Business Process Management and Semantic Interoperability

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Abstract Contemporary organizations are exposed to an environment that is changing at a continually increasing pace. Some of the external forces challenging organizations today are *Business Network Transformation, Business Process Outsourcing*, *Web 2.0*, the *Internet of Services*, *the Internet of Things* and the *Changing Needs of End Users* in organizations. In this environment, organizations must retain internal stability and focus on improving their core strengths to stay competitive and grow both their top and bottom lines. However, leveraging the full potential of each of these trends requires organizations to be agile, co-innovate within supply webs and continually redefine relationships. The major challenge that arises for Business Process Management and Semantic Interoperability (BPM&SI) research and future technology is the mitigation of risks arising from these conflicting themes. The purpose of this chapter is to motivate several research themes and technology research areas within the field of BPM&SI that will address this conflict in order to leverage the full potential of BPM in the future.

1 Introduction

Business Process Management and Semantic Interoperability (BPM&SI) research has its roots in three distinct areas: *Business Process Management, Semantics* and *Interoperability*. Each has a long tradition.[1] Today, we have a sophisticated

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[1]Early examples of research emphasizing the notions of BPM are Taylor's Scientific Management (Taylor 1911) and Nordsieck's conceptualisation of an organization (Nordsieck 1934). In particular in the 1990's, business processes and their IT support gained increased attention (Davenport 1993; Hammer 1997). Research in semantics has its roots in linguistics and they are a tradition that

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understanding of various aspects within these areas. While the term Business Process Management is rather established, Semantic Interoperability, despite past inflated expectations,[2] is a concept that has only recently emerged. In a recent research roadmap provided by the European Union,[3] the concept has been tangibly described within the domain of healthcare: All efforts at creating an electronic health record are pointless unless all relevant stakeholders can access these health records securely and meaning is transmitted correctly and without alteration between different systems, despite changing formats and languages, using different protocols, etc.

However, despite a lot of progress in recent years, the technical state-of-the-art in the area of BPM&SI is challenged through a range of trends in business and society. These trends include *Business Network Transformation, Business Process Outsourcing, Web 2.0* and the *Internet of Services and Things*. Together, they motivate a need for BPM Suites to the extent that the market for these suites will be among the fastest growing software markets at least until 2011.[4] But they also reveal a lack of emphasis on two general research themes in BPM&SI: the *end user* and *communities*. As of today, only with rare exceptions are products, tools, technologies, methods and languages in the area of BPM&SI usable for end users or specifically targeted at them. Similarly, they are not designed to facilitate a community or to be used by a large number of users within a community, whereby the use grows over-proportionally with a growing community. Pre-conditions for working end user or community approaches are usability and a solid value proposition. In turn, if these pre-conditions are not met, BPM tools and technologies will not achieve mass market readiness.

The lack of emphasis on end users and communities is not the only problem preventing BPM tools and technologies from broad adoption. Despite progress in the more technical space of Workflow Management, we are still not in a position to have a clear abstraction layer of processes within applications. Workflow management systems and business applications remain separate tool paradigms, burying application process logic within code and user interfaces. Moreover, current efforts in workflow technology do not target a paradigmatic shift in application development. That is, a shift towards describing process flows similarly to data structures in a dedicated abstraction layer is required. We continue to treat BPM as a tool, which allows us to package it for specific purposes, but prevents us from using related technology in an additional and very important way: as a means to ease application

dates back at least to the ancient Babylonians and later the ancient Greeks (Hymes 1974). In Computer Science, the notion of semantics became important within Artificial Intelligence, Expert Systems and later the Semantic Web.

[2]Rishel 2009.

[3]Stroetmann et al. 2009.

[4]Laurence and Carina (2008) The Business Process Outsourcing market alone (although currently BPM suites are not necessarily a technical enabler for BPO) is estimated by analyst firm IDC to be in excess of 120 Billion USD in 2009 (Dialani et al. 2008). Gartner estimates the same market to be sized around 172 Billion USD in 2009. Both analyst firms estimate the CAGR (compound annual growth rate) at around 10%.

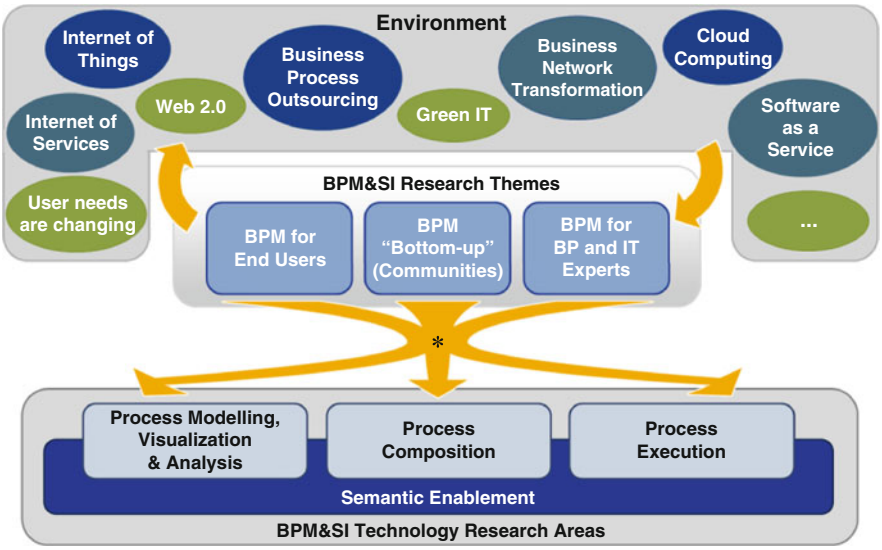

Fig. 1 Changing user needs

development, driving down total cost of development and introducing higher quality standards.

In order for BPM products, tools, technologies, methods and languages to become increasingly mainstream, BPM&SI research needs to focus on *end user and community enablement of BPM* as well as on significantly increasing capabilities in traditional research focussing primarily on business process (BP) and IT experts. In each of these three research themes, significant progress needs to be achieved in three technology research areas: *process modeling, visualization and analysis; process composition; and process execution*. Thereby, semantic *enablement* of these three technology research areas will be of paramount importance for achieving breakthrough results. The research themes and technology research areas mentioned as well as the business trends (introduced in the next section) that lead to a demand for these themes and areas are depicted in Fig. 1. It should be noted that the research challenges described here are of a technical nature. It is explicitly not the focus of this discussion to motivate non-technical challenges that would need to be addressed through sociological or economical research, for example.

2 Major Relevant Business Trends

2.1 Business Network Transformation

Business Network Transformation (BNT) enables contemporary organizations to leverage an entire network for innovation, top line growth and bottom line growth.

Responsibilities shift quickly and frequently between organizations in a supply web, whereby new tiers emerge and existing ones vanish. Innovation is driven by customer demands. Entire supply webs depend on their ability to react collaboratively in a very short time. Pressure increases through changes in the environment of a supply web: shareholders need to be satisfied, legislative changes need to be implemented and environmental concerns are to be taken into account. While actors within inter-organizational business processes flexibly enact upon quickly changing strategies, the technology they use must be enabling, not restricting. Furthermore, the technology they use must be tailored for business user profiles. Actors within inter-organizational business processes must be enabled to work together effectively as a community.

2.2 Business Process Outsourcing

Business Process Outsourcing (BPO) refers to a trend where an economic rationale suggests bundling entire processes, contracting a 3rd party and having this partner execute the process. On the provider-side, economies of scale are achieved through high volumes of transactions, driving down marginal cost for additional transactions, while having the ability to quickly ramp up new customers. On the demand-side, BPO requires similar technological capabilities to BNT. Economically, BPO's key success factor today is standardization. There is currently no market that targets more process flexibility, hence restricting the business case for BPO to a few scenarios such as human resources, procurement and payroll. In these scenarios, variations from standardized processes only rarely make sense from a business perspective or could be critical from a legal perspective. However, if the provider market is to be complemented with solutions where customers can subscribe to business processes that are tailored specifically for them, economies of scale must still be achieved through marginal cost, but the cost of flexibility must be significantly decreased.

2.3 Internet of Services

The vision of the Internet of Services (IoS) is to go beyond the short-tail focus of the current software-as-a-service marketplace and into the long tail of enterprise services, with shifting complexity for the supply and demand sides. Beyond present generation Web Services like ordering books, geographical mash-ups, and booking flights, more complex business transactions from mainstream industries are targeted for the next wave of consumable services; for example, from land search to property conveyance, from business directories to business formation and from disparate personal registrations to cohesive life event support (e.g., births, marriage, change of address). Complex challenges come into view when considering how these could be exposed as commoditised services. These are long-running, and interactions with backend applications from potentially several agencies need to be

reliably mediated. Navigation of such services needs to be as seamless for consumers as linking to pages, facilitated by semantic descriptions of services and their interactions. On the demand-side, business processes, not just individuals, are expected to be consumers of "cloud" services. When harnessed through business processes, services are being drawn out of internal stovepipes and rigid B2B interactions. The demands of users and communities drive what business processes need to be composed out of services, whereby the detour through IT departments poses significant restrictions such as longer cycles, increased TCO, and problems associated with what is commonly called the business-IT divide. The single biggest challenge that arises for application providers is how to address the long tail imposed through the Internet of Services vision appropriately.

2.4 Internet of Things

The Internet of Things (IoT) fuses the digital world and the physical world by bringing different concepts and technical components together: pervasive networks, miniaturization of devices, mobile communication and new models for business processes. Applications, services, middleware components, networks, and endpoints will be structurally connected in entirely new ways. Tangible business benefits will include high resolution management of assets and products, improved lifecycle management and better collaboration between enterprises. Improved sensor and device capabilities will also allow business logic to be executed on the "edges" of a network, enabling existing business processes to be decentralized for the benefit of performance, scalability and local decision making. Within supply webs, the IoT vision leads to increased transparency, shorter decision cycles and shorter exception handling cycles. It will be end users and communities that drive actual business processes leveraging the IoT, and therefore, supporting technologies must be tailored accordingly.

2.5 Changing Needs of End Users

The consequences of an ever increasing amount of technology surrounding us, particularly in the consumer space, are manifold in various areas such as society and business. Most importantly, with members of Generation Y now being the well-established young generation within contemporary organizations and members of Generation Z close to entering organizational life, there is an increasing amount of organizational actors that get quickly frustrated with cumbersome technology, restricting technology, the inability to do things themselves, interaction lengths that exceed their attention spans and the inability to share information and consume shared information. These highly connected young organizational actors live and act within various new digital networks in their private life, which becomes their

mode of being. Unless these mechanisms are resembled in organizational IT, the full potential of Generation Y and Z members cannot be unleashed. Hence, there must be a specific emphasis on topics such as self-enablement, community enablement and information sharing within the area of BPM&SI.

3 Research Themes

All introduced business trends substantiate the claim made in the introduction: without an increased focus of BPM&SI research on *BPM for End users*, *BPM for BP* and *IT Experts* and *BPM "Bottom-Up" (for Communities)*, the resulting challenges cannot be addressed. Decisions to shift responsibilities between organizations (e.g., BNT and BPO) are not decisions made by IT departments. These decisions are made by senior executives within lines of business or by the executive board of organizations. Inefficient or ineffective software support for a certain business process is detected within the business not within IT departments. And finally, many organizational actors within business processes need to somehow interact with computers through traditional interfaces (keyboard, mouse and screen), whereby the gap between business applications and consumer applications has widened over the past few years. In particular, when innovation is introduced, the positive effects of increased efforts in end user consumption are undeniable.[5] Several BPMS vendors have recently started to target end users and communities in particular and were able to gain firsthand experience.[6]

In this section, we will introduce the three BPM&SI research themes, *BPM for End users*, *BPM for BP* and *IT Experts* and *BPM "Bottom-Up" (for Communities)* in more detail.

3.1 BPM for End Users

Today, most BPM&SI technologies, applications, methods, languages and products are primarily targeted at more technical users such as developers, process architects and technical consultants. Even though things are slowly changing, end users play virtually no role in BPM initiatives today. However, the knowledge on how business processes are executed in organizations resides in end users. This problem is commonly referred to as the business–IT gap and manifests in the space of BPM&SI in that the "business user is an untapped source of process operational expertise."[7] This is critical as the vast majority of IT users are non-technical users (Fig. 2).

[5]Phelan 2009.

[6]Kerremans et al. 2009.

[7]Rosser 2008.

Fig. 2 Distribution of IT users in contemporary organizations (Quinn 2005)

Supporting the business user appropriately remains a major challenge from an application provision perspective if another fact, in particular, is considered: 82% of all decision makers consider the user interface a determining factor for a replacement of existing business applications; 86% of these decision makers see the user interface as the primary reason for productivity gains.[8] This shows how much the end user is emphasized in procurement decisions, not only in terms of functionality, but also in terms of experience. Unless the technological excellence of a BPM Suite is targeted at business or end users, applications with this target group will fail on the market.

3.2 BPM Bottom-Up ("BPM for Communities")

BPM Bottom-up focuses on leveraging two recent trends. The first is the *societal trend* of sharing information, consuming shared information, and relying on information that originated in a community (bazaar style[9]) rather than on information that originated in privileged groups (cathedral style). The second is a *technological* trend that makes end user devices and technologies increasingly usable so that more and more large-scale consumer platforms arise that depend purely on technology,

[8]Thornton 2007.

[9]For a discussion on the paradigms bazaar vs. cathedral in software engineering (Raymond 1999).

both hardware-based (e.g., mobile phones) and software-based (Internet platforms such as Facebook, LinkedIn, etc.). As of today, the community structure within BPM is such that a small amount of actors have knowledge on languages, tools, technologies, methods or products. Process modeling, implementation, analysis and re-engineering initiatives in organizations are executed by some of these few knowledgeable actors but often lack support and acceptance of a larger community within these organizations. Leveraging the societal and technological trends discussed above in the BPM&SI space will help to overcome the community structure that is unfavorable if BPM is to become increasingly mainstream.

As a result, a second major challenge from the perspective of application provisioning is the effective support of communities. A direct effect of better community enablement of BPM&SI technologies, methods, languages, tools and products is a value proposition that stretches beyond the top management and targets all organizational members. BPM initiatives of the future will be conducted bottom-up, whereby organizational actors expose their processes and share this knowledge with colleagues. Aggregations of such processes resemble an entire organizational process landscape whereby acceptance and support from the users who carry the knowledge on operations and procedures no longer pose a problem. Solutions of the future will be delivered as a platform, where users can subscribe to modeling and consuming processes, because they have an intrinsic motivation to do so. This motivation is manifold and consists of an interest in understanding organizational procedures beyond their reach, understanding best practices in other organizations and enabling more efficient and targeted interactions with colleagues.

3.3 BPM for BP and IT Experts

Research targeted at BP and IT experts has probably the longest tradition within the area of BPM&SI. Today, we have a sophisticated understanding of various aspects within these areas. In the area of BPM, examples include the knowledge of what patterns exist in business processes,[10] how to support business processes through workflow technology[11] or how to express business processes in models.[12] In the area of semantics, examples are ontologies and reasoners that help us to build representations of the real world and infer from sets of rules. Semantic interoperability in particular has been progressing with EDI over the past decades, which is nothing other than a taxonomy of business documents.

However, despite the progress made in these areas, many problems remain unsolved. The single biggest problem from an enterprise application provision perspective is the still prevalent separation of workflow management systems

[10]For a discussion on the paradigms bazaar vs. cathedral in software engineering (Raymond 1999).

[11]Aalst and Hee 2004.

[12]Weske 2007.

(WFMS) and business applications, or, to put it differently, an insufficient decoupling of a process perspective within business applications. Workflows, or more abstractly business processes, are hardcoded within applications (insufficient abstraction), and if they are explicit in WFMS, they are often decoupled from business applications (two different application paradigms). The consequences are higher total cost of application development, higher cost of process adaptation and insufficient transparency of how business processes are executed.

It has long been demanded to decouple a process layer within applications similarly to data that, in today's large-scale applications, is handled within database management systems. However, since we have clearly not yet arrived there, we must assert that such an abstraction has consequences beyond those originally anticipated. In fact, such an abstraction changes the current programming models fundamentally, leading to a new paradigm for application development. Developers in the future will describe processes within enterprise applications with a set of low-level technical patterns taking into account security, data access and integrity, constraints and business logic. Functionality will be invoked through fine-granular services. The paradigmatic shift will be to *describe* processes during application development rather than implementing them, similar to how data structures are described in SQL rather than implemented.

The third challenge from the perspective of application provisioning is thus not targeted at prospective users, but at the process of developing these applications. If successfully addressed, total cost of development will go down as developers do not have to implement business logic and constraints anymore. These aspects can be modeled and invoked. In the same instance, quality will be higher as the risk for errors decreases. Also, through the ability to change business processes more quickly, the business value associated with Business Process Outsourcing and Business Network Transformation can be realized. Furthermore, the visions of the Internet of Services and Things will be substantiated through a foundation for composing processes from fine-granular services invoking representations of objects in the real world.

4 Technology Research Areas

So far, we have discussed business trends and resulting research themes for the BPM&SI Research Program. This section is concerned with three technology research areas: *Process Modeling*, *Visualization and Analysis*; *Process Composition*; and *Process Execution*. Technological progress in these three areas will be used to facilitate the creation of a sufficient knowledge base within the three themes *BPM for End Users*, *BPM for BP* and *IT Experts and BPM Bottom-up*, which in turn aims at realizing the associated benefits.

Intersecting the three introduced research themes with the three technology research areas leads to nine different areas in which capabilities need to be built up. This relationship is depicted in Fig. 3.

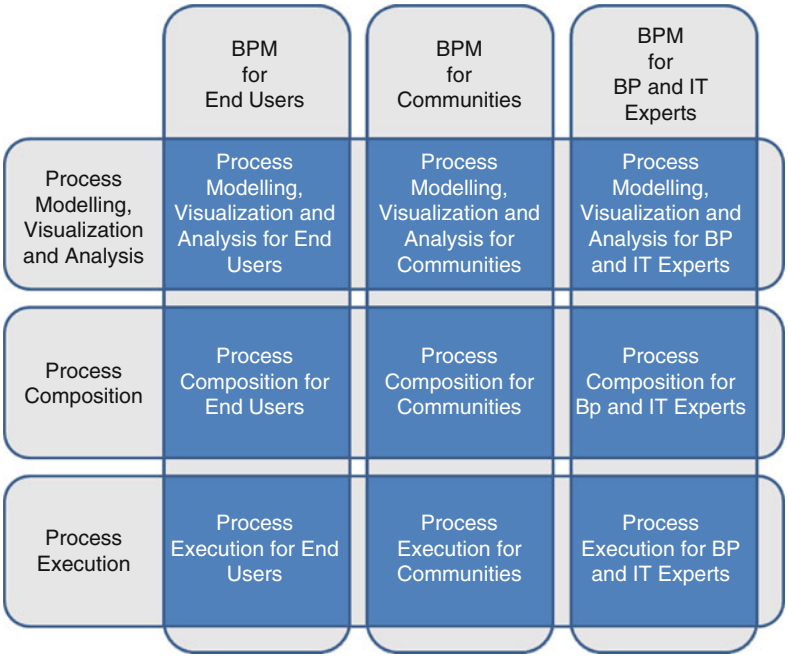

Fig. 3 BPM&SI research challenges as a result of research themes and technology research areas

4.1 Process Modeling, Visualization and Analysis

The first technology research area is concerned with expressing and analyzing business processes. In order to successfully target end users in particular, several research questions must be addressed. First and foremost, it must be understood what kind of modeling techniques and paradigms are most appropriate for end users. Research in this area will need to go beyond strip-down versions of BPMN. Good examples of mass consumable process description are cook books and they rarely come along as process models. A single end user nearly always works on tasks sequentially, hence if they are to express processes they work on, do we really need splits and joins or can we find alternative means to express conditions and their implications? Similarly, we need to understand how end users are most effectively enabled to analyze processes. How can process analysis information be embedded into applications familiar to end users such as MS Outlook, MS Excel or widgets and how can it be delivered through consumer appliances such as mobile phones? In many instances, the leading UI of end users follows a certain paradigm. For example, in GIS (Geo spatial Information System), users spend significant amounts of time looking at maps. How can process information be efficiently compiled, re-bundled and embedded into such environments? How can process analysis information be

shared effectively amongst involved stakeholders? How can end users be enabled to define process KPIs that matter for them and analyze processes accordingly?

Enabling the end user is only the first step in order to transform the notion of BPM to be mass market ready. Understanding how communities can effectively collaborate on BPM initiatives is the next step and of paramount importance. How can a community of modelers overcome problems such as different levels of modeling abstraction? How can modelers work rather independently whereby the combination of all individual models not only makes sense but provides an organizational process landscape? With many of the problems being associated with stakeholders speaking different languages, what are the semantic prerequisites for working BPM community approaches? Also, can the viral models existing in other application domains work in BPM? This requires conditions in which single end users, or a single line of business profits from process modeling or analysis, and additional users increase the value for the entire user base. Quite possibly, a "cloud" infrastructure can help in this respect as public clouds can host a multitude of players and their users. So what does "cloud" BPM look like, in particular, for modeling, visualization and analysis? What is the benefit of a cloud solution over an on-premise solution other than common economic factors? Obviously, a successful BPM-related tool in this space must also be lightweight, interactive and to a certain extent entertaining so that a single user or a single line of business would want to subscribe to the corresponding service.

The third and final set of research challenges in the area of process modeling, visualization and analysis targets BP and IT experts. More traditional yet not fully addressed problems include mappings between flow-oriented (more native and understandable process description) and block-structured (machine-interpretable) BP languages in order to develop transformations from, e.g., BPMN to BPEL. While this problem targets WFMS (that are primarily decoupled from enterprise systems today), it needs to be examined in more detail which patterns (existing sets and news ones) allow application developers to declare processes similar to data structures in SQL so that a proper process abstraction layer in application development becomes reality. For both cases, significant research is necessary in order to bridge the gap between end user and community tools, and languages motivated above and the technical layers. With the envisaged progress in the end user and community spaces, particularly through using semantic mechanisms to describe process blocks, breakthrough in usability can be achieved. As constraint-based process languages get more popular, major challenges also remain in the area of bridging the gap between constraint-based languages and flow-based languages.

4.2 Process Composition

As with process modeling, visualization and analysis, three different research themes must be supported within the technology research area of process composition: end users, communities and BP and IT experts. Furthermore, there are two

types of composition that need to be taken into account: core process composition and process context composition. The former refers to putting activities into a timely order to execute accordingly. The latter refers to putting an activity within a process into context to make informed decisions where necessary, also known as "mash-up". For information workers in particular, the borderline between both paradigms blurs.

For end users, important questions include from what they actually compose both processes and process context. In general, domain-independent modeling paradigms (e.g., "activity" or "event") seem to be too cumbersome to be handled by end users and too many problems remain, such as different levels of abstraction in modeling. Accordingly, how can domain-specific semantic building blocks (e.g., "print" or "file") be leveraged effectively for both types of composition? How can end users effectively contribute to the definition of such semantic building blocks? How can they change and configure them? What level of semantic commitment from end users is necessary for the adaptation of underlying domain ontologies?

Understanding what it is that end users can effectively compose processes and their context from is only the first step. What means of automatic process composition can be used to facilitate process composition for end users and what do they need to specify in order for a tool to automatically compose a process for them? What do composition tools look like or how can composition services be embedded in existing end user tools? What are good use cases for both process composition and process context composition, either defining processes from scratch or extend/configure/customize existing processes? How can collaboration between end users be facilitated most effectively? How can consumer space devices such as smart phones be systematically leveraged for collaboration within processes?

Enabling BPM community approaches is the next significant challenge along the way to mass market readiness. How can entire communities compose processes together while members specify their tasks independent of each other? What mechanisms are necessary in order to specify interfaces between users? What mechanisms must be in place in order to define processes along entire supply chains crossing organizational borders? If organizational borders are crossed, how can interoperability between different sets of semantic process building blocks be achieved? How can different sets of expertise in a community be leveraged in order to arrive at composed processes? What level of expertise is necessary in order to define business rules, conditions or possible combinations of process building blocks? Facilitating a community of modelers supposedly works best with a shared infrastructure. If so, how can a BPM-centric platform-as-a-service in the "cloud" be established that caters for the needs of a community? For instance, how can hosted processes be turned into services by their owners and offered for a charge? Use cases like this to highlight differences between on-premise and on-demand BPM solutions that go beyond mere technological distinctions or economic calculations.

Once end user and community enablement are sufficiently understood, the resulting mechanisms need to be tied back to a more technical layer. Here, it is necessary to make sense out of what end users have specified or documented.

Similarly, the task here is to abstract sufficiently from technical details within applications and to describe on a business level how processes are executed. At this stage, no sufficient integration between end user languages or tools and technical representations has been achieved within large-scale applications. A resulting question is how semantic process building blocks that make sense for end users are represented technically? The relationship between representations for end users and BP and IT experts is many-to-many. A technically identical concept can be translated into two different things for end users. Similarly, two things that are identical for an end user can have multiple technical representations. How can this many-to-many relationship be managed? How can it be guaranteed that there are no technical collisions from specifications of end users or communities? In addition to technical support for end user and community enablement, there is a range of technically hard problems that has not yet been sufficiently addressed. How do technical services need to be designed in order to qualify for the composition of a workflow? How does state-retaining information need to be specified in a workflow that is composed from services? How are exceptions handled, which exceptions are propagated back to end users, and how can this be done? How does all of this work in a "cloud" environment?

In the area of process context, we are far less mature than in the traditional technical workflow research. Here, the questions are centered around type systems for message exchange, suitability of bus concepts for event handling, architectural options of distributing workload between server and client with their security implications, development and delivery paradigms of mash-up components for technical experts, and their link to end user capabilities. In particular, the Internet of Services vision will be facilitated by addressing the research challenges in the process composition technology research area.

4.3 Process Execution

Important research challenges in the area of process execution remain for the end user. Most importantly, end users need to be able to take control of running workflows as they "own" the business processes behind the workflows. They need to be able to change or stop them, adapt them, adjust control flow and other activities. How can this be achieved without compromising the integrity of running processes? How can rollback mechanisms be added to points where end users can influence running processes? How can they systematically monitor a running process from a business perspective? How do compiler concepts look that translate high-level languages into kernel concepts? How can domain-specific semantic building blocks be translated to domain-independent kernel concepts? A recent trend in community ready applications is a blurred borderline between runtime and design time. Can this borderline be blurred in the area of BPM as well and, if yes, how? In particular for process context through mash-ups, it is of paramount importance that users can make changes that take immediate effect, ideally while they make these changes.

In the community context, process execution also faces a range of challenges. How does distributed workflow execution change through SOA across organizations? How can governance mechanisms be specified that retain various levels of integrity, such as legal integrity, integrity from a business perspective (such as constraints being in line with corporate goals) and integrity from a technical perspective (such as data integrity)? How can the semantic gaps be closed that inevitably exist in larger communities, in particular in communities that span across organizations? How can community approaches be integrated into legacy applications for seamlessly running larger processes and for analysis?

The single most important challenge that remains in the space of BP and IT experts is how to develop technologies that will aid application development by decoupling a process layer similarly to the separation of the data layer. In other words, how can the still existing distinction of WFMS and enterprise applications be overcome? How can business integrity mechanisms be manifested in a more technical process layer within applications so that a better segregation of duties can be achieved during development? If process technology is to be an integral part of applications, how can the corresponding technologies scale to throughputs of millions of daily transactions, particularly within larger communities? Furthermore, there are many challenges associated with defining workflows from services, which is the cornerstone for the Internet of Services vision. How can a workflow layer handle states if it is loosely coupled from services? How can rollbacks be achieved in such an environment? How can a workflow layer handle services if the services themselves impose activities that transcend the context of the workflow? How can rollbacks be achieved in such an environment?

5 Summary

In this chapter, we have motivated that research in BPM&SI needs to stretch beyond the directions currently taken. In order to achieve the benefits associated with systematically supporting business processes with technology, it is of paramount importance to specifically target additional user groups and scenarios.

Business or end users hold the expertise on procedures and operations in organizations. Systematically including them in BPM initiatives must go beyond involving them in interviews on how processes are executed. Unless they will be provided with tools and technologies, which they understand and from which they get value, they will never be part of a BPM initiative.

Understanding and supporting the needs of business or end users directly leads to a second research theme, that of communities. Human beings have formed communities for a long time, but it is an undeniable societal trend, enforced through technological progress that many of these communities become virtual. Examples within the consumer space show us that people see value in joining technology-enabled networks and building communities there. So far, there is no reason to believe that the mechanisms that work for Facebook, MySpace and others cannot

work in an organizational setting for the sake of collaboration and for supporting business processes within and across organizations.

These two new research themes in the area of BPM&SI need to be complemented with breakthrough progress in the more traditional space of research, that of supporting BP and IT experts. After many years of research, business applications and workflow management systems remain separate paradigms. We have not yet fully understood what it means to replace application development with one of the prevalent paradigms (object-oriented, functional or imperative) by application development, whereby one part is the explicit description of processes. We also have not yet fully understood what it means to turn control of large-scale business applications to workflow engines at runtime to support this paradigm holistically.

Unless these three research themes are addressed appropriately, it is questionable as to whether BPM&SI tools, technologies, methods, languages and products will ever be broadly adopted. In this case, it is similarly questionable as to whether we will ever be able to overcome the current cathedral-style community structure in BPM&SI. In turn, it is our strong belief that the future will hold significant opportunities for those who will be able to provide answers to the questions outlined in this essay.

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