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Abstract

In recent years, flexibility has emerged as an important guiding principle in the design of business processes. However, research on process flexibility has traditionally been solely focused on ways of how the demand for process flexibility can be satisfied by advanced process modelling techniques, i.e., issues intrinsic to the process. This paper proposes to extent existing research by studying the extrinsic drivers for process flexibility, i.e. an analysis of the root causes that drive the demand for flexible processes. These drivers can be found in the context of the process, which may include among others time, location, weather, legislation, culture or performance requirements. We argue for a stronger and more explicit consideration of these contextual factors in the design and modelling of business processes. Based on a real case study, we discuss how context can be conceptualized and integrated with existing approaches to business process design. These extensions are an essential foundation for the definition and implementation of agile processes and as such of high practical and theoretical value.

Keywords

Process modelling, process flexibility, context-awareness

INTRODUCTION

The notion of flexibility has emerged as a pivotal research topic in Business Process Management (BPM) over the last years (Balabko *et al.*, 2005). The need for flexibility stems from the observation that organisations often face continuous and unprecedented changes in their respective business environments (Quinn, 1992). Such disturbances and perturbations of business routines need to be reflected within the business processes, in the sense that processes need to be able to adapt to such change, *viz.*, they need to be flexible. In simple terms, business process flexibility is the capability to yield to externally triggered change by modifying only those aspects of a process that need to be changed and keeping other parts stable, *i.e.,* the ability to change the process without completely replacing it (Regev and Wegmann, 2005). Thus, process flexibility consists of an extrinsic trigger for change and change mechanisms for intrinsic process adaptation.

Yet, existing related research that deals with change management and evolution management typically addresses issues of change only *after* requirements have already been changed (Arnold and Bohner, 1996). The focus traditionally has been on requirements traceability and impact analysis of the change (Ramesh and Jarke, 2001). We propose with our approach to perform the impact analysis within the business process prior to and as a means for fully identifying the change in the environment. Thereby, the impact of a change and an associated process modification could be fully understood prior to migration to a living process.

As an example for environmental circumstances that drive process flexibility, consider the ”teleclaims” process of one of Australia’s largest insurance companies. The process is designed to handle inbound phone calls from customers who have a range of different insurance claims including household, car, etc. The process is supported by a call centre operating in Brisbane.

While this process runs smoothly for most of the year, the organisation faces a dramatically increased number of incoming phone calls during the Australian storm season (October-March). Storms cause a higher number of damages and increase the number of incoming weekly phone calls from 8,000 to more than 20,000. This change in the context not only puts significant burden on the call centre, but also on the succeeding back-office processes related to evaluating and managing these claims. In order to cope with this increased call traffic, the insurance company operates an event-based response system that differentiates calls into a number of categories of situations based on how severe the storms are. Based on the guidelines of the system, the first category includes localized storms and flooding and leads to a call volume of 10-50 % above average and an increased wait time of about 5-10 minutes for a period of at least two hours. The second category is triggered when strong wind, hail

and structural damage occurs. This leads initially to a wait time of 10-30 minutes and the call volume is 50-100 % above the forecast for at least two hours. The third category covers wide-spread damage leading to wait times of more than 30 minutes.

Individual response strategies have been defined for each of these categories, utilizing additional external resources together with changes in the procedure by which claims are lodged. First, additional resources are utilized through redeployment of employees from other departments (*e.g.*, sales) and hiring of casual staff. While most of these people are trained, their performance in terms of average call handling time is lower than the performance of the professional call centre agents. Second, a streamlined way of lodging the claims is applied in order to reduce the average call handling time and to reduce the waiting time in the queue. In this so-called "rapid lodgement process" only a reduced amount of information is collected from the claimant. This leads to an average call handling time of 380 seconds for experienced call centre agents and 450 seconds for additionally employed agents, down from the usual average of 550 seconds. One mechanism to deal with the different performance of these two types of agents is call routing which directs new and straight-forward cases to the casual additional workforce, while more complicated follow-up calls are directed to the experienced workforce.

Two managers in charge for claim services and the related back-office processes evaluate the severance of the weather conditions, *i.e.*, they monitor the relevant environmental setting of this business process, and trigger the different escalation categories leading to different variations of the process.

This example shows how a change in the environment requires flexible process adaptation. This change can be anticipated and is triggered when the relevant change occurs (*e.g.*, a change in weather). Current process modelling techniques, however, provide no support for modelling the relevant stimuli for change. A work-around that can often be observed in modelling practice is that relevant contextual variables become an explicit part of the control flow leading to a decision point such as "Check, if process occurs within storm season". Such an explicit consideration leads to unnecessary model extensions, mixes individual run-time with build-time decisions and tends to reduce the acceptance of the process models by end users who would not be exposed to this decision in the daily execution of the process. A second commonly employed workaround is to draft multiple process models for different scenarios and to highlight process deviations within these models (*e.g.*, by colour coding). The shortcoming of this approach is the high degree of redundancy between the models. Figure 1 shows an example of such a workaround as it was employed in the Australian insurance company we considered. As can be seen, process changes due to storm season are highlighted in blue.

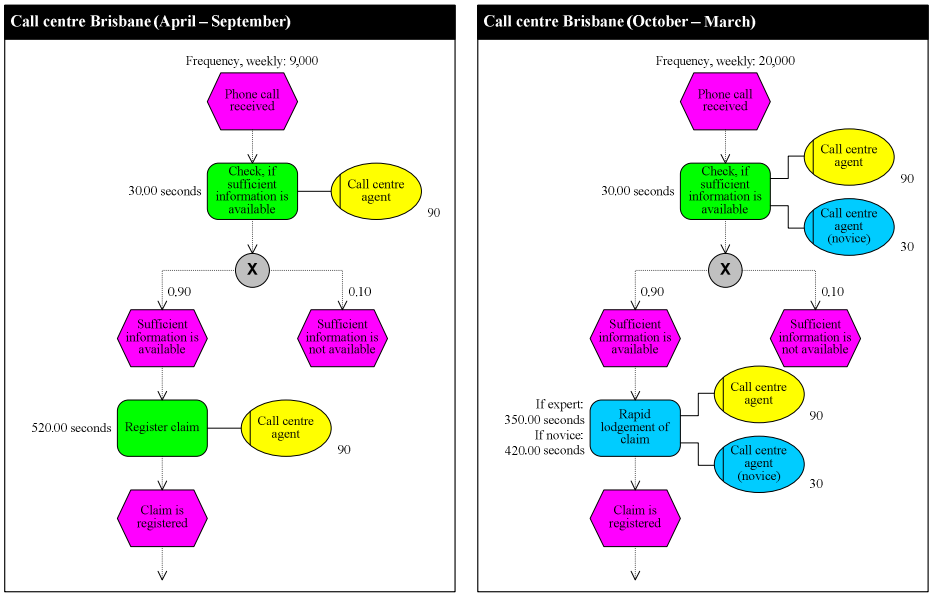

Figure 1: Traditional process models capturing process changes

We conclude that challenges exist to identify, document and analyse the requirements for flexibility, *viz.,* factors that drive change, *explicitly* within a process model rather than implicitly or outside of it. This will help to better understand the interrelationships between changes in the relevant environmental setting of an organisation and the imposed process changes. The increased awareness will provide higher levels of agility and the explicit study of the drivers for process change can lead to better change mitigation strategies.

The combination of all implicit and explicit circumstances that impact the situation of a process can be termed the *context* in which a business process is embedded (Schmidt, 2000). In other words, context is the relevant subset of the entire situation of a business process that requires a business process to adapt to potential changes in

the context variables. But what exactly constitutes the context of a business process? This question can be broken down into two research questions: 1) What contextual variables have impact on process design and/or execution (*e.g.*, location, but not legislation), and 2) How do different values for these variables actually impact process design and subsequent changes *(e.g.*, processes in France require an additional quality assurance, while the same processes in Italy can be completed without such a check)? This in turn leads to the question of how the context of a business process can be conceptualized. We subsume these and related questions under the notion of *context-aware business processes.*

The overall objective of our research is to take current process modelling research out of its narrow focus on capturing the immediate control flow and to put it into the wider scope of the organisational environment by studying cause-effect relationships. This has been motivated by repeated calls for a research agenda on process modelling that provides a holistic view on problems, issues and phenomena associated with process modelling (Dalal *et al.*, 2004). As with the case described above, this paper has further been motivated by the exploration of current process modelling projects in large Australian organisations in which we identified a number of unsolved modelling challenges, see also (Raduescu *et al.*, 2006). The explicit *aim of this paper*, which is part of a larger research project, is to provide a first taxonomy for context which can be used as a reference frame for the development of improved, theoretical sound and practically applicable process modelling techniques.

This paper is structured as follows. The next section provides a brief overview about the current status of related work on process flexibility and context-awareness. This overview leads to a set of new research challenges, *i.e.*, a new research agenda. The third section focuses on the integration of contextual information into business processes and introduces a new process-related taxonomy for context. A case study in the fourth section gives some insights into the application of this framework before the final section summarises our work up to today and discusses future research activities in this area.

BACKGROUND & RELATED WORK

Our research can broadly be subsumed under the two research streams of process flexibility and context awareness, both of which denote established research areas in disciplines related to Information Systems. Thus, we see potential and first evidence that our research can leverage and integrate existing approaches whilst facilitating a new and extended perspective to the field of Business Process Management. In the following we briefly recapitulate theories and approaches that we deem suitable as a starting point for our investigation.

Process Flexibility

A reasonable argument for the increased consideration of context in the area of Business Process Management is the relationship of an organisation to its changing environment. The continuously, and often in an unprecedented manner appearing turbulences of the situation (*e.g.*, changes of national policies, new taxes, terror attacks) in which business processes are embedded and enacted creates a demand for flexibility in the processes themselves in order to be able to cope with such dynamics. In essence, a business process connects different views upon an organisation (*e.g.*, data, human resources and IT) and can be considered as a procedure aimed at reaching certain goals (Hammer and Champy, 1993). A business process model is typically a graphical depiction of at least the activities, events/states, and control flow logic that constitute a business process (Curtis *et al.*, 1992). Additionally, many process models also include information regarding the involved data, organisational/IT resources and potentially other artefacts such as external stakeholders or performance metrics (Scheer, 2000). Overall goals that define the objectives of a process may also be included in a business process models (Soffer and Wand, 2005). Usually, hard-goals (*i.e.,* operational) and soft-goals (*i.e.*, strategic) are differentiated.

Recently, a number of research efforts have been undertaken to extend the traditional notion of business process modelling towards more agility. Several approaches have emerged for “adaptive” or “flexible” process designs that are able to cope with changes that may occur during the lifetime of a business process. Rosemann and van der Aalst (2007), for instance, developed a process modelling technique that supports adaptability by extending traditional techniques with variation points. Schmidt (2005) suggested an approach to support process flexibility through the use of Web services, and Narendra (2004) introduced a method to provide support and management for adaptive workflows.

This body of research has in common that it is concentrated on intrinsic ways of adopting or modifying business processes. However, the actual drivers for flexibility and their interrelationships with process changes have not yet been thoroughly discussed. As a consequence, current process modelling techniques at most capture the reactive part of process flexibility, but not the stimulus for change. We argue that it is exactly this stimulus for change that needs to be taken into consideration. The motivation for an increased consideration of context in a process model is that it provides a cause-effect relationship between the demands for process flexibility and their impact on processes. An explicit context awareness encourages monitoring of the relevant process context (*e.g.,* weather or

competitors' price changes). The early identification of context changes together with knowledge about what type of process changes are required leads to increased process flexibility and decreased reaction and change time.

Context Awareness and Understanding

The basic idea of context awareness is not new. In fact, we adopted it from related disciplines such as Web systems engineering (Kaltz *et al.*, 2005) and mobile applications research (Mikalsen and Kofod-Petersen, 2004). Even within the Information Systems discipline itself has contextualization emerged as a notion related to conceptual modelling (Analyti *et al.*, 2007) and can further be widely found in many research models that include moderating, contextual variables.

The term "context-aware" was coined by Schilit and Theimer (1994). A very generic definition of context is provided by Dey (2001) who defines context as "any information that can be used to characterize the situation of an entity".

Typically, approaches to incorporating contextual factors into information systems, such as approaches in the mobile applications area, focus around the user and their interaction with the systems (Dey, 2001; Schilit and Theimer, 1994). Context in this area of research is often reduced to the notion of locality (*e.g.*, what is the closest restaurant and how do I make a booking?) and user characteristics (*e.g.*, what type of food does the user of the mobile application like?). Existing frameworks such as the ECOIN framework (Firat *et al.*, 2005), and the a CAPella framework (Dey *et al.*, 2004) attempt to represent context as simple properties that can be interpreted based either on the inbuilt framework structures or based on very generic ontologies that have no structure prior to design time. By giving a limited amount of structure, and semantic guidance, at the initial stage of systems design, the system will keep its extensibility, but also gain a number of interpretive and functional abilities. However, attempting to introduce these interaction-focussed approaches to the area of process flexibility requires that the process is aware of its surroundings *irrespective* of user interactions. In order to facilitate this general awareness in a structured manner, categories and layers of context may be used, which requires a sound understanding of the context.

Regarding approaches for structuring, understanding and describing context, we found that in the area of context modelling and description a substantial amount of research has already been conducted, for example in the form of context architectures (Siljee *et al.*, 2005) or context ontologies (Chen *et al.*, 2003). For instance, the Context Ontology Language (Strang *et al.*, 2003) is designed to accommodate selected aspects of context such as temperature, scales, the relative strengths of aspects and further metadata. It is designed to relate measurements back to the semantics expressed in a system. In terms of limitations for the process flexibility discussion, it lacks linkages to causes, both in terms of guiding goals and environmental stimuli.

INTEGRATING CONTEXT INTO BUSINESS PROCESSES

The scope of a business process model, which incorporates external context factors into its design, must be large enough to include factors that may implicitly be recognised by the designer but may not necessarily be constant across the lifecycle of the process. For example, the national interest rate has impact on inventory management strategies, and varies, of course, over time. The scope of the process however, must still be confined to those factors which, due to their nature, would require extensive foundational changes to the process.

The scope of a business process model is closely linked to the process goals. These can be used to answer the questions "is a certain context variable relevant?" and "what potential values of context should be considered?" As can be seen, the question whether or not certain facets of the process context are relevant must be answered with respect to the set of goals imposed on the process. These goals, when applied to process modelling, determine relationships between process steps, in terms of their strategic, operational, or otherwise regulatory steps (Regev *et al.*, 2005). They are part of the reason why in the area of Business Process Management context must be thought of not just as single pieces of information, but rather as states and sets of states. By examining why a process exists and what the objectives and goals of the process are, the context factors that pose relevance to the process can be pre-determined and modelled at a formal level over and above the typical description levels of organisation, data, resource and IT (Jablonski and Bussler, 1996; Scheer, 2000), *i.e.*, the immediate context of a business process.

By integrating contextual aspects with goal-oriented business process modelling, the flexibility required to handle changing environmental circumstances can be modelled to provide for the determined set of objectives in relation to the desired goals. As an example of incorporating goals into processes with reference to contextual factors, consider the following banking industry example. A banks' overall goal is to provide banking services. In fulfilling this goal, the banks' major objective is to provide shareholders with maximum profit. Many contextual factors must be taken into account in achieving this goal. Arguably, a factor with great impact in this case is the savings/investment (supply and demand) curve. In a situation where more money is being saved in the bank compared to the money being lent out, the bank would have a short term objective to increase loans to profit

from its cash supplies. This short term objective is linked to both context, *i.e.*, timeframe or interest rate of the national bank, and the overall strategic goal, *i.e.*, maximizing profit. The chain of events needed to increase loans may be modelled formally by a business process model, which relates the current context (demand-supply relationship) to the identified objectives and proposes required process changes, if necessary.

In order to determine how current process modelling techniques support the capture of context, they can be differentiated by the degrees to which they are able to capture information that goes beyond the traditional description of control flow, *i.e.*, the sequence of activities and events/states including required transition conditions. We call these elements that extend the narrow focus on control flow information the *immediate context* of a business process. Usually, this immediate context of a business process comprises IT applications, responsible organisational units and required data (Jablonski and Bussler, 1996). Table 1 provides an overview about the components of the immediate context that are supported in selected process modelling techniques. In this table, a "+" indicates a direct support for a context element, a "+/–" indicates a partial support and a "–" indicates a lack of support.

Technique	Control flow	Data	Application	Organisation	Further context
EPC	+	+	+	+	+/-
BPMN	+	+/-	-	+	-
Petri Nets	+	-	-	-	-
IDEF3	+	+/-	-	-	+/-
YAWL	+	+	+/-	+	+/-
UML AD	+	+	-	+/-	-

Table 1: Popular process modelling techniques and supported perspectives

From Table 1 we conclude that different techniques focus on different aspects of business processes and hence only suit selected perspectives and objectives. In particular we observe a missing consideration of contextual aspects that transcend the traditional close proximity to regular control flow. Extended EPCs, for instance, support the explicit representation of process-related risks in business process models (Rosemann and zur Muehlen, 2005). Across all process modelling techniques, however, we observe a lack of context consideration in a structured way. We concur with Green and Rosemann (2000) that there is a need for a richer, integrated view to support the development and maintenance of rich process models that provide an enhanced ability to conceptualize, communicate and understand business processes *and* their context of operation. In order to provide a better structure for research on context-aware process models, we propose a stratified layer framework that extends the scope of process modelling beyond the immediate context by incorporating and differentiating four types of context, *i.e.*, immediate, internal, external and environmental context into concentric layers.

A Framework for Context-Awareness in Business Processes

Figure 2 gives a reference frame that can be used to identify, document, understand and integrate relevant context with business process models. We differentiate four types of context based on their proximity to the 'core' business process. In the following we introduce and discuss these different types, starting with the immediate context that, as noted above, is closest to the core of business process models, *viz.*, capturing the flow of activities.

Immediate Context:

The immediate context of a business process includes those elements, which go beyond the constructs that constitute the control flow, and covers elements that tend to be already well-considered in business process modelling techniques (see Table 1). These elements are typically essential to the understanding and execution of a business process (*e.g.*, what data do I require? Where do I get the data from? Who is in charge for the next activity?). Following existing classifications (Jablonski and Bussler, 1996; Scheer, 2000), the immediate context includes (input, output) data, organisational constructs (*e.g.*, organisational unit, group, position, person) and IT and related resources (*e.g.*, application system, server, database, logistical resources).

Internal Context:

The internal context has a less immediate relationship with the business process and covers information on the internal environment of an organisation that impacts the process. This includes, for example, the corporate strategy and related process objectives. A change from a quality-focused strategy to a cost-cutting strategy, for instance, will have an impact on a broad range of business processes (*e.g.,* elimination of quality control activities, scaling down of special resources). Policies are another important internal context variable as they are the main constraining factor on business process design activities. An explicit understanding of the effect of a policy on a process provides not only guiding information for a process improvement discussion, but equally can be an important information for an intended change of a (counter-productive) policy. Further examples for

internal context variables are the main stakeholders in an organisation and their risk perceptions, communication and logistical infrastructures (*e.g.*, regional distribution of factories) and financial and other resources (legal experts, R&D). The latter one can form an important enabling or constraining factor in the capability to change.

External Context:

The external context captures elements that are beyond the control sphere of an organisation but still reside within the business network in which it operates. Although this context is not in immediate proximity to the day-to-day business operations of the organisation, it still poses relatively high impact on the way the organisation designs and executes its business processes. External context variables can be identified from frameworks such as the Five Forces model (Porter, 1979) and may include external stakeholders (*e.g.,* suppliers, customers, financial and logistical service providers) and their strategies, demands, resources and occurring failures. Furthermore, it includes factors specific to the industry (*e.g.*, overall demand for the services of an industry, technological innovations) and regulations such as industry-specific practices (*e.g.*, supply chain management practices). In general, external context will often demand compliance of internal business processes and as such provide a set of constraints that have to be considered and continuously observed in order to achieve conformance objectives in addition, or substitution, to performance objectives (Parkinson and Baker, 2005).

Environmental context

The environmental context, as the outermost layer, resides beyond the business network in which the organisation is embedded but nevertheless poses a contingency effect on the business processes. It includes factors such as weather (*e.g.*, increasing call volume during storm season), time (*e.g.*, different business operating models on Sundays or before Christmas) and workforce related factors (*e.g.*, overall worker shortage or strike). A well-known example is the US Homeland Security Advisory System with its alert levels green (low), blue (guarded), yellow (elevated), orange (high), and red (extreme). Each of these levels is clearly associated with a comprehensive set of process changes within the relevant departments and armed forces. While some of such environmental variables may change regularly and can have a very strong impact on a business process (consider the teleclaims example and the impact of weather conditions), many of these variables and especially their current values can have a very long life span (*e.g.*, availability of natural resources in a country, currency, political system, preferred business language). Other factors can be attributed to the macro-economical setting in which an organisation operates. Examples include legislative regulations such as national policies (*e.g.*, workplace regulations) and other requirements (*e.g.*, Sarbanes Oxley, Basel 2).

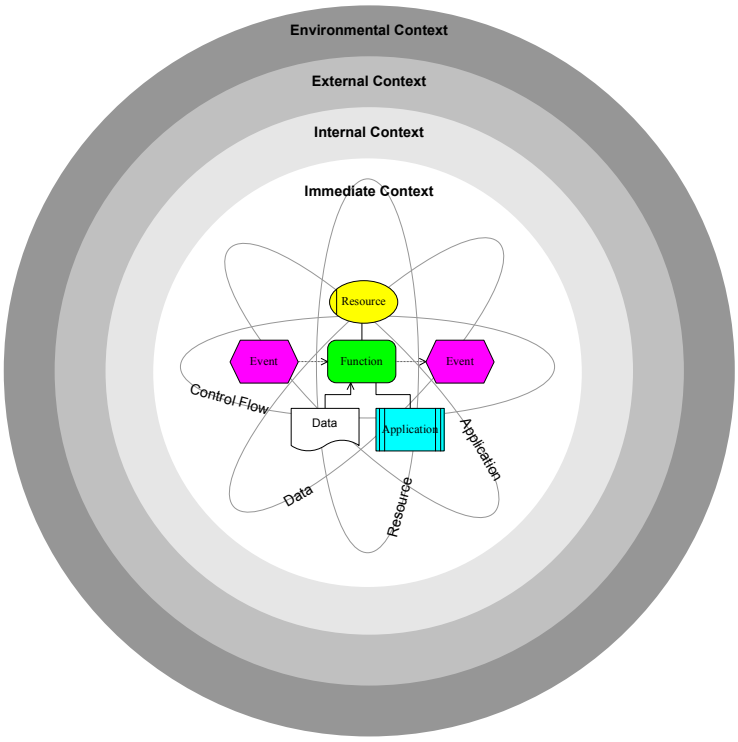

Figure 2: Context-Awareness framework

Between the layers and the context elements within them, many relationships may occur. Contextual impacts from an 'outward' layer may be mediated or mitigated by more 'inward' context elements (*e.g.*, an internal policy is designed as a reaction to a new national policy). Context elements may also influence other context elements

on the same layer (*e.g.*, an internal work policy requires the four-eye principle that requires a second organisational resource to respond to a process).

With the help of this reference frame we can more fully understand different types of context and their impact, proximity and relevance to a given process. In the following we give a first indication of the applicability of the reference frame by applying it to a case study of an Australian airline company.

CASE STUDY

In our study of current process modelling projects in large Australian organisations (Raduescu *et al.*, 2006) we have explored the ticket reservation and check-in process of a major Australian airline. This process, while seemingly stable, is exposed to a large number of contextual impacts and is thus regularly required to change "on-the-fly".

Usually, the process is triggered when a customer selects their destination, along with departure and return dates and times. An online form can be used to draft an itinerary based on certain preferences such as departure times, type of plane, overall costs, etc. After confirmation and electronic payment an eTicket is issued, which is an electronic version of a traditional paper ticket. It allows travellers to check-in at the airport using photo identification and, were applicable, to check-in and select available seats over the Internet from home or at dedicated "quick check-in" terminals at the airport. Normally, also traditional counters are available for check-in. Independent from the check-in option selected, at some stage a traveller is required to undergo safety checks, *i.e.*, passport controls for international flights and baggage checks before boarding the aircraft. Figure 3 gives the corresponding process model. In this model, parts of the process that are subject to change due to variations in the context are highlighted grey.

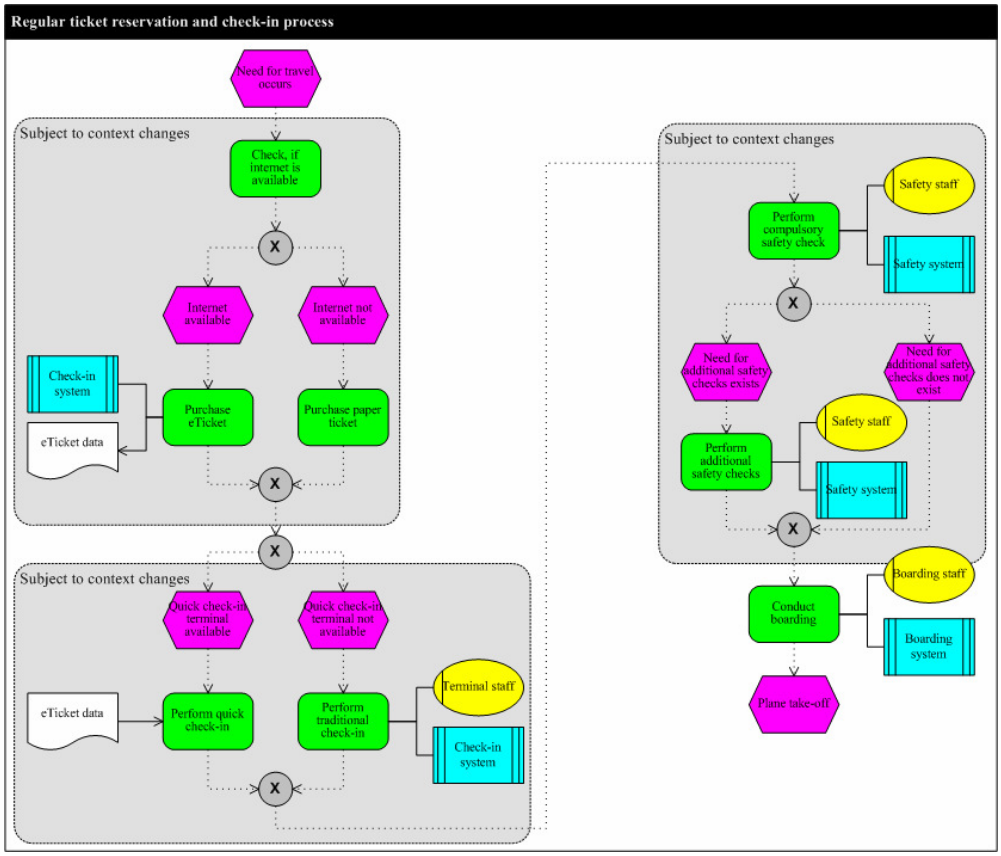

Figure 3: Airline process model with context consideration

This process typically runs smoothly in regular business environments. However, certain environmental situations may occur that require the process to change. For instance, staffing levels for traditional check-in counters are estimated based on an average 'eTicket to paper Ticket' ratio, availability of quick check-in terminals. Weather conditions, server breakdown, holiday season, system failures and other circumstances may lead to more traditional check-ins than expected and/or catered for. Consequently, several mitigation strategies need to be executed in order to avoid having customers miss deadlines due to large check-in waiting queues. First, more check-in counters need to be staffed. Second, business and first class check-in counters are used to

also process economic passenger check-ins. Third, the lodgement time of check-ins has to be reduced. Usually, this is achieved by disallowing seating modifications or special seating requests.

Another example of a contextual 'impact' on this process relates to increased safety considerations. An alert system, similar to that used by the US Department of Homeland Security, is installed to distinguish three levels of awareness. Several scenarios (*e.g.*, certain VIPs arrive or depart, major public events, terrorism, etc.) lead to different safety levels that in turn require safety procedures to change. For instance, tests for explosive goods that are usually conducted on a random basis become mandatory, or a second hand luggage safety check immediately prior to boarding is performed. Furthermore, some flights require additional identification procedures (*e.g.*, biometric data verification for flights to/from the United States). One impact of these procedures is that for each case different staffing levels are required.

Forthcoming from this case description is the question of how the adaptation of the process to changing contexts can be supported and the relevant details explicitly captured and used. The related challenge is to identify different types of contextual influences and determine their consequences to each part of the traditional business process. This in turn would allow for comprehensive monitoring of the context, which would enable the early anticipation and execution of required process changes. By examining the chain of events that necessitates changes in the process, reactions can be anticipated based on observations in the early stages of the chain, i.e., at best in the environmental context. As an example, a change in weather conditions (e.g., storm, tsunami, tornado) may lead to a significant number of travellers urging to re-route their flights on the departure date. The related process changes can be anticipated simply by regularly observing the weather forecast, which in turn enables, for instances, a pre-determination of required staffing levels. The same principle holds for later stages of the chain, even if the timeframe for process adaptation may be shorter. As an example, waiting queue dynamics (internal context) can be observed at the terminals in order to establish a potential need for further staffed terminals or for opening business and first class counters to economy class travellers.

Based on the reference frame described above we can identify and capture relevant context, in particular changes within and inter-relationships between context, and their impact on the business process. Studying the goals of a process contributes to determining relevant context layers outside of an organisation (*i.e.*, external and environmental). With the knowledge of goals, objectives as well as the semantics of the different context layers (*viz.*, the scope of the business process), types of context with a direct impact on the business process *outside* of an organisation can be identified by asking questions of relevance to given objectives and goals (*e.g.*, are weather conditions relevant to achieving the process objective?). In order to establish relevant context *inside* of an organisation (*i.e.*, on an internal and immediate layer), the direct effects of the context on the immediate layers are determined. The effects that external and environmental context has upon internal context (*e.g.*, the establishment of new national legislative requirements leading to the modification of organisational policies). Referring to our case of the Australian airline company, Table 2 gives some examples of context variables that pose an effect, immediately or mediated, on the ticket reservation and check-in process. In this table various instances of context are given and described in plain English. Also, the ultimate consequences to the immediate core of a process and related perspectives are enumerated.

Immediate Context				Internal Context	External Context	Environmental Context
Control flow	**Data**	**Organization**	**IT**			
	Flight re-routing information	Increased terminal staffing levels				Storm
Additional security checks, repeated execution of safety checks	Increased customer data requirements	Increased security staffing levels	Biometric identification system	Establishment of airline safety policies	Passing of industry safety regulations	Passing of Patriot Act
Focus on eTicket processes, increased customer self-service	Electronic customer and flight data	Increased terminal staffing levels	Web-based reservation and check-in system		Market price changes	
Manual check-in, seat reservation and safety check processes	Paper-based customer, flight and seating information	Increased terminal and safety staffing levels	Web-based reservation and check-in system not available	System failure		

Table 2: Examples of context relevant to the ticket reservation and check-in process

CONCLUSIONS

This paper was motivated by observations of current challenges in process modelling projects in large Australian organisations. While popular process modelling techniques have substantially matured and are now able to eloquently handle the core constructs of a process and its immediate context in the form of data, applications and resources, a wider consideration of contextual information is still not supported. This leads to the sub-optimal design of multiple business processes for different contexts (*e.g.*, different times of the year or locations) with a high level of redundancy, significance maintenance efforts, low scalability in the case of multiple contextual variables, and a poor understanding of the context-process relationship. In order to progress this area of applied research, we investigated the current body of knowledge and proposed a framework that helps to gain a better understanding of different types of context and their impact on business processes. We provided evidence for the applicability of the framework in a case study of an Australian airline.

A noted limitation of the research described in this paper stems from the fact that in terms of research, the area of process flexibility is still in the explorative stages. The conceptual and graphical integration of our context reference frame with existing process modelling techniques is currently underway. Furthermore, our findings remain to be comprehensively tested with respect to the impact that explicit context consideration in process models has on further dependant variables of interest, such as the perceived understandability of the model, the agility of the described process to react to externally triggered changes, etc. However, our case study demonstrates first evidence of the usefulness of our context reference frame.

Future research will derive extensions of selected popular process modelling techniques (*e.g.*, EPC, BPMN) in order to explicitly integrate the identified different types of context into business process models. Such enhanced models have the potential to provide the conceptual foundation for truly agile processes, in which, for example, Web services could play an important role in monitoring relevant contextual variables (*e.g.*, weather) and triggering required process changes. Our work provides a theoretical reference frame upon which different relevant types of context can be captured and monitored so that a stronger, potentially automated, link can be established between the stimuli for change and the reaction to the change within a business process model.

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