change.

Keywords

Business processes, context, context-awareness, case studies, change, adaptation

INTRODUCTION

Business Process Management (BPM) has received widespread interest in academia and the community of practice as a paradigm for the design, automation, and monitoring of an organisation's business processes. Originating in the Business Process Reengineering initiatives of the 1990's, BPM inspired the development of a wide variety of methodologies, techniques, and tools (cf. Kettinger et al. 1997). As an example, over the past decade, business process modelling has been steadily increasing in popularity (Davies et al. 2006). Organisations have committed large investments to identify, standardise, and document business processes with the intention to improve business performance and enable subsequent automation through process-aware information systems (Dumas et al. 2005) and workflow management systems (Jablonski and Bussler 1996).

While the practice of BPM is widely established to date, there is no generally accepted understanding of what a business process is. Melão and Pidd (2008) identify four emerging viewpoints definitions of business processes. Following this classification, typical approaches, such as Six Sigma and Total Quality Management, take a static approach to process design, operation, and change. These approaches tend to be inward looking, and focus on streamlining processes against internal objectives and constraints of the organisation. However, the scale of globalised operations in multinational organisations, and the emerging risks of a highly networked economy and tightly connected financial markets demand an increased consideration of *external* factors in the design of business processes. For instance, off-shoring and expansion into developing economies has increased the exposure to threats such as political change, natural hazards, terrorist attacks or trends in macroeconomic factors such as exchange rates and commodity prices, which defy control of the enterprise. Following Melão and Pidd, we adopt the view of a business process as a network of feedback loops in close interaction with its environment.

These challenges have prompted a re-thinking of how business processes and supporting IS should be designed and managed, from highly optimised and standardised business processes to agile and overall *context-aware* business processes (e.g., Rosemann et al. 2008). In industries characterized by a high degree of inter-organisational processes (e.g., transportation and logistics), organisations have begun to move away from classical process standardisation and continuous improvement efforts as a consequence of diminishing returns

and inherent instability of the supply chain (Fujimoto 2001). In academia, the study of challenges in designing external adaptive processes has emerged as a popular research field (Narasipuram et al. 2008; Recker et al. 2006, Günther, 2008 #59).

However, the academic discussion of context-awareness in business processes is still in its infancy (Rosemann et al. 2008). While a significant body of knowledge exists on the intrinsic measures of adaptation (Dreiling et al. 2008; Hallerbach et al. 2008; Rosemann and van der Aalst 2007), only little attention was given so far to the extrinsic reasons for adaptation (e.g., Ploesser et al. 2008). The latter includes questions about the identification of relevant types of context change (what external events necessitate process change?), and the consequences of such change (how to adapt the affected processes?).

The aim of this paper is to provide a better understanding of the different types of context change and the required types of process adaptations. The paper is structured accordingly. In Section 2 we elaborate on definitions of context-awareness in IS and related fields to establish the current state-of-the-art. In Section 3, we propose a conceptual framework for the investigation of context-driven process adaptation. We use the framework in Section 4 to conduct a secondary data analysis of published case studies about process adaptation to determine four different archetypes of context change. The paper closes with a summary and outlook.

BACKGROUND

Over recent years, the term context and context-awareness has emerged in a wide range of fields such as cognitive psychology, linguistics, IS, and computer science. Context as a concept has found application in artificial intelligence (e.g., Brézillon 1999) and conceptual modelling (e.g., Janiesch 2007). The ubiquitousness of computing devices and advances in computing power spurred the development of context-aware applications that bridge the physical world of information consumers and the virtual world of information processing. Context-awareness has emerged as a popular concept in pervasive computing research, with a predominant focus on the immediate environment of human actors (Schilit et al. 1994). Dey and Abowd (2001) provide a generic definition of *context* as “any information that can be used to characterize the situation of entities”. Chen and Kotz (2000) define *context-aware* systems as computer systems that provide relevant services and information to users in accordance to their context. A substantial amount of research has been conducted in the area of context modelling (Chen and Kotz 2000; Strang and Linnhoff-Popien 2004) and several propositions for the structuring and representation of contextual knowledge have emerged (Chen et al. 2003).

In the IS literature, context is often understood as the background in which design work is embedded. Leppänen (2006) and Becker et al. (2007c), for instance, introduce individual factors that have impact on the performance of methods in different environments. Commercial examples for the use of context in IS development include definitions of context for service marketplaces (Stettner and Janiesch 2009) and context models for managing the representation and use of business context information (UN/CEFACT 2008). In BPM, Rosemann et al. (2006) suggest four relevant types of context pertaining to the design of business processes ranging from process-specific factors to environmental factors. Over recent years, the scholarly discussion of context in BPM and IS development has shifted from considering mostly static factors that determine IS behaviour (such as country, industry, and brand) to dynamic factors (such as weather patterns, pricing, and competitor action) in the IS context (e.g. Hallerbach et al. 2008; Rosemann et al. 2008). This comes as a result of changes in the operating environment of the modern firm, which is increasingly complex and dynamic and subject to frequent change (Serman 2000). Consequently, awareness of this context and anticipation of change in the design and operation of IS has crucial importance.

In a case study reported by van der Aalst, Dumas and Rosemann (2007), the business processes and underlying IS of an insurance company need to adapt to changes in certain context factors, in this case weather patterns (severe storms, flooding, etc.). Without this capability, the company would not be able to process the dramatically increased volume of customer requests that follow a weather-related event. In turn, it would fail to meet service level agreements and would have to accept a deteriorating grade of service, which will ultimately have a significant impact on its customer retention rates. While the operator of a supporting IS mainly has to deal with combinatorial complexity, the consideration of external factors such of weather patterns typically exceeds the possibilities of systems configuration. Context-awareness demands the process manager to deal with the dynamic complexity during process enactment (*runtime*), which, to date, is poorly supported by classical process design or support methods and technology.

A FRAMEWORK FOR CONTEXT CHANGE IDENTIFICATION

Context change requires organisation to make sense of either uncertain or ambiguous situations. The cognitive processes required for attaining situational awareness and reaching a conclusion, i.e. shaping responses in such a situation, have been studied on an individual level (e.g., Endsley 1995; Sarter and Woods 1995) as well as

organisational level (e.g., Weick 1995; Weick et al. 1999). Generally, the literature distinguishes between attaining a state of “awareness” (an understanding of elements in the environment and their meaning) and the processes of decision-making and task performance, i.e. the state of “preparedness” (e.g., changing the process design, altering the IS support, increasing staff numbers, etc.). In the following, we will explore the relationship between these constructs and the business process life cycle.

Based on a review of related work in organisational science, IS, and computer science, we provide a set of questions for organisations to increase awareness of and preparedness for external context change. We operationalize *awareness* as: a) what is relevant context; b) where does context change impact processes; c) how does context change impact processes; and d) when does context change occur. These questions allow for the identification of measures for the awareness of the organisation with respect to contextual variables. We then operationalize *preparedness* as: e) by what means should the required adaptations be conducted; and d) which improvements to context-driven adaptation are possible. These questions allow for the identification of measures for the degree of preparedness of the case with respect to environmental change.

Figure 1 summarises these questions along a context-aware process life cycle model. This work follows the design science approach to research in seeking to provide practically relevant IT artefacts such as constructs, models, methods, and instantiations (Hevner et al. 2004). The life cycle model is a first draft of a novel methodology that can be used to identify context change, assess its impact, and prepare responses to that. We derive its stages and the resulting propositions, from prior research. Sterman (2000) outlines a 5-step model of the system dynamics modelling process: problem articulation and dynamic hypothesis (what); formulation of a simulation model (where); testing (how and when); policy design, evaluation, and learning (corresponding to the two final stages of how & which). On an individual level and group level, Endsley (1995) identifies three stages of awareness: perception (what); comprehension (where and how); projection (when). This is followed by the processes of decision-making and task performance (corresponding to the two final stages of how & which).

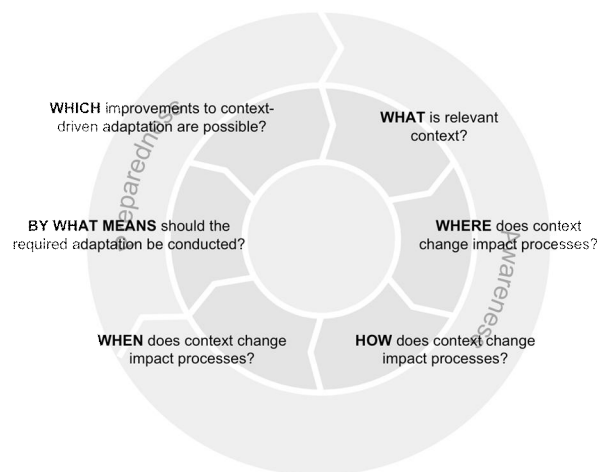


Figure 1: Context-aware Process Life Cycle

In the following, we discuss the stages of the life cycle in more detail to uncover related research challenges. For this purpose, we highlight theories that informed the design of this life cycle model and known techniques that can be deployed in the different stages of the model as well as their limitations. We argue that each question defines a research agenda and may stimulate further research and exploration.

1) What is Relevant Context?

Isolating the factors that appear to contribute to the observed symptom is an important first step towards managing dynamic complexity in the process context (Sterman 2000). Context classification schemata such as the one proposed by Rosemann et al. (2008) and causal loop diagrams (Sterman 2000) aid the process designer in creating an initial causal map. Techniques of environmental scanning and taxonomies such as PESTLE (political, economic, social, technological, legal, and environmental) can deliver important input to this stage (Aguilar 1967). While there are specialised description models for context information, there is no commonly accepted, universal context classification model available (Janiesch 2007).

2) Where Does Context Change Impact Processes?

Once sufficient information about the relevant context factors is available, the process designer can proceed to tracing the causal relationships between elements in the context and the elements of the process system. This

provides insight into what elements of the process are affected by contextual change. Contemporary process design techniques are ill-suited to achieve this task and workarounds have emerged in the modelling practice (Rosemann et al. 2008). Research in related fields such as dynamic systems modelling, total quality management, and enterprise risk management has given rise to a number of promising instruments. Examples include stock & flow diagrams (Sterman 2000) and cause & effect diagrams (Ishikawa 1990). However, current business process design methods lack support for, or integration of, such techniques.

3) How does Context Change Impact Processes?

Once an initial causal model of elements in the context and the elements of the process system is at hand, the process designer can proceed to a more detailed analysis of the impact of context change on the process system. Of particular interest during this stage is how context change affects the goals and objectives specified for the process (Soffer and Wand 2005). This requires a quantification of change impact, e.g., by expressing the causal relationship between context factors and elements of the process system in mathematical models. Ultimately, this can feed into the simulation of context change, for example, to predict process efficacy under certain contextual conditions.

4) When Does Context Change Occur and When Does It Impact Processes?

The final stage consists of forecasting when a context change is likely to occur and at which point in time it affects active processes. Econometrics and macroeconomic models can provide the algorithmic foundations of such analyses (Blanchard 2008). System dynamics modelling allows the simulation and sensitivity analysis of context models (Sterman 2000). Yet, analysing historical data can only be a first step. A predictive analytics of process performance and extrapolation of future trends has to follow (Davenport and Harris 2007). Research into sensory networks and complex event processing in the context of database management systems provides an increasingly accurate snapshot of information concerning the state of the real world. These solutions may provide advanced technological support that can be leveraged in process management to monitor and scan relevant context.

5) By What Means Should the Required Process Adaptation Be Conducted?

Once relevant contextual change is detected, business processes impacted by this context have to be adapted. This change may involve organizational measures as well as IT adaptation. Frameworks and measures for business process change have extensively been discussed in the management literature and BPM. Regarding relevant design activities to understand such change, the area of process modelling recommends the use of abstract patterns or building blocks of processes and their models so that required process design changes can be effected on a model of the process while maintaining required consistency levels (Günther et al. 2008).

6) Which Improvements to Context-driven Adaptation Are Possible?

Learning from past disruption offers the potential for continuous improvement and calibration of the process design. Weick (1969) observes that successful organisations are able to revise the selection of variables and repertoire of actions and retain what proved successful. Related literature suggests a closed-loop approach to learning from existing process design as well as learning from contextual process variations. Likewise, process mining has been proposed for the ex-post analysis of event logs of information systems to support process change in evolutionary systems (Ghattas et al. 2008).

Note that with regard to this paper, a further elaboration of questions 5) and 6) is out of scope.

ARCHETYPES OF CONTEXT CHANGE

Setup and Identification of Context Change in Real World Cases

In the previous section, we have introduced the stages of a context-aware process life cycle and have enumerated techniques for achieving context-awareness. In the following, we argue that an understanding of the archetypes of context change and required adaptation strategies is an important first step toward context-aware IS.

We conducted an exploratory study of published cases to elicit the current level of context-awareness within organisations. The cases were identified based on publication in the commercial press, and cover different sectors, industries, and country borders. The criteria for case selection were 1) the operational execution of the processes within the case organisation had to be impacted by a factor external to the organisation, 2) this external factor was not an singular situation of high uncertainty (e.g., terrorist attack), 3) the material found had to provide enough information to understand the interrelation of external factors (driver) and internal reactions (change), and 4) the case organisation had to be a Fortune 500 organisation in order to ensure a wide understanding of the environment and business. The sampling was restricted to high-profile outlets with

visibility on a national and international level (e.g. archives of The Australian, Wall Street Journal, and aggregators such as Factiva) and extended longitudinally to control selection bias (Denrell 2005). We coded the industry using the North American Industry Classification Scheme (NAICS)¹ and process type using the American Productivity and Quality Center Process Classification Framework (APQCF)². The collection of additional cases was suspended when a point of theoretical saturation was reached (i.e. learning about patterns was perceived to be marginal). For an overview of the cases considered, cf. Table 1.

Table 1: Context Cases

#	Case	Industry (NAICS)	Process classific. (APQCF)	Content
1	Adidas	Manufacturing	Develop production and materials strategies (10221)	Adidas moves production to address a surge in turnover and wage costs in China
2	AirAsia	Transportation & Warehousing	Develop and manage pricing (10151)	Airline maintains its pricing by compensating higher fuel prices through increased service sales
3	Coles	Retail Trade	Develop and manage promot. activities (10152)	Retailer responds to natural catastrophe by allowing shoppers to donate during check out
4	FedEx	Transportation & Warehousing	Plan, transport, and deliver outbound product (10360)	FedEx operates meteorological centre to swiftly reroute shipments
5	General Motors	Manufacturing	Schedule production (10303);	GM operate hurricane monitoring system to swiftly move production away from landfall area
6	Hewlett Packard	Manufacturing	Relocate employees and manage assignm. (10518)	HP integrates teleconferencing in travel management solution to reduce air travel
7	Hong Kong Int. Airport	Transportation & Warehousing	Record and manage EHS events (11191)	HKIA installs thermal imaging device to scan passengers in response to SARS outbreak
8	IKEA	Retail Trade	Operate warehousing (10340)	IKEA dynamically adapts warehousing in response to consumer demand
9	Intel	Manufacturing	Schedule production (10303)	Plant layout allows Intel to effortlessly swap production to another site should disaster strike
10	KfW Bank	Finance & Insurance	Process payments (10876)	Bank fails to stop scheduled swap transaction only hours after business partner files bankruptcy
11	NAB	Finance & Insurance	Process accounts payable (10756)	Processing error in nightly money transfers coincides with weekly payroll payments
12	Optus	Information	Ensure quality of service (10323)	Installation of faulty updates of software forces Optus to dispatch ad hoc teams
13	Qantas (1)	Transportation & Warehousing	Develop and manage pricing (10151)	Qantas is forced to respond to opening of the trans-Pacific route by lowering airfares.
14	Qantas (2)	Transportation & Warehousing	Develop and manage promot. activities (10152)	Increased consumer-awareness and regulations move Qantas to introduce carbon-offset scheme
15	Suncorp	Finance & Insurance	Manage customer service requests (10388)	Suncorp operates event-response system to handle weather-related insurance claims volume
16	Wal-Mart (1)	Retail Trade	Develop & implement HR plans (10416)	Wal-Mart responds to presidential campaign by briefing its store management on unionisation
17	Wal-Mart (2)	Retail Trade	Develop sourcing strategies (10277)	Wal-Mart considers seasonality by increasingly sourcing produce locally

Case Analysis

Considering all 17 observed cases, each case was coded with the dimensions of awareness and preparedness by the authors. We confirmed the coding with an additional 10 coders on a 1-to-3 Likert scale (with 1 being low and 3 being high). Using this codification approach as a basic framework, we scattered the reported cases in a two-dimensional matrix, according to the average scores for *awareness* and *preparedness* (see Figure 2). Our analysis led to a clustering of cases in 4 archetypes of context change. A first, bottom-left cluster of cases groups organisations facing rather rare situations such as the failure of IT or sudden bankruptcy of a transaction partner. Change in this cluster is typically of sudden nature (breakdown of IT system during peak load) and temporary. We refer to this archetype as *element of surprise*.

¹ North American Industry Classification Scheme (www.census.gov/naics)

² American Productivity and Quality Center Process Classification Framework (www.apqc.org/pcf)

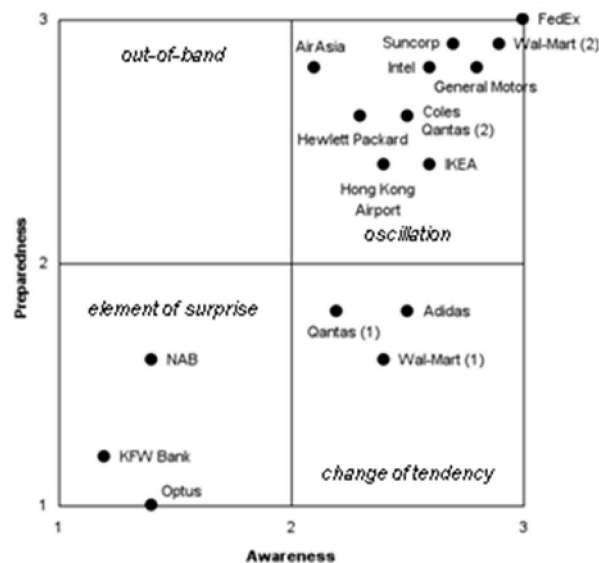


Figure 2: Classification of Published Cases

For example, KfW Bank lost €350 Million in a scheduled swap transaction to Lehman Brothers hours *after* the American investment bank announces bankruptcy. The sequence of events points to severe deficiencies in risk management and context-aware operations. Albeit the reviewed sources agree that the bank was aware of the crisis at the transaction partner (i.e., what), it was apparently unaware of where, how, and when its own operations were consequently impacted.

Similarly, National Australia Bank (NAB) experienced a major software disruption for a day so that salaries of Australian workers could not be transferred during the regular payroll run. While NAB was aware of the software/ data problem (what, where, when) and claimed that proper protocols were in place, they were unable to resolve or mitigate in time. During normal operations the error may have gone unnoticed, but due to the coincidence with the monthly payroll run (what), the error caused a loss of reputation and customer satisfaction even to customers of other banks (how).

The second, bottom-right cluster comprises cases exposed to events that induce lasting macroeconomic and microeconomic effects. Change in this cluster is long lasting or permanent (e.g. change of labour legislation), urging the organisation to reconsider its strategy. This archetype is named *change of tendency*.

For example, Adidas is impacted by a changing political agenda in China. After the abolishment of export rebates and the introduction of new environmental laws and minimal wages (what), Adidas faces an increase in manufacturing (where) cost (how), such as increased labour costs (when) because of these regulations. This changed economic climate forces Adidas to think about alternatives to current pricing or the location of their current plants.

Also, due to the deregulation of the trans-Pacific flight route from Australia to the U.S., Qantas experiences an increased competition (what). This is impacting Qantas capacity planning and pricing models for these routes (where). Without response Qantas can expect to lose price-conscious customers to its competition (how). Consequently, Qantas has to factor political change as well as competitor action into their strategy for trans-Pacific flight (when). Consequently, as of late customers have seen a significant drop in prices.

We did not find any cases that fit into the top-left corner of the matrix, which we refer to as *out-of-band*. This may partly be due to the fact that preparedness involves a certain level of awareness at the very least and partly due to the fact that the case may not have raised enough awareness to reach media outlets and become publicly known. A poster case for this archetype would be a situation where a contingency plan exists but is never executed due to lack of monitoring, i.e. context-awareness or active monitoring.

In the top-right quadrant a cluster of cases emerges, where contextual variables induce frequent and recurring change. In these cases, change cannot be characterised as a one-off or exceptional situation. Instead, organisations must be alert and prepared to promptly adapt to, or fence off, major disruptions. We refer to this archetype as *oscillation* and believe that introducing context-aware IS may provide the foundation for building the right variability into the respective business operations. This cluster can further be subdivided into cases where change occurs in cycles, i.e., periodic change, and those where change is to a large extent acyclic, or

aperiodic. Examples for periodic change encompass the customisation of products and considering seasonality in the sourcing of produce. Examples of cases dealing with aperiodic change comprise context change in weather patterns, pandemics, and conflict. The cases operate monitoring systems and have put change management processes in place to ensure awareness and preparedness in a changing environment.

As a logistics provider FedEx relies on timely delivery of their transported goods. Local disruptions such as tropical storms, strikes, and blackouts (what) can significantly delay or even halt their deliveries which results in violations of agreed service level agreements with their customers (how). Consequently, in scheduling and even while vehicles are in transit, FedEx actively monitors and (re-)schedules flights and trucks (where) since not all of the context changes can be anticipated beforehand. While seasonal storms can be dealt with in advance, sudden large-scale blackouts require immediate actions (when). This is a good example of a high level of awareness and preparedness for process adaptation to context change.

Wal-Mart changed the sourcing of vegetables to local farmers, after they observed an increased demand for local produce and rising cost for transportation (what, where). While this is a rather long-term adaptation to context change, it demonstrates the ability to implement a seasonal adaptation of sourcing (when) in order to cut costs and (potentially) fight off a decrease in sales if they do not comply with customer attitude (how). This example could also be classified in the second quadrant, but it demonstrates a strong awareness and innovative adaptation to context change.

The following table summarizes the cases of the above discussion and exemplifies in short answers the what, where, how and when of context change. When analysing the cases an immediate drawback was that there was no commonly accepted model to categorize and analyse context change (what). As suggested in Section 3, we used the PESTLE framework as one means to structure the analysis into political (P), economic (Ec), social (S), technological (T), legal (L), and environmental (En) context change. We found the factor of temporal context change missing and the framework too coarse for a detailed discussion. To classify the where, we used APQCF. Concerning the how, we found that not only the impact on the actual business process is of relevance but also indirect impact (e.g. customer satisfaction) has to be considered when defining the magnitude of the response. We found less difficulty in determining when context change occurred.

Table 2: Detailed Analysis of Selected Cases

#	Case	What?	Where?	How?	When?
1	Adidas	Change of export rebates and minimum wage in China (P, Ec)	Manufacturing execution and recruiting	Rise of manufacturing cost	Payroll (persistent)
4	FedEx	Local disruption (En, time)	Network planning and flight scheduling	Delay or stop transport/ SLA violation	During transport execution (acyclic, cyclic)
10	KFW Bank	Market downturn, bankruptcy of transaction partner, link to own operations (Ec)	Scheduled swap transactions	Money transferred to bankrupt transaction partner, money lost	Unknown (presumably scheduled nightly transaction) (acyclic)
11	NAB	Processing error on a high transaction volume day (T, time)	Payment management	No money transferred, loss of reputation and customer satisfaction	Nightly money transfers at payday (cyclic)
13	Qantas (1)	Deregulation and competitor action (P, Ec)	Network planning & flight scheduling, marketing, pricing	Empty seats, loss of passengers to competitor	Government action and opening of competitor route (acyclic)
17	Wal-Mart (2)	Rise of transport cost and lack of freshness of produce (customer attitudes) (Ec, S)	Demand forecasting, merchandise and assortment planning, transportation management, operational buying	Increase in costs and decrease in sale	Revenue (seasonal)

Organisations that face similar context changes as the cases in *element of surprise* need to consider exception handling techniques. We refer to this strategy as *incremental learning*, i.e. the organisation incrementally expands its repertoire of responses to exceptional situations. Ultimately, it should consider investigating the causes of change further, e.g. by means of a root cause analysis. In *change of tendency*, organisations facing long-lasting and predictable change can tap into the classic repertoire of process reengineering techniques. Accordingly, we refer to this as *strategy change*. Organisation urged to prepare for sudden, disruptive change in *out-of-band* that may be difficult to predict need to consider contingency planning techniques. Accordingly, we

refer to this strategy as *contingency planning*. If possible, they may consider reducing long-term operational risk by changing their strategic positioning. Finally, organisations in *oscillation* exposed to frequent, predictable, and disruptive change should consider *context-awareness* as a strategy in process design.

The analysis of the cases indicates that context-awareness and process adaptations can take multiple forms and requires different strategies, depending on a number of factors. Examples are the extent of preparedness for change, the awareness of change, and foremost the type of context change. We can derive the following distinctions from the discussion above:

Gradual change vs. sudden change: If we compare the cases of Adidas and the KfW Bank, we can see that context change in the first case was an observation of gradual economic change supported by political decisions. The second case exhibited a sudden change with the bankruptcy of a transaction partner, which should have had an impact on the KfW Bank's transactions.

One-off vs. frequent: Change can be either one-off such as political change (Adidas, Qantas) or the appearance or disappearance of competitors (Qantas, KfW Bank) or frequent such as weather and stock or oil prices (FedEx, HP, AirAsia). While the coverage of frequent changes is paramount, even the consideration of singular events can prove to be beneficial as singular cases may reappear in a similar form (e.g. in a different country). Organisations can learn from these initial cases and use this knowledge to enhance their IT.

Predictable vs. unpredictable: While gradual change is most likely predictable, sudden change must not be unpredictable but can be anticipated. Only in cases where the extent and point of time of context change can be (roughly) anticipated, a proper response strategy can be prepared, and ultimately executed. We consider all of the above cases to be predictable. It is questionable if there is an adequate response to unpredictable change. As we explicitly excluded these cases, we cannot give a definitive answer to this.

Long lasting vs. disruptive but brief: Context change can be permanent at least for a period of time (e.g., wage increases (Adidas) or deregulations (Adidas, Qantas)), context change can also be brief but nevertheless disruptive (e.g., terrorist attacks, thunderstorms, etc (FedEx)). The appropriateness of the response depends on the proper evaluation of the situation, i.e. e.g. to unify plant layout (Intel) or to (potentially) abandon affected plants (Adidas).

While these four distinctions are not exhaustive, they give an initial idea of the requirements and impact on context change. Consequently, they also have to be taken into consideration when adapting processes.

CONCLUSION & OUTLOOK

This paper explored the issue of context-awareness in the design and overall management of business processes. A review of the literature reveals that while context-awareness has received widespread attention in the development of pervasive computing applications, its impact in the IS discipline so far has been limited. As a first step towards an improved understanding of context-awareness in IS, we propose a conceptual framework for the investigation of context change and its impact on business processes. This framework is derived from prior research in system dynamics (Sterman 2000), and human factors (Endsley 1995). We applied the framework to a number of published case studies about process adaptation to evaluate the applicability of the framework and by eliciting the current level of context-awareness in these organisations.

The research has led to the identification of four archetypes of context change, each requiring different adaptation strategies on the level of an organisation's business processes. Based on the analysis of change requirements, we propose matching process adaptation strategies: incremental learning, strategy change, contingency planning, and context-awareness. While we have included industry and process classifications in Table 1, we have so far not considered them in the clustering and analysis of cases. As a next step, we plan to extend the work in this sense and provide guidelines for organisations in selecting the right adaptation strategy for the right process type.

We acknowledge certain limitations of our work, the most dominant of which is probably related to the generalisability of the cases considered, specifically in cases where selection bias (Denrell 2005) and reporting bias (Yin 2003) was difficult to control. The types of sources and outlets selected for the investigation arguably exhibit a bias to report on extreme cases, rather than the norm. A second shortcoming in some cases is information quality. The varying completeness and quality of the available data obviously poses a burden for the coding exercise. However, we do argue that the data provides sufficient evidence for emerging clusters, or revelatory cases, as was the intention of the investigation. We are currently validating the framework in a detailed case study where we have internal access to systems that are affected rather than analysing through third party information of commercial news. This approach will be replicated to other cases exhibiting different types of context change in the future to test the framework under alternating conditions.

Ongoing activities in the development of the framework include the definition of detailed procedural guidelines for its application and careful testing across a range of settings. Other issues include the exhaustiveness of existing classification schemata. For instance, we found temporal aspect of context change missing from the popular PESTLE classification scheme and the existing dimensions too coarse for a detailed discussion. Future activities may explore the inclusion of additional dimensions into these frameworks, the development of a common context meta-model and the combination with a layered modelling approach of context factors on different levels of abstraction (i.e. immediate, internal, external, environmental context).

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