The Next Stage of Operational Business Intelligence: Creating New Challenges for Business Process Management

Olivera Marjanovic
School of Business, University of Sydney, Australia
o.marjanovic@econ.usyd.edu.au

Abstract

Current practices in the area of Business Intelligence (BI) and Business Performance Management (BPerM) confirm the need for better integration of BI and Business Processes (BPs). This is especially the case with operational BI that aims to unify strategic and tactical decision making, by integrating BI solutions with organisation's constantly evolving BPs. However, operational BI has a very limited view of BP and Business Process Management (BProM) systems. In essence, it focuses on a limited number of core, transactional BPs that are, by definition, highly structured and repetitive.

This paper argues that in order to support customer-facing employees in service-oriented industries, it is necessary to consider knowledge intensive BPs and their possible integration with operational BI. This paper offers a critical analysis of case-handling BPs in the context of operational BI. It then identifies a number of research challenges related to a new type of case-handling BProM system.

1. Introduction

These days, companies operate in a very complex, dynamic environment that requires agility and proactive decision-making. To learn from the past and forecast the future, many companies are adopting Business Intelligence (BI) tools and systems. The initial implementations of BI were *data-centric* where the main emphasis was on reporting and advanced analytics. In fact, data-centric applications are still the most widely used type of BI applications. At the same time, the latest research and practice in this area confirm the need for *process-centric* applications that require better integration of BI solutions with intra- and inter- organisational Business Processes (BPs).

There are many reasons why BPs need to be taken into account when implementing any BI solution. First of all, operational BPs generate transactional, process-related data that need to be integrated with other types of company's data, to enable enterprise-wide analysis. Furthermore, models of these BPs, as well as their running instances, provide the context that can be used to improve the quality of process-related data analysis.

Furthermore, companies currently undertaking various Business Performance Management (BPerM) initiatives, have come to the conclusion that the best way to link their strategic and operational levels is via BPs. In fact, correct mapping between strategic and business process KPIs (Key Performance Indicators) will ensure that BPs are used to implement organisational strategies [1]. At the same time, this mapping enables organisations to detect possible process-related problems at the operational level and then address them, within the most appropriate BPs.

Finally, in order to determine business value of BI solutions, it is necessary to determine their impact on business processes. Thus, "business value of BI lays in its use within management processes that impact operational processes (which in turn, drive revenue or reduce costs), as well as its use within those operational processes themselves" [2].

In very recent times, the need to better integrate BI and Business Process Management (BProM) became even more evident in the case of *operational* BI. "Operational BI builds on existing technology standards to make business intelligence more flexible, transparent and cost-effective by tightly integrating BI with organisation's constantly evolving business processes" [3]. Consequently, operational BI requires organisations to become more *process-aware*. This also means that organisations require better integration of their existing BI and BProM systems.

However, this paper argues that, currently, operational BI has a very limited view of BPs and BProM systems. So far, it deals with a very limited number of organisation's core transactional business processes at the operational level. By definition, these processes are highly structured and repetitive and could be, to a large extent, predefined and modeled.

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This approach appears to be best suited for some types of organisations (e.g. manufacturing companies) with highly standardised operational processes. On the other hand, in service-oriented industries, at least their main (if not all) front-end business processes need to be customer-driven and even personalised to suit the needs and requirements of different customers.

In a typical scenario, a customer-facing employee will use BI tools to determine customer's current business value (or profile). Then, they will apply their knowledge and expertise to offer the best possible option to this customer, while taking into account organisational rules and policies. This paper focuses on customer services that are implemented via more or less complex business processes (e.g. provision of a home loan service), rather than simple information services.

To distinguish these processes from typical operational BPs, this paper uses the term *case-handling* BPs. Current practice shows that these processes are very important for service-oriented industries, as they can be directly linked to a sustainable competitive advantage [4].

In most cases, the customer will "fit" into one of the standard cases. Consequently, their service will be implemented via a "standard" business process, designed by the company, for the particular customer profile. In terms of possible BP support, these standard processes can be effectively supported by the existing BProM solutions (such as workflow technology).

However, in some cases, the employee may decide to offer a very different, highly personalised version of a BP to their highly valued customer. It is important to note that this new BP is not just a simple modification of one of the existing types of BPs. It is a brand new process, designed by the employee rather than a process analyst. As such, this process reflects employee' knowledge and experience as well as creativity and problem solving skills.

Obviously, in this case, the employee needs support not only to design a personalised BP, but also to implement it, efficiently and effectively. However, this is the point where the existing BProM solutions reach their limit, as they do not support end-user composition and execution of BPs. In fact, currently available BProM solutions (such as workflows and Enterprise Resource Planning (ERP) systems) are best suited for highly structured, repetitive, high-volume, transactional BP at the operational level. Obviously, case-handling BPs require different type of BProM support.

The main objective of this paper is to critically analyse the new type of BProM support and describe its possible integration with operational BI. From the research perspective, the main contribution of this paper is in identification of the new research and development challenges, related to case-handling BProM support in the context of operational BI. From the practitioner perspective, this paper describes how to expand operational BI beyond transactional operational BPs towards knowledge-intensive BPs, to help employees to implement personalised customer services in a more efficient and effective way.

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2. Related work: Operational BI and BP integration

According to the current literature, BI and BPs are typically integrated in two different ways. The first one is to implement BI solutions on the top of a BProM system. Alternatively, a BProM system could be used as a source of process-related data for a BI solution. The main objective of this section is to illustrate these two approaches and motivate the need for a new type of integration, as proposed in this paper.

The first type of integration enables process analysts and operational managers to get a better insight into operational processes, so they can identify process inefficiencies, as well as possibilities for improvement. This applies to individual processes as well as to a set of related processes. For example, in the case of an exception (a delay in the procurement process), an application of a BI service on the top of a BProM system, will enable the procurement manager to analyse possible effects of the delay on different operational BPs, so they can manage this exception.

This particular approach has been strongly promoted by researchers and practitioners in the BProM community, as they seek to extend monitoring and analytical capabilities of various existing BProM systems. For example, the Business Process Intelligence (BPI) tool suite, proposed by [5], describes a set of integrated tools that provide several features such as analysis, prediction, monitoring and optimisation of business processes. Another notable example includes the so-called BPI techniques suite that includes a set of process mining techniques, used to discover a model of a composite web service (i.e. a business process) and its transactional behaviour from process logs [6].

Although these two examples of BPI illustrate very sophisticated analysis of business processes, this analysis is more technical than business oriented. On the other hand, in order to improve the business value of BProM technology it is necessary to bridge the gap between business and technology levels and start looking at BProM from the business perspective [4].

Another serious limitation of the existing BProM solutions, also related to BI and BP integration, is that they do not support analysis across different BPs supported by different BProM systems. However, this type of analysis is very important, because processes do not exist in isolation and a possible change within one process is likely to affect other related BPs.

The second approach to BI and BP integration is achieved by using BProM systems as a source of process-related data for BI systems. In recent times, this particular approach has been adopted and promoted by operational BI. This is because, operational BI recognises the need to synchronise the efforts of decision makers at strategic, tactical and operational levels, to reach a common set of business goals. More precisely, "at the strategic level, executives define strategies and goals. At the tactical level, management in the business units sets direction for their organisations, so that at the operational level individuals can take the right actions" [7]. Thus, operational BI also focuses on improving business processes by capturing and analysing operational data for the purpose of taking immediate actions to improve business processes [8].

However, organisations are yet to realise the full potential of operational BI. "For many companies achieving operational BI simply means viewing operational data from their primary ERP system, namely SAP" [8]. This approach offers a very limited view of a small set of operational processes supported by a particular BProM system.

Furthermore, organisational implementation of BPerM requires very good understanding of business processes as well as their relationships in order to find out the relevant indicators and rules, and then determine where the data to compute them can be found [9]. In fact, [10] argues that the promise of performance management is not about software (in this case BI software), but rather about managing a set of business processes to achieve a desired result.

To support BPerM initiatives at the technical level, companies typically use an enterprise data warehouse combined with a reactive component. This component is commonly implemented through Business Activity Monitoring (BAM) tools [11] designed to provide monitoring of time-critical operational processes and generate alerts. However, it is important to point out that current BAM solutions do not offer adequate process support (as for example BProM technologies). So far, they focus on individual critical operations, rather than complete BPs.

Furthermore, several BI vendors claim to offer integration of their BI tools with BPs so these processes can be optimised. In fact, several leading vendors have added workflow support to their tools to enable event and notification-based support. However, "they focus merely on adding process metrics to their product architecture for traditional reporting and analysis" [5]. Another serious limitation is, that they focus exclusively on core, transactional business processes at the operational level.

While acknowledging that it is very important to include operational business processes, this paper argues that the alignment between BI and BProM should go beyond operational BPs. This is especially the case with service industry and customer-facing employees who need support to create customer-centered business processes. These business processes are knowledge-intensive, and compared to operational business processes, can be used to create a sustainable competitive advantage [4]. The following section will use several motivating examples to better illustrate the need for this new type of integration.

3. Motivating examples

Research presented in this paper has been motivated by the real need to support customer-facing employees to create and implement personalised services via customer-centered BPs. There are numerous examples, coming from different service industries that can be used to illustrate this need. For example, a home-loan officer decides to design a highly personalised home-loan package for their VIP customer. A lifestyle advisor, working in a Wellness center, decides to create a highly personalised version of a lifestyle program for a customer that appears to have very different needs from all their existing customer groups. A librarian – a "human face" of the business process called "Ask your librarian" - receives a quite unique request for a very rare book from their VIP customer, who is also a very influential member of their library advisory committee. To help this customer, the librarian will need to create new tasks and include people from external organisations (e.g. from the Australian National Archive). An insurance officer, processing motor accident insurance claims, finds out from their new customer, that they are also looking to purchase a new house in the near future. The employee concludes that this customer is very likely to look for a new home & content insurance package, sometimes in the future. So the employee decides to impress this customer by offering "super efficient" processing of her insurance claim. They also want to make sure, that their newly created process includes a follow up call from a

colleague, in charge of home& content insurance services.

It is important to observe that, although these examples come from different domains, they seam to follow the same pattern that could be described as follows. A customer-facing employee uses a BI tool to create "a 360 degree" view of their customer to determine their profile as well as their current business value. Although this is not a trivial task, there is nothing new here and currently available operational BI tools already provide this functionality. Then, in the next step, the employee uses his/her knowledge and expertise to decide what is best for the particular customer. In many cases, their customer will fit one of the existing customers' categories. So to implement this service, the employee just need to initiate a "standard" version of a BP process, developed by the company, for this particular customer category. Then to execute and monitor customer's BP instance, they can simply use an existing workflow management system. Again, there is noting new here, as the existing BProM provide the required level of support.

However, in some cases, the employee may decide to design a personalised service that is different from their "standard" services. From the BP perspective, it is important to observe that these personalised cases are not just simple modifications of the existing processes and should not be managed as BP exceptions. These new processes may include new tasks, different resources as well as a very different coordination mechanism. In some cases, models of these BPs will evolve while the employee is looking for possible solutions. But most importantly, these processes need to be designed by the employee (rather than process analyst) within the constraints of organisation's rules and policies.

At this point, the employee needs the most appropriate BProM support to implement this new BP, rather than manually coordinate different people and their tasks, that in some instances could be a very challenging task on its own. However, this is the point where currently available BProM solutions reach their limit. They don't provide effective support for an end-user (in this case the employee) to design and implement their own processes for another category of end-users (in this case the customer). Furthermore, any such BProM solution needs to be tightly integrated with operational BI. This is because execution of any personalised BP for the given customer will create new intelligence that, in turn, needs to be taken into account when updating customer's profile. Also, to design a personalised BP, the employee needs to use BI support to select the best resources and tools, analyse possible effects on the related operational BP (e.g. processing of monthly home-loan repayments) as well as learn about any existing "similar" cases.

From the business perspective, personalized BPs create new opportunities for competitive differentiation. For example, [17] argues that the core competencies of an organization are derived from *episodic* knowledge (contextually situated decisions and their outcomes) rather than semantic knowledge that is widely available in an organisation. Obviously the main source of competitive advantage is the expertise of professionals involved in design and implementation of personalised solutions. Ideally this expertise needs to be somehow captured and later harvested to facilitate organisational learning.

At the same time, this scenario opens up new challenge for BProM technology, in order to support case-handling BPs processes. The following section will demonstrate why the existing BPM solutions cannot offer the required level of support.

4. An overview of the existing BProM technologies

This section gives a brief overview of the existing BProM technologies and explains their current limitations related to possible support for case-handling BP.

4.1. Workflow technology

Workflow technology has been widely recognised as one of the most influential business technologies and, for many years, as the leading process-oriented technology [18]. In essence, workflows are designed to specify, execute, manage, monitor and streamline business processes by allocating the right task to the right person, at the right point of time, along with the resources needed to perform the assigned task. This technology enables integration of different tools and technologies used to support the individual tasks. For this reason, it is also considered to be one of the leading process *integration* technologies [18].

Workflow design and implementation involves two distinct phases: *modelling* (also called built-time) and *execution* (run-time) phases. Briefly, during workflow modelling, individual tasks, roles and tasks dependencies are identified and combined in a business process model according to the corresponding business rules. It is important to note that workflow models are created by workflow analysts (i.e. process experts) rather than end-users. Furthermore, these models are

executable models. This means that once such a model is created by using a graphical modelling language and stored in the workflow repository, it is ready to be used (without any other programming involved). This is one of the reasons why workflow technology has been so popular.

During run-time, a number of different process instances are created, on the basis of the same model. For example, a model of the business process "Home Loan Application" is created during built-time and stored in the workflow repository. Then during run time, each customer applying for a home loan will have his/her own BP instance of the same process model. Therefore, a process model typically has numerous corresponding process instances, all running in parallel. However, all these instances will follow the same BP model.

It is important to observe that workflow technology requires a process model to be fully predefined during built-time, before it could be used during run-time. This means that, at any point during process execution, it is possible to use this model to determine what should happen next. Consequently, workflow technology is highly suitable for repetitive, well-structured business processes. Obviously not all processes fit this description and any attempt to apply workflow technology to a less-structured BP is likely to be very problematic.

Even though task coordination is fully automated, workflows significantly differ from job-shop scheduling systems. During workflow execution, human agents still *participate* in decision-making and use their knowledge to determine possible outcomes. For example, a home-loan officer will decide whether to approve a particular home loan application. However, all possible outcomes (decision types) are known in advance, and need to be pre-defined and captured by the workflow model (i.e. an application is approved or not).

Only recently, the workflow community has started to concentrate more on flexible business processes where models (including coordination structures) cannot be fully specified in advance. Notable examples include adaptive workflows [19] and emergent workflows [20]. However, flexibility of the existing adaptive and emergent workflows is still limited as they still focus on BP structure and use control-flow oriented models. Furthermore, in spite of the increased flexibility, these BProM systems still deal with operational business processes.

4.2. Enterprise Resource Planning systems (ERPs)

ERP systems emerged in mid 90s and for the first time, offered integrated, off-the-shelf solutions to support BP integration in an organisation. In order to support the coordination aspect of a BP, ERPs have an embedded workflow system. However workflow models are not directly available to the users, as in workflow management systems. Rather, business processes are implemented via various modules that incorporate standardised, benchmark models of the core organisational BPs. Thus, in order to implement these processes, an organisation has to select and configure the required modules.

Although there are many examples of successful implementation of ERP systems, there are also numerous counter-examples that illustrate various problems with this technology and its adoption in an organisation. First of all, design of ERP systems is based on the assumption that generic, benchmark examples of processes, embedded within these systems, would suit all businesses. So instead of designing new BP models, the users need to configure these pre-defined models. However, as [16] points out: "..developing a deep understanding of the business and its interactions in the value chain follows from contrasting alternative perspectives, rather than slavishly following one "true" method". When people develop new ways of doing things (within the normative and managerial boundaries of what is possible) their organisations learn too". This is especially applicable to case-handling BPs.

Furthermore, standardised processes cannot be used to create competitive advantage for a company, at least not directly. This point is also illustrated by [14] "… the non-proprietor, idealized business processes tend to evolve towards a public definition and don't directly afford competitive differentiation" (pg. 6). Indirectly, these processes can create competitive advantage through, for example, improved efficiency of standardised BPs. However, having in mind that these systems are currently widely available, process efficiency alone is not sufficient for competitive differentiation.

As ERP systems incorporate generic BP definitions, inevitably they are very costly to configure, maintain and upgrade. In summary, similarly to the workflow-based systems, ERP technology is still best suited for the operational business processes. It does not offer enough flexibility to support case-handling BP, as defined in this paper.

4.3. Web services

Service Oriented Architecture (SOA) and in particular, web services have been increasingly used to support composition and execution of complex business processes. This is why they are also considered as BProM technology. In essence, web services are self-contained, modular, Internet-based applications, offered by different providers that have standard interface to enable efficient integration and implementation of complex business applications. Recent reports by various leading industry analysts and practitioners claim that web-services are going to revolutionise the existing IT applications, as they enable easy integration of different platforms, tools and resources [21]. *Composite* web services enable flexible, on-demand integration of individual services offered by different providers, to meet a specific business objective. This integration is made possible by the fact that web services are platform neutral so as long as they comply with the common SOA they can be integrated into a more complex structure. From the business perspective, composite web services enable integration and implementation of complex, dynamic inter-organisational business processes.

Web service-based BProM is an emerging field and there are many research and developmental challenges yet to be solved, including the problem of web service coordination (orchestration) in a complex BP [21]. For example, currently available standards/languages for web service composition and coordination (such as widely used BPEL4WS [22]), use the coordination model inherited from their predecessors - workflows. This model is based on the same control-flow paradigm. Consequently, they are equally inflexible, because they require all process components to be specified and pre-ordered in advance. The same point can be illustrated by an interesting analogy, as described in [23]. They compare the currently available models for web service orchestration to a vending machine, with a set number of buttons that can be only pressed in a predefined order. What is needed is a more flexible model, analogous to a telephone call that involves a series of exchanges between parties at each end in a more flexible, dynamic fashion.

Although web-services could be used to enable more flexible composition and execution of business processes, than any other BProM technology, it is necessary to design and adopt a different coordination models. Possible examples include a declarative model (see for example [24]), or models based on Event-Condition-Action paradigm (see [25]). However, the control-flow oriented coordination model still remains the most dominant in this area.

In summary, currently available BProM systems (including workflow-based, ERP and web service-based solutions) are not capable to offer the required level of support to people dealing with case-handling BP, for the following reasons. Current systems still focus on BP at the operational level. BP models need to be predefined by process analysts rather than customer-facing end-users, who have the domain knowledge. Finally, they do not offer enough flexibility that is required during specification and execution of case-handling BP.

5. Case-handling BPs – the knowledge dimension

Currently, most developers of BProM systems focus exclusively on the BP structure. Thus, they distinguish between structured, semi-structured and unstructured business processes (see for example [13]). However, this widely used classification is not suitable for case-handling BP as their instances could range from highly structured and predictable (for different, but "standard" categories of their customers) to highly personalised BP instance, designed on-the-fly, for a particular highly valued customer.

This paper argues that in order to understand the research and implementation challenges related to possible BProM support for case-handling BPs, it is necessary to look beyond process structure. Instead, it is important to focus on the knowledge dimension in order to understand what kind of knowledge people create, share and reuse during design and execution of case-handling BPs.

As a starting point, this paper adopts the well-known concepts of explicit and tacit knowledge. *Explicit knowledge* can be written down or drawn and easily described to other people. Consequently, it can be organised, distributed and managed. Good examples of explicit knowledge are various organisational procedures (i.e. describing how things should be done). Procedures are important for at least two reasons. In the case of standardised processes, procedures are important to guide people performing individual tasks. They are also very important from the normative (legal) perspective, to define responsibilities and protect rights of all parties involved. So, if something goes wrong, it is possible to trace process execution, compare it with prescribed procedures and detect what went wrong and who was responsible. However, it is also important to acknowledge the negative aspect of

pre-defined procedures. They are also associated with the concept of organisational control because they are often imposed upon workers "to ensure control and compliance with pre-ordained approach and technology" [14]. So far, developers of BProM solutions count on standardisation and predictability of organisational procedures to design technical solutions that will make processes as efficient as possible and minimize the resources needed.

On the other hand, *tacit knowledge* are things known by people but usually not documented anywhere such as the know-how, understanding mental models and insights of an individual or disciplines [15]. Often, tacit knowledge is very difficult to communicate easily. This is why it cannot be automated, organised and managed by technology, as in the case of explicit knowledge. However, this knowledge can be externalised, to some degree, trough a problem solving process, reflection, knowledge-in-action and "working things out". Externalisation of tacit knowledge in an organization results in development of organisational *practices*. They evolve from the accumulated experience and reflection-in-action. They are created by empowered workers through their ability to make decisions.

In reality, all business processes combine, to some degree, both procedures and practices. For example, highly structured operational business processes have a very prominent procedural component that could be easily represented by the corresponding process model. The practice component is less prominent and is usually developed through exception handling.

On the other hand case-handling BPs combine practices and procedures in a different way than operational BPs. In most, "standard cases" these processes are predominantly procedural. However, highly personalised cases are more practice-oriented. As [16] pointed out "humans interpret rules and do what is best". Therefore, new practices get developed through the accumulated experience in dealing with these unique cases. The rules that need to be interpreted are, in fact, the explicit knowledge (i.e. the procedural aspect of case handling procedures). In fact, the procedural aspect of case-handling BPs is there to define the rights and responsibilities of all people involved and to ensure that work is carried out in consistent and compliant manner.

Furthermore, based on the procedural aspect, it is possible to predict the process models to some extent and only for the most common cases. However, a customer-facing employee, with domain expertise will develop new practices related to process design, selection of individual tasks and resources as well as BP coordination. This is why they need to be in charge of process design and monitoring, rather than process analysts.

Finally, from the organisational perspective it is important to capture these practices (to some extent) in order to help employees to share and reuse their BP-related knowledge, as well as use it to derive new organisational procedures.

6. Case-handling BP: Creating New challenges for BProM

The main objective of this section is to describe the main research and development challenges related to case-handling BP support and their integration with operational BI. The initial set of requirements for the new type of BProM was identified during a previous project undertaken by the author. This particular project used the action-learning research method to investigate BProM support for creation and implementation of personalised lifestyle programs by program advisors, working in a Lifestyle center with a very large number of independent service providers. Personalised lifestyle programs are typical examples of case-handling BPs. This project also involved development of a prototype of process-oriented CRM (Customer Relationship Management) system, based on a proprietary component-based workflow solution (for more details see [12]).

The reflection phase of this project confirmed the need for a different type of BProM support. This project was then followed by a number of exploratory case studies of other types of case-based BPs in different domains. These case studies also confirmed a number of research and development challenges related to possible case-handling BProM support and its integration with operational BI.

In this paper, these challenges are further generalised so they could be applied to any service-industry interested to support case-handling BP and integrate them with operational BI. These challenges can be described as follows:

- ***Modeling and verification of case-handling BP***

While in the traditional BProM systems, process models are designed and verified by process analysts (e.g. workflow analysts), in the case of case handling BP process designers are end-users, i.e. customer-facing employees. As already pointed out, these end-users should be able to create a personalised BP for another category of end-users, in this case, their customer.

This requirement opens up a number of interesting research challenges related to modeling and verification of the assembled process. For example, in some cases, employees should be able to look for "similar" models, created in the past by another employee. The main problem here is to define what a similar BP model is, and how to retrieve it and then help the employee to modify it. Alternatively, if employees decide to design a brand new model, this should be also a guided process, where BI could also play an important part.

Once the most appropriate model is created or assembled, the next step is to verify its correctness. In traditional BProM systems, process verification typically includes verification of syntactical correctness (e.g. detection of potential deadlocks and livelocks), as well as temporal consistency (e.g. verification of temporal constraints). In the case of case-handling BPs, it is necessary to extend this concept even further. As already pointed out, these processes include both procedure and practice components, so it is possible to envisage the so-called "normative verification" where organisational procedures, relevant for a particular case, are retrieved and made available to the employee.

This requirement also creates the following new research challenge for operational BI. As pointed out, "traditional" operational BI solutions provide highly integrated structured data, coming from different operational sources (including BProM systems). A new BI challenge is to provide employees with semi-structured and unstructured data (including documents and relevant organisational policies), all related to the particular process instance. Indeed, this particular research challenge is closely related to new developments in BI, where integration and analysis of semi-structured and unstructured data have been recognised as one of the top ten trends in BI in the future (see [26]). This paper places this emerging BI trend into the context of case-handling business processes.

- ***Pro-active monitoring of case-handling BPs***

The existing BProM solutions offer very sophisticated tools for monitoring of process instances. However, it is necessary to extend the existing monitoring tools used by BPerM systems (i.e. scorecards and dashboards) to include monitoring of case-handling processes for individual customers as well as groups of customers (on the basis of their value). This is very important because all data, related to execution of a particular case-handling BP, needs to be taken into account when determining customer's value in the future. Furthermore, monitoring should be pro-active, so based on the process model it should be possible to detect and predict some process-related problems. However, for the monitoring purposes, it is not sufficient just to generate alerts (as in BAM). Employees need support for situated decision-making and for implementation of the required process changes. Again, this should be a guided process where BI could also play an important part.

- ***Case-handling Business Process Intelligence***

Current solutions in the area of operational BI offer very sophisticated analysis of historical data. In the case of case-handling BP it is also necessary to analyse process-related data in order to identify opportunities for possible process improvement. Another interesting research challenge, that also requires integration of operational BI and process logs, is to identify and predict the most suitable models of case-handling business processes for a new customer.

- ***Knowledge management (KM) and BI***

As with other knowledge-intensive processes, it is necessary to support knowledge management activities related to case-handling BP, to ensure that best practices in customer-relationship management are shared and retained by the company. In particular, it is important to support sharing and reuse of process-related externalised tacit knowledge. So over time, some of these practices could be also turned into organisational procedures.

This particular requirement opens up another interesting research challenge related to understanding of BP context that is crucial for sharing and reuse of externalised tacit knowledge. In fact, this is one of the key research challenges in the area of process-related KM [15].

So far, operational BI can provide some answers, at least, related to historical and operational data, while BProM can put this data into the context of the current BP instance. However, to address this research challenge, it is necessary to integrate operational BI, case-handling BProM and possible knowledge management support. This is a very challenging problem. In fact, current literature in the area of process-related knowledge management confirms that process-related knowledge management represents the next generation of KM systems [27].

- ***Customer BI***

Finally, in the case of case-handling business processes, it is very important to enable *customers* to monitor BP execution, request changes (if appropriate) or even select their own business process model. This research challenge is related to one of the future trends in BI – that is to bring BI to the customer. "With the concept of BI to the customer, leading-edge companies are expanding their capabilities beyond their firewalls and allowing their customers access to their own data, leveraging the same functionality currently available in house. For example, the investors (customers) can have real-time access to their data so they can answer their own questions, model different scenarios and download needed information into their own BI applications"[28].

This paper goes one step further and envisages that, in addition to real-time access to their data, customers need to have real-time access to "their" business processes used to handle their individual cases. In other words, it is necessary to offer BProM support to customers so they can actively participate in their own case-handling BP, as required.

Implementation of this vision will bring us one step closer to the so-called ambient organisations [29] where customers become an integral part of business. This is especially important if companies want to make their case-handling BP, truly customer-centered.

7. Conclusion

Operational BI recognises the need to synchronise the efforts of decision makers at the strategic, tactical and operational levels to reach a common set of business goals and objectives. The key enables of this synchronisation are business processes.

However, currently, operational BI has a very limited view of BP and BProM systems. In essence, it deals with a limited number of core transactional, operational BPs that are, by definition, highly structured and repetitive. This paper argues that in service-oriented industries, operational BI needs to be also integrated with case-handling BPs. These are customer-centered BPs, created by customer-facing employees who have the domain knowledge, required to make situated decisions in order to offer the best possible solution to the given customer, taking into account their current business value (as determined with the help of operational BI tools).

Therefore, possible support should not stop when the decision maker makes a decision on the basis of customer's current value. In the case of the service industries, it is necessary to support this decision-maker to implement his/her decision via the most suitable BP. In such BP cannot be found among BPs used to handle standard cases, then the employee should be able to design a completely new, highly personalised BP to meet the needs of a particular customer.

This particular requirement creates new research and development challenges for BProM systems. However, currently available solutions in this area are designed to support operational BPs and, as such, are not capable to provide the required support for case-handling BPs.

The main objective of this paper was to critically analyse case-handling BPs and make the case for their integration with operational BI. The paper also identified a set of research and development challenges for a new type of BProM system for case-handling BP.

Our current work in this area includes further investigation of the identified research and development challenges via more case studies in different service industries. This research will eventually lead to development of a new type BProM system for case-handling BP.

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