

Agile Business Process Management with Sense and Respond

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Abstract

Market players that can respond to critical market events faster than their competitors, will end up as winners in the emerging new economy. In order to win the next phase in the never-ending market race, they will also need to integrate their business processes with those of their suppliers and business partners. Additionally, the ability to quickly adjust processes to better respond to one's customers will also become a decisive factor in the new economy. In this paper, we discuss the deficiencies of formal existing process management approaches and propose an agile process management approach based on Sense and Respond loop.

1. The Agile Enterprise—an Introduction

“.com”, E-Business, E-Commerce, outsourcing, virtual enterprises, globalized markets, “the flat world” [7] —the last decade presented a plethora of new trends and strategies recommended to enterprises to keep in touch with their markets and stay prosperous. Several publications indicate that a fundamental change in how business is made is taking place, or *has* taken place already in many firms on various places around the world. Not only by developments in the United States, Europe or Japan, but particularly also by the pressure of upcoming nations like India or China, it turns out that strategies valuable in the 80's and 90's are not necessarily helpful in the 21st century [5, 8, 11].

However, beside all “hypes” and whatever particular recommendations these and other authors have given, the way from *traditional* over *dynamic* or *virtual* enterprises eventually leads to a general structure of *agile enterprises*. This is particularly true for enterprises in the technology market. But what does *agile* mean on the company level? And what are the implication for IT and process- and eventually also knowledge-management? *Agility* is usually seen as the

capability of a system to react to unforeseen developments and to handle unanticipated change [1, 11]. This necessity to stay agile seems to be the only undoubted “bottom line insight” most authors share, observing the behavior of today's business “ecosystem”.

But there is another point of view: Haeckl et al. [8] suggest to move from a “Make-and-Sell” towards a “Sense-and-Respond” enterprise strategy. The latter strategy is often associated with biological structures, which is also the reason why Meyer and Davis [5] predict a convergence of *information, biology and business*.

Following these ideas, it seems to be more appropriate to see a modern enterprise like an organism that continuously needs to monitor itself (e.g., process monitoring, controlling) and its “ecosystem” (*sense*) as well as to be prepared to quickly take actions to changes (*respond*) in the sense of an autopoietic system [10].

2. ERP and EAI

In the 1990's, many companies, particularly the “big players”, started the *enterprise resource planning* (ERP) wave. Hence, today systems like SAP are self-evident in a modern company, just as relational databases were in the 80's. However, as Lee et al. point out: “Most firms prefer to buy and install ERP applications with little modification. In order to make this possible, organizations must reengineer their business processes prior to initial implementation” [9].

Yet today the question arises, if buying software and using standardized processes as all other companies do, is a sufficient strategy considering the agility of today's markets. Being able to quickly adapt to changing environments becomes a critical condition of a successful enterprise. Consequently, during the 90's (also driven by internet technology and the need for business-to-business data exchange) *enterprise application integration* (EAI) was the next logical step.

One effect of system integration was that different systems were then able to interact over common channels, often using messages or events. At the moment, this infrastructure is mainly used as integration infrastructure to leverage interoperability between different business systems and applications. But the particularly interesting point is that these *enterprise buses* or messaging systems can be seen as the *nervous system* of an enterprise [13].

However, from the *agile perspective* (following Michael Dell [6]), a heterogeneous system is not necessarily a bad thing but can be conceived as a chance. Heterogeneous systems—wisely implemented—mean being off the beaten track and may even increase the ability to differentiate;

Additionally We observe service oriented architectures that currently support open interfaces between applications and can be orchestrated with standards-based workflow languages like BPEL. That said, SOAs still tend to be able to build the foundation for agile business processes, as workflows in these architectures could be modified rather quickly. But assuming that the technical capability of the back-end systems fully support agile processes alone is still not sufficient: the business process is often modeled top-down; which means that quick reaction to changes in the environment is not easily done. Moreover, there is often a discrepancy between *what is assumed to happen* and what is really happening.

Ideally, future tools allow complete roundtrip engineering: helping the user in detecting unexpected developments, refactoring or reengineering from business processes, implementation of these processes and monitoring of the results. Recently, message/service-oriented systems appeared to be the leading design paradigm, which come in handy, as *service oriented architecture* (SOA) supports our concept of Sense-and-Respond-based design, as described in this paper.

3. Business Process Management with Sense and Respond

Let's now focus on traditional business process management (BPM) systems that are using formal process models which are used to govern the execution of business processes. These systems act as a centralized control hub, and invoke functions in ERP systems and business applications based on a formal plan given by the process model.

As introduced above, one major issue of this approach is that the process model assumes that it corresponds to a high level of predictability of the world in which a given enterprise operates. Where change occurs gradually and incrementally, a sensible process management approach would stress efficiency in doing what the market will want and minimizing the cost and expenses of making and selling it. Such a business will articulate its mission and policies

which will rarely be modified, because doing so would be disruptive; and disruption is the enemy of efficiency.

But in unpredictable markets, in which customers themselves become unreliable predictors of their future needs, adaptiveness must take precedence over short time efficiency-considerations. A problem with existing business process models (such as BPEL4WS) is that they have no awareness of ongoing and external information that is not directly part of the business process execution. Business process models have weaknesses in incorporating changes and external signals of the business environment which can significantly influence or interrupt the process execution. Traditional business process management systems are closed systems, since a process model formally defines in advance (a priori) the course of execution, and does not consider any other context information that is not related to process execution.

4. Event-Based Infrastructure for Process Management

SARI is a managed Sense-and-Respond system that continuously receives, processes and augments events from various source systems, and transforms these events in near real-time into performance indicators and intelligent business actions. It automatically discovers and analyses business situations or exceptions, and can create reactive and proactive responses such as generating early warnings, preventing damage, loss or extensive cost, exploiting time-critical business opportunities, or adapting business systems with minimal latency.

An event-based infrastructure such as SARI creates for enterprises a new level of awareness about the ongoing activities within business processes. The awareness is founded in the ongoing processing and evaluation of events which carry the context and key information of the current state of the business. SARI uses this context information of events to combine it with other available enterprise data sources (e.g., data warehouses), in order to (1) minimize the latency between cause and effect of business decisions (2) minimize the latency for discovering business situations and exceptions (3) deliver up-to-date performance data (4) trigger proactive action to exploit business opportunities or avoiding loss or failure (5) respond to unanticipated requests in unpredictable business environments and eventually help finding meaning in a flood of low-level events. In order to provide these capabilities, SARI manages "Sense-and-Response loops" which can be divided into the following 5 stages

- **Sense** describe current state of business environment
- **Interpret** transform events into meaningful business information (e.g. key performance indicators)

- **Analyze** find possibilities to improve current situation, make root cause analysis ...
- **Decide** determine appropriate action for response; rules can be applied for automation
- **Respond** communicate decision back to system (as event)

The response again has an effect on the source systems (from which SARI originally received the events), and consequently also on the performance and the success of the company. Since the 5 stages are part of the Sense-and-Respond loop, the events of actions as part of a response are immediately captured and processed again. *With each cycle of the Sense-and-Respond loop, the system improves the information quality and analytical results.* The processing of events within these cycles enables a continuous improvement of the business operations and business intelligence of the enterprise.

5. Modeling Approaches

Still we face the problem that a crucial step, the *process modeling* and all related aspects (controlling, modification) are still done in a top-down approach by the management. Unfortunately, this has not much to do with modern, agile strategies as mentioned above [5, 8]. According to the SARI model introduced in the previous section, particularly the steps 2–4 should be done assisted by (process) managers in a user-friendly way.

We see a clear parallel to the development in software engineering in the last two decades: until the middle of the 90's research tried to bring Software Engineering to an engineering discipline comparable to architecture or mechanical engineering. Actually, these attempts were mainly unsuccessful by several reasons.

Consequently, software engineering moved away from fruitless planning and creation of tons of architecture documents that eventually never were implemented, towards a methodology of developing systems, in a way that it is rather easily possible to continuously modify and extend them as needed [2, 3]. Despite a lot of “waves” and “fashions” agile methodology and methods derived from Open Source projects proved to be very successful. Process management can learn from these experiences without the need to repeat the same mistakes. Iterative software development in agile SE processes demonstrates better capabilities to cope with uncertain requirements in fast-changing environments. The core principles of agile software-development are as follow: (1) welcoming changing requirements, even late in the development (2) delivering working software frequently (3) highest priority to satisfy the customer through early and continuous delivery of valuable software.

6. Towards Agile Business Process Management

While agile software development can handle a permanent stream of customer requirements very well, and produces continuously valuable software, it is becoming a major challenge for traditional and formally oriented business process management systems.

The core principles of agile business process management are as follow: (1) empowering individuals by emphasizing flexibility and responsiveness over efficiency and predictability (2) responding quickly and intelligently to events in the business environment (3) give highest priority to sense and respond to customer needs, and preferences in order to continuously deliver value to the customer.

An important aspect has to be added: agile process management is not only and maybe not even mainly a technological challenge; but a challenge in establishing suitable company policies and culture. Employees have to be encouraged to try out new ways, also to make mistakes. *Making the right mistakes earlier than the competitor* [14] means learning faster and being faster adapted to changes in the markets!

Too much stability in a system is shown to be dangerous, as inflexibility is the consequence; on the other hand, too much degrees of freedom leads to unpredictable behavior. The art of management is to lead the company “on the edge of chaos”. Hence, “Seed, Select, Amplify” [5] are assumed to be the successful concept of the *adaptive enterprise*.

7. Managing Sense-and-Respond Loops with SARI

Putting the pieces together, we propose a multi-layer, service-oriented architecture targeting the requirements of agile process management and Sense-and-Respond loops. Using the SOA approach, we model SARI as a pool of services (system services and Sense-and-Respond services) and establish the infrastructure that enables a robust communication and interaction between them. The underlying infrastructure offers system services, which can be universally used by the Sense-and-Respond services. The system services fulfill basic tasks such as event-correlation, event-synchronization, logging, thread management, exception handling and centralized configuration management. The Event Service Bus provides the communication infrastructure that enables a robust and flexible information transfer between Sense-and-Respond services.

Each phase in the Sense-and-Respond loop introduced previously, is supported by special Sense-and-Respond services which can flexibly interact with each other by an event service bus. With SARI it is possible to include also user-

defined services for various tasks, such as discovering situations; a third-party analysis tool as an analytical service or an external rule engine for making automated decisions in Sense-and-Respond loops. Also, user-defined services are able to send and receive events from the event service bus.

Finally, SARI includes a monitoring dashboard which provides an interface for end-users. It gives an overview of the current status of the event-processing during the execution of Sense-and-Respond loops, delivers reports from data available in the data warehouse and real-time data store, and offers search tools for discovering event patterns in historical events.

The advantages of the SARI architecture can be summarized as follows:

- **Real-time business information:** Minimal latency for preparing and analyzing data, and hence, improved visibility and accuracy of business performance indicators.
- **Optimized business processes** by integrating analytics based on real-time data and historical data
- **Automatic discovery of situations and exceptions**
- **Generating more accurate forecasts:** In near real-time under consideration of current and historic data; these forecasts can be used to proactively adapt the business environment.
- **Integrating internal and external data sources:** correlate and merge event streams from the internal and external business environment
- **Less integration effort:** significantly lower integration effort than traditional data warehouse solutions

8. Conclusions and Future Work

Traditional Business Process Management approaches are unable to move quickly when changes occur. In this paper, we suggest more agile approaches for managing business processes in order to accommodate faster changes in business environments. Similar to agile software development methodologies, the core principles and emphasis of values and priorities will shift. We introduced the concept of Sense-and-Respond loops for monitoring and coordinating the activities of business processes, and proposed an architecture for an event-driven infrastructure (SARI) which is able to process the events of Sense and Respond loops.

The work presented in this paper is part of a larger, long-term research effort aiming to develop an agile business process management platform with Sense and Respond capabilities. This includes server-side infrastructure as well as

front-ends supporting domain experts to work with the processes, and to adapt them as needed. We have developed a graphical model for modeling the event processing tasks within Sense and Respond loops, and are building a distributed system for SARI. Part of the client-side infrastructure is an “Event-Cloud” [12] that allows users to browse and monitor events occurring in the business environment, and to learn from them in order to optimize processes and develop new strategies.

“All we can do is watch carefully, to keep an open mind. And be ready to move. Giving up the illusion that you can predict the future is a very liberating moment. All you can do is give yourself the capacity to respond... The creation of that capacity is the purpose of strategy.”
Lord John Brown [4]

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