

Just-in-Time Business Intelligence and Real-Time Decisioning

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Abstract—Enterprise agility often may be the difference between organizational success and failure. The changing conditions in which businesses operate might be from customers, competitors, partners, market forces, regulatory forces, or world events. In these circumstances, decisioning is playing a critical role and must also be made in real time. Real-time decisioning is an analytic approach that allows organizations to automate the ‘next best actions’ based upon their goals and objectives. It embeds real-time analytic capabilities into business processes and substitutes traditional Business Intelligence (BI) which is oriented dominantly towards analyzing historical data coming from processes that are already accomplished..

Keywords—Business agility, just-in-time business intelligence, decision-making process, real-time decisioning.

I. INTRODUCTION

Seeing, understanding and acting in real time is what defines the ‘Agile Enterprise’. Enterprise agility – the ability to change business and adapt quickly to changing conditions – often may be the difference between organizational success and failure [1].

The changing conditions might be from customers, competitors, partners, market forces, regulatory forces, or world events. Whatever the cause, not being able to adapt quickly has caught many a company flat-footed and unable to respond to an innovation by a more agile competitor.

In the past, enterprise agility has been exceedingly difficult to achieve because viewing all the critical data streaming through the systems, applications, and processes that make up an enterprise’s transaction and information data flow, could not be done in cost effective manner [2].

But, things are changing dramatically. Now business information that can be understood in its business context is flowing between applications – and even between our organizations and those of our business partners, customers, and suppliers. We can now observe in real time any critical piece of business data within these flowing business messages and we can probe for deeper understanding by asking “what if” kinds of questions.

This means that for the first time, IT and Line of Business Managers will have deep visibility to business data in real-time. This will have a dramatic impact on an enterprise’s ability to be agile. This promises to make organizations more

competitive, more responsive, more secure, more compliant, and more profitable [3].

In these circumstances, decisioning is playing a critical role and must also be made in real time.

II. CHARACTERISTICS OF REAL-TIME DECISIONING WHEN APPLIED TO BUSINESS MANAGEMENT

A. Real-Time Business

Business transactions happen in real time. All of them generate data – customer data, product data, sales data, even meta-data, i.e. data about data. People’s as well as businesses’ expectations lie in the real time world. We are impatient. We expect everything to be ‘always on’, always up to date. It would be unacceptable now for any of these transactions or services to be delivered in batch. People couldn’t bid on auctions, or book flights. Nobody wants current account that shows yesterday’s balance.

The point is clear: in an ‘always on world’ where we run our lives minute by minute, wirelessly connected to a wide variety of information sources, we cannot afford to run our businesses based on out of date information.

Customers expect instant results, and don’t want to wait for answers. We are already struggling to make sense of the data we have, and data volumes are growing significantly faster than processor capability. If we carry on doing the same things each year, we are going to have a problem: ever more data and ever less insight into our businesses.

Almost every business practice has adapted to shortening business cycles, except for the Business Intelligence world. Why do we run our business operations disconnected from the insights that could make us more money and reduce costs? Why should we use out-of-date information all the time? Clearly something has to change in the way that we (human beings) use technology to process and analyze data.

Businesses that can use this data to provide faster, better, cheaper, individually personalized services will be the inevitable winners of the next information age – the age of intelligent business.

B. Real Power of Today’s Business Intelligence

Almost every major business or organization the world over uses some form of Business Intelligence (BI) to run their business. BI enables us to plan and budget, control costs, figure out how to acquire new customers, and understand how to retain our existing ones; how to comply with regulators and

ultimately to report results to shareholders. In short, BI is the eyes and ears checking the performance of our businesses [4].

There is no doubt that BI has helped to publish information, held in static databases, to many middle and senior business managers effectively. It has enabled us to move from consolidating financials monthly, to daily.

We can now view data onscreen in published reports, nicely formatted, in place of the continuous computer paper printouts inches thick delivered on a trolley. But simply because you can now automate the distribution of data to users doesn't mean that in every case you should. Clearly you can generate an ROI that shows how much money you'd save compared with doing it manually, but users constantly complain of information overload.

Distributing reports out to the field doesn't change people's behavior. If the goal is to get them to manage their budgets more effectively, then training might be in order. Just sending a report, where the only indication that they're heading for an overspend is one number buried somewhere in the report, is not effective at decision making and driving change.

The frustration by business users is most often stated as 'information arrives just too late to be really useful'. While at first blush this appears to be a timing problem, it's clear that information needs to be acted upon in order to be useful. Business people universally agree that they don't need more reports. What's lacking is real insight.

This insight is needed at the front line in business operations where it can be used to improve performance. There is too much information that lacks real insight and not enough time to make sense of it all.

To put it shortly: more reports faster, isn't the answer. But it's the answer that today's BI comes up with most frequently.

C. Problem of Latency

Without getting too technical, the real problem is 'Latency'. Latency is the time taken from something happening or changing to the moment when we can do something about it. It is the root cause of the problem in the architecture used today for BI. Latency, of course, is not a simple concept, but it is critical to BI.

A study of BI latency [5] shows that there are three types of latency:

- data latency,
- analysis latency, and
- decision and action latency

These three types of latency and their impact on business value are shown in Fig. 1.

Much of the recent work in BI has been to do with reducing the first category: data latency; feeding data faster into the data warehouse. The apocryphal example is the supermarket chain where the data is available for analysis in the data warehouse before the customer has left the car park.

But, this is not enough. Analysis latency and decision and/or action latency should also be shortened or even declined. The ultimate goal is to minimize the entire latency and, consequently, to minimize the lost business value as well.

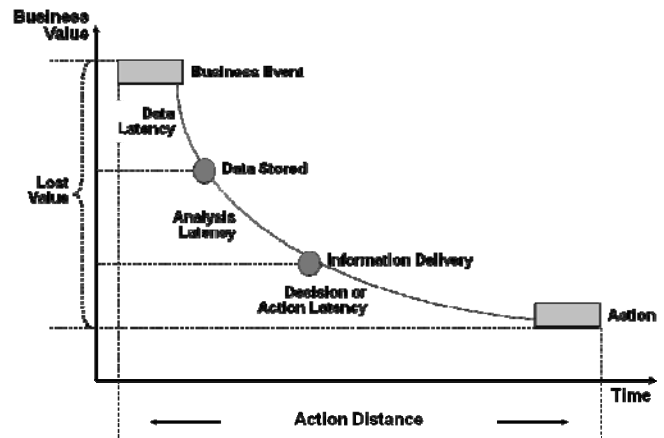


Fig. 1 types of latency

Fig. 2 demonstrates consequences of shortening the overall latency in a decisioning process.

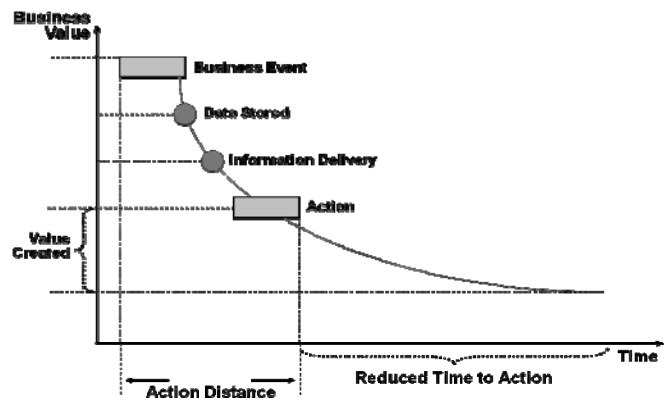


Fig. 2 shortening the overall latency

So the major problem with current BI is only partly the data latency; just as critical is the manual analysis process, and the time taken for real decisions to be made which can positively affect the business.

A retailer might survive these long delays. But in today's real time world, many businesses cannot afford to wait and are looking to BI to provide, not only the information, but the insight, the decision and in many cases the automated action.

D. Real-Time Decisioning

Real-time decisioning is an analytic process that allows organizations to automate the 'next best actions' based upon their goals and objectives. It embeds real-time analytic capabilities into business processes. It analyzes events as they happen, and recommends actions that will most likely influence those events to achieve a set of defined performance goals.

Real-time decisioning captures the result of every event and recommendation, and learns from experience. This allows the solution to self-correct and significantly affects the operation

of processes in real-time which can lead to more informed business decision making and more agile business management [6].

This kind of decisioning is an active participant in business processes. Because it can be embedded in virtually any process, it is uniquely positioned to observe all process parameters. Those can include contextual information, such as time of day and purpose for a customer's phone call, and profile data about the actors, such as the customer making the call and the agent answering the call.

III. THE THREE-STEP PROCESS: EVENT-INSIGHT-ACTION CYCLE

To better understand the main features of real-time decisioning, let us think for a moment about how, for example, customer experiences are analyzed and operated by one person. The owner has a very good view of all company activities; therefore he or she can take good care of his/her customers. If there is a problem with one of his/her products, he or she will personally and quickly discover the issue and react to it. He or she can optimize his/her inventory against what he or she knows about the buying habits of his/her customers and also shortcut unnecessary processes and react quickly whenever he or she learns something new.

In large companies, processes are distributed across many participants, including systems and people; there is no one person capable of learning from the many interactions and activities that pertain to each customer [7]. When problem or opportunities arise, they may be noted and analyzed later – sometimes weeks or even months after-the-fact. Rarely is a person or system able to react to the problems or opportunities as they occur.

In general, there is a three-step process that typically takes place before directed, insightful action can be taken in response to a problem or opportunity, as illustrated in Fig. 3.

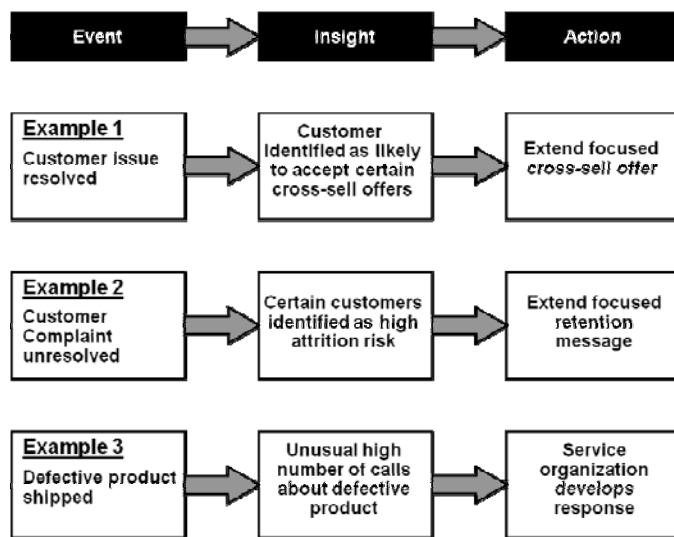


Fig. 3 event – insight – action cycle

The lag time between the event (e.g., defective product

being sold to customers) and insight can be weeks. During this time, the organization assumes a substantial liability in terms of additional service costs, replacement product, and customer dissatisfaction. But, the liability does not end there.

The company must still make a decision on how it should respond to the event, and take action. In the example of an organization shipping defective product, it may be several more days or weeks to execute the appropriate response (e.g., proactively contact customers with recall notice). Again, the organization assumes a significant liability in terms of service costs and customer dissatisfaction during this lag time [8].

The lag problem illustrated above can cause a direct and substantial impact to both sides of the business' profit and loss.

IV. LIMITATIONS OF TRADITIONAL DECISIONING APPROACHES

A. Offline Analytics

Some organizations attempt to identify and react to key events by using offline analytics such as traditional business intelligence (BI) tools. Once insights are gained, a reactive plan is set into motion to address the problem or opportunity [9]. But, this approach has some severe limitations.

In terms of the simple three-step process described above, the singular purpose of offline analytics is to identify important insights. The automations of actions must be pushed to another system that is discontinuous with the overall decisioning process. This creates a capability gap between insights and recommended actions.

As a result, organizations must make up for this capability gap by spending more time and money on manual steps such as integration between the offline analytics and processes. Additionally, offline analytics are not capable of 'learning' whether their prescribed recommendation was successful or not because there is no feedback from processes to analytics. Organizations relying on offline analytics for decisioning have to query manually the system to determine recommendation effectiveness.

While offline analytics play an important role within every organization, it has inherent limitations that restrict its ability to make decisions and influence events as they take place. These limitations include [10]:

- An inability to define key performance goals that the analytics are designed to support.
- An inability to monitor processes and results in real-time.
- Time lag issues from the time an event takes place until the problem/opportunity insight is queried.
- High costs issues associated with the highly skilled, manual analyses (and people) that is needed to extract new knowledge.
- A narrow focus on a small number of important analyses due to their manual nature.
- A complicated infrastructure that makes analyses fragile as well as prone to a high degree of

administration.

- An inability to recommend and/or automate appropriate actions in real-time based on key insights.

Today, companies waste a lot of money by taking the wrong actions with their customers [11]. Traditional offline analytic tools are not designed to identify key events in real-time and take appropriate action automatically.

B. Rule-Based Systems

Some organizations try to use rule-based systems to predict scenarios that trigger specific actions to take place [12]. While this approach seems to provide a high degree of control, organizations cannot predict every unique scenario that must be defined in a rule-based system. In reality, rule-based systems actually provide a limited amount of control to help organizations achieve their performance goals.

In terms of the simple three-step process described earlier, the purpose of rule based systems is to execute specific actions when certain conditions exist.

Whereas rule-based systems play an important role within some organizations, these systems have inherent limitations that restrict its ability to make the right decisions to achieve performance goals and objectives. These limitations usually include:

- Scalability problems that result from the number of rules that must be manually written to predict every unique situation that should receive a pre-defined response. Even simple rule-based system implementations can have multiple-thousands of rules.
- Complexity problems that result from the nested functions that must be written to address the granular details of segmentation schemes and unique scenarios.
- Administration problems that arise from the complexity and scalability problems.
- One or more administrator must make changes throughout hundreds or thousands of rules contained in the system.
- Flexibility problems that result from the inability to quickly adapt the system to changing customer or market conditions.
- A lack of closed-loop insight that would be able to show the effectiveness of the rules-driven recommendations.

Whereas rule-based systems are able to take action automatically, the recommended action is not always the best action to achieve performance goals. Additionally, rule-based systems provide a limited amount of control that quickly gets over-complex as the number of rules increases.

To avoid limitations of traditional rule-based systems, they are evolving to so-called Business Rule Engines (BREs). BRE technology intends to traverse the enterprise, interacting with disparate data sources and applications and executing the decision-making process [13].

Limitations of business intelligence offline analytic tools and traditional rule-based systems as compared to real-time analytics and Business Rule Engines are shown in Fig. 4.

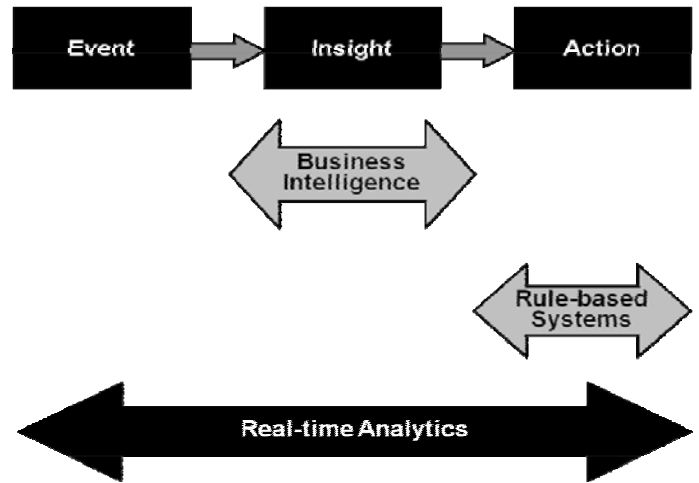


Fig. 4 real-time functional limitations of business intelligence tools and rule-based systems

V. A BREAK-THROUGH APPROACH TO REAL-TIME DECISIONING

A. Decision Typology

When the BI community speaks about supporting better business decisions, it traditionally does so from the perspective of strategic decision-making. However, as the BI space matures in terms of technique and technology (and user demands grow), BI continues to evolve. Today, there is significant attention and interest in supporting tactical decision-making as well. Yet, strategic and tactical are not the only types of decisions made in an organization. Many argue that there is a third type: operational decision-making. Table I shows definitions and examples for the three categories.

TABLE I
DECISION CATEGORIES

Decision Category	Examples
Strategic	Broad decisions affecting the entire organization (for example, mergers and acquisitions, market expansion, and new product development)
Tactical	Managed determination of process, customers, products, and so on (for example, defining the acceptable level of risk for new applicants)
Operational	Transactional decisions (for example, approving or declining a specific application, detecting fraud, and so on)

The end game for BI is not simply exposing actionable information and insight. It is also to ensure that action is taken to improve business performance. The challenge for BI is not only to determine what information is combined with what knowledge but also to ensure appropriate action is taken.

For strategic and tactical decisions, any action taken requires human intervention. Curiously, there may be considerably less effort on the BI team to service these types of decisions. The BI team may need to build a data store and install tools that allow users to perform their own research for insight. An Online Analytical Processing (OLAP) cube, for

example, is implemented for a subject matter expert to interrogate data. The BI team often focuses only on providing the cube and tools, and the user is tasked with finding any actionable insight, making these types of decisions less difficult to implement than projects focused on operational decisions. Operational decisions can be, and often are, automated [14].

Fig. 5 shows the direct relationship between the decision category and the amount of human intervention required. Since they are often automated, considerably more research and implementation work rests on the shoulders of the BI team.

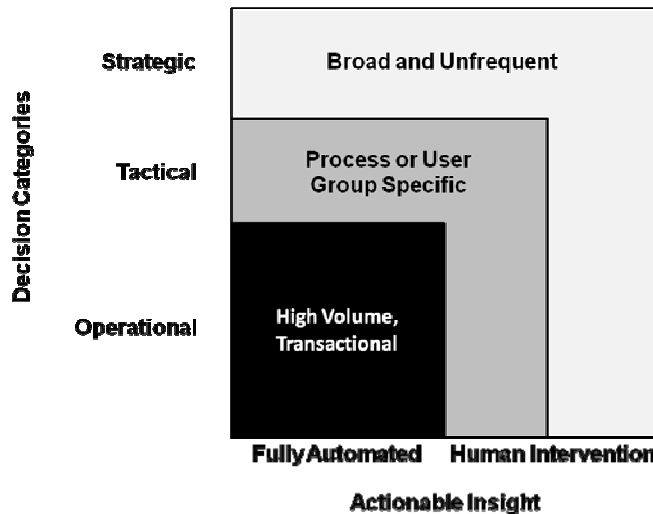


Fig. 5 decisions and automation matrix

Strategic decisions (such as those regarding expansion) have broad implications for the direction of the organization as a whole. Answers to these types of questions are rarely derived from a purely automated environment. Even when building simulation models, subject matter experts must still evaluate the results and formalize actions taken.

Tactical decisions are focused on managing processes, such as evaluating and establishing the level of risk the organization is willing to assume for specific loan products (for example, mortgages).

Operational decisions, however, are the most fundamental. They address individual business transactions (such as whether a loan is approved or not). In addition, they likely represent the highest number of decisions made on a routine, day-to-day basis. It is precisely for that reason that operational decision making can and should be targeted for a high degree of automation.

In order to provide BI value, business architects must understand the types of decisions made in organizations, including strategic, tactical, and operational. Each category provides clues as to the type of action process that is feasible. Strategic and tactical decisions are often best suited with some human intervention. Once a decision has been made, it is possible that the action process is a composite of several

disparate adjustments to operations. On the other hand, operational decisions can often be fully automated and the subsequent actions can be a part of an inline process.

B. Automating the Decision-Making Process

Although maybe somewhat surprising, the research revealed that not all user communities follow the same process or have the same requirements to make decisions [15]. Thus, architects must include defining the process for each BI requirement being designed and implemented. To that end, BI architects must answer two questions:

- *What is the decision-making process?* The notion of helping organizations make better decisions and become more efficient is hardly new. To effectively implement systems that support the decision-making process, you must understand the process.
- *How can the BI environment make that process better?* Once the BI architect understands the decision-making process, it is important to answer two subordinate questions:
 - What are the most predominant decision-making process patterns used in the organization?
 - What technologies can be implemented to support and automate those patterns?

Automating the decision cycle provides many benefits, including the following:

- decision consistency
- real-time capability
- addresses operational decisions
- 24-hour-a-day, 7-day-a-week capability

Those benefits are fundamental for building a real-time decisioning system.

C. Real-Time Decisioning Approach

A real-time decisioning approach can help organizations to proactively and consistently take the best actions with their customers, and in turn achieve their desired performance and effectiveness goals [16].

There are few characteristics of real-time decisioning platforms that make it uniquely suitable for operation within processes:

- First, it can look at a broad array of data; unlike humans, an automated system can look at hundreds or even thousands of pieces of data, checking all of them for correlations, in parallel and within the time period that that data is still relevant to customer interaction.
- Second, the analysis is done as a part of the process, so there is no delay of discovery. As soon as data reflects the problem, it is discovered.
- Third, the analysis is automatic, so that there is no need for a person to be alert and perform the necessary queries to detect the anomaly, it is detected automatically.

Such a break-through approach can overcome the limitations of traditional decisioning approaches including business intelligence and rule-based systems, due to its

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VI. HOW REAL-TIME DECISIONING WORKS

Here, we present six steps which have to be accomplished to make real-time decisioning possible. These steps include:

- a. define performance goals
- b. connect existing ERP and CRM systems and customer processes
- c. monitor processes in real-time
- d. learn about customers and processes automatically
- e. evaluate the impact of potential actions on all performance goals
- f. drive the best actions and refine business processes

In following subsections we discuss these six steps.

A. Define Performance Goals

Compliant to business strategy of the enterprise, specific performance goals are defined, such as [17]:

- customer retention rates
- self-service success and failure rates
- cross-sell revenue rates
- sales cycle success rates

These goals are defined with the real-time decisioning platform as goals that are to be tracked, understood, and managed.

B. Connect Existing ERP and CRM Systems and Customer Processes

The real-time decisioning platform is to be connected to enterprise resource planning applications, customer relationship management applications, self-service channels, databases, data warehouses and data marts, and other applications and systems.

Connecting the real-time decisioning platform to these types of legacy applications and data sources can be done rather quickly, particularly if Web services technology is implemented, since Web services technology enables connection and integration of applications and systems of virtually any kind without much intervention needed.

C. Monitor Processes in Real-Time

The system continually monitors the real-time stream of events that are generated by the flow of customer and process interactions within the enterprise. As a means of processes monitoring a kind of modified rule-based system can be used.

D. Learn about Customers and Processes Automatically

The real-time decisioning platform automatically builds and maintains real-time predictive models that track and explain the specific factors that drive organization's key performance goals. A form of predictive and proactive business intelligence solution may be used to make insight into customer and process behavior.

On a real-time basis, the shifting patterns of customer and process behavior are continually discovered and prioritized to enable proper reaction to changing conditions and learn about customers and processes automatically.

E. Evaluate the Impact of Potential Actions on All Performance Goals

In real-time, the system evaluates the impact of all relevant decisions and recommendations on customer profitability and organization's performance goals. This is unique because it realizes that performance goals are multifaceted and interdependent.

For example, cross-sell offers may have a bigger impact on defection rates of unsatisfied customers vs. satisfied customers [18]. In this case, the system must automatically calculate and evaluate the relationship between customer satisfaction, retention, and cross-sell acceptance likelihood to decide the best action to recommend.

F. Drive the Best Actions and Refine Business Processes

Businesses make real-time adjustments to their business processes to improve their performance relative to their goals. Some of these adjustments will happen through offline changes to people, process, or technology.

VII. IMPROVING PROCESSES WITH REAL-TIME DECISIONING

By trying real-time decisioning to the improvement of specific performance goals, an organization can add intelligence and significantly influence every enterprise business process.

Real-time decisioning can advise operational systems to optimize recommendations that are made in process, and it can also make decisions where none were made before.

Using real-time decisioning makes it possible to make informed decisions regarding how to treat every participant in a given process based on the characteristics of the actor, as well as the context.

The promise of real-time decisioning is to provide actionable insight into business processes. Of course, the most significant aspect of traditional BI technology is that they fall short of that promise. The typical BI tool can, at best, expose insight to user communities. However, it is entirely up to the users themselves to decide what to do with any found insight, as well as how to implement that insight in order to maximize or improve operations.

Approaches such as Business Performance Management (BPM) provide a roadmap to take insight and drive it back into operations [19]. However, what tools can be implemented to make BPM happen? What technology can reach across BI and Operations in such a way as to complete the cycle, going from data to information to insight and, finally, to action, transforming, and improving operations.

Technology supporting real-time decisioning is designed to reach across platforms, data architectures, and applications in an effort to extract the necessary data of a particular decision, glean the necessary information and insight, and finally act on

that insight based on established business rules, subsequently modifying actions and operations toward improved performance.

Real-time analytics is discussed by BI analysts and software vendors throughout the BI industry. Unfortunately, with all the discussion regarding the importance of real-time analytics, there is little or no guidance regarding its implementation, i.e. transforming it into real-time decisioning systems.

Real-time decisioning environments must provide a means to expand the capability of effective decision-making. Optimizing the decision support process requires an understanding of the process itself. The more complex the information, or the closer one gets to real-time cycles, the less likely human intervention is welcomed.

The problem, of course, is how to take these decision-making steps and implement them as inline processes. One proven approach is to encapsulate the knowledge of subject matter experts into a BRE. It is the task of the BRE technology to provide a means to capture the decision steps, reduce them to efficient code, and implement them inline, making decisions 24 hours a day, 7 days a week, in real-time.

The act of encapsulating business knowledge into the BRE environment affords two other benefits as well. First, BREs provide a means to consistently apply the decision-making process across our enterprise. This ensures that our organization is making the best decision possible each time as opposed to relying on junior analysts or inexperienced individuals. Secondly, BREs ensure decision-making integrity and accuracy even at the most granular level of data.

VIII. EXAMPLE OF REAL-TIME DECISIONING IMPLEMENTATION IN A CONTACT CENTER

A call center has the objective of reducing costs by keeping every customer in the interactive voice response (IVR) for self-service. The concept is to reduce the number of service requests that utilize live agents.

Typically, a global decision like this is not optimal. Organizations realize that different customers provide differing amounts of value to the organization, and therefore some customers require different treatment such as better service. The most valuable customers generally deserve the premium service and this can be usually assured in human-to-human interaction mode.

For example, when high-value customers call into the contact center, it may be a better and smarter long-term strategy to direct them to specialist agents as soon as customers are identified. This serves to shorten overall time to resolution (i.e., service costs), and enables the organization to provide outstanding customer service to a selected group of high value customers.

But how does an organization dynamically decide which customers should be treated as privileged since they deserve it and therefore sent directly to human agents instead of keeping them in the IVR?

With real-time decisioning, it could be solved like this:

- The real-time decisioning platform predicts the effect that routing the customer directly to a human agent will have on the likelihood of:
 - the call being resolved with a live agent anyway;
 - succeeding in a cross-selling effort for this customer at this time;
 - affecting the retention factors for this customer;
 - reducing the overall time to issue (problem) resolution.
- The real-time decisioning platform determines, based on the prediction (cited above) and additional business rules, when it is better aligned with the company's goals to route the customer directly to the live agent.

The real time decisioning platform may discover that there are situations where it is better to route customers directly to a live agent.

For example:

- The customer has a high potential value score. The long-term or life cycle value that this customer can provide may justify better treatment today to retain the customer.
- The caller has called three or more times earlier in the same day. This may indicate possible attrition risk which is better handled in personal contact.
- The caller is not identified as high value customer but the system discovers he had made three subsequent purchases the same day. In spite of the fact that the value potential of this customer is not yet recognized as high, it may be a good decision to serve him in direct contact with a human agent who can, through a longer interaction with the caller, examine how 'serious' he is in his intention to buy something more from the company.
- This is the first call for the caller in a long time (perhaps after six or more months). This is an opportunity to nurture the relationship with the customer and may be a perfect cross-selling opportunity.
- Every time the caller calls, the IVR interaction is a direct 'zero-out' – the caller presses '0' until transferred to a live agent. This may indicate a customer that is frustrated with newer customer service technologies. It is better to route this call directly to a human agent. Another option may be to try to educate the caller in use of IVR, which can be accomplished by prompting the agent to explain how the desired operation could have been easily achieved in the IVR.

Following with the example, the real-time decisioning platform may advise the call router to route calls based on the likelihood of customer to accept a cross-sell offer – but only if the queue is below a certain size at the specific moment of the call, and only if the customer is of a certain, precisely determined lifetime value.

IX. CONCLUSION

Today, enterprises are under relentless pressure to achieve higher levels of agility: the need for speed and flexibility is paramount in every industry [20]. Increasingly, the best organizations, to remain leaders, must have faster response to customers, competitors and to other external market forces. They must make decisions quickly, possibly in real time.

Automated real-time decisioning is the next automation frontier. Its influence in the business world has the potential to be as significant as other major automation efforts have been in some earlier cases.

Real-time decisioning is an analytic process that allows organizations to automate the 'next best actions' based upon their goals and objectives. It embeds real-time analytic capabilities into business processes. It analyzes events as they happen, and recommends actions that will most likely influence those events to achieve a set of defined performance goals.

Some organizations attempt to identify and react to key events by using offline analytics such as traditional business intelligence (BI) tools, as well as rule-based systems to predict scenarios that trigger specific actions to take place. Once insights are gained, a reactive plan is set into motion to address the problem or opportunity. But, this approach has some severe limitations.

Using real-time decisioning makes it possible to make informed decisions regarding how to treat every participant in a given process based on the characteristics of the actor, as well as the context.

In conclusion, we can make a little comparison to illustrate the real-time decisioning potential: when businesses switched to tracking documents digitally, not only efficiency was affected, but a whole new world of applications was opened; in a similar way, real-time decisioning will certainly create and define entirely new ways of doing business.

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