SAP DECISION MANAGEMENT VISION AND ROADMAP

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Keywords: S/4HANA, Rule as a Service, Decision Management, HRF, DSM, BRFplus, BRM, HCP, Cloud Foundry, BRMS, IoT, Big Data
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1 BACKGROUND

The business rules approach originates from expert systems, a technology trend of the late 1970s and early 1980s. While expert systems modeled complete solutions with rules, including facts and logic, their application domain was confined, mainly since their "holistic model" did not accommodate well external code, data bases, physical interfaces, other solutions and real world problems.

This document centers on a more recent and well accepted use case for business rules - modeling part of the business logic of an application or a process. In such concept, business rules are defined using design concepts, such as decision tables and decision trees, and typically grouped into rule sets to handle specific events or situations. Rule sets are habitually called as services to handle point-specific tasks that hand results back to a traditional programming flow implemented with a Business Process Management software or with code. Calling rule sets as services ease optimization and integration.

If during the first years, many of the use cases for Business Rules Management Systems (BRMS) were enterprise policy oriented, the need to externalize decisions in many more domains introduced the concept of Decision Management Systems (DMS) that extended the requirements from this supporting function. While the business rule approach started with a very narrow definition of what an IF-THEN business rule should be and how business problems have to be solved, Decision Management accepts many other metaphors: spreadsheet-like decision tables, flows, decision trees and formulas are the most important ones. These are more easily understood and implemented by functional experts, mainly because of their sequential execution. The DMS concept contains the capabilities known from BRMS with a strong focus on simplification for ease of adoption by applications in different domains. Additionally, DMS put more focus on decision analytics, rule-mining, and simulation for continuous improvement of the implemented decisions. This combines the traditional business rules modelling concepts with predictive analytics and optimization. In this document we use of the terms BRMS and DMS as well as rules and decisions in alternating ways, and the reader should regard the decision technology under discussion in its broader term.

The proliferation of heterogeneous landscapes as well as cloud platforms extended the scope of use to a growing number of end user oriented decision management tasks. The variety of landscapes and the growing number of online use cases poses new challenges for BRMS, such as managing several decision technologies on different landscapes, or melding persisted Big Data and fast transactional data, as required by many Internet of Things (IoT) scenarios.

The objective of this document is to describe these new demand trends for BRMS as well as the roadmap of SAP product offerings view of these trends. SAP offers several propriety BRMS solutions on different technology stacks, where the three main are SAP NW Decision Service Management (DSM) / Business Rule Framework plus (BRFplus) on the ABAP stack, SAP Business Rule Management (BRM) on the Java stack and SAP HANA Rules Framework (HRF) in SAP HANA. These different rule frameworks emerged due to the required depth of integration between business applications on different stacks and the BRMS engine.

In view of the industry trends described below, the focus of this document is on embedding HRF analytical rules processing into SAP NW DSM to provide S/4HANA with differentiating decision management capabilities and the provision of rules services as key functionality to SAP Cloud platforms.

1.1 Why BRMS?

In daily business, strategic plans are implemented by a countless number of decisions, either manually or automated in business applications. The ability of organizations to change decision making and the time needed for such changes depends highly on the method of implementation. A Business Rule Management System (BRMS) is a software system used to define, deploy, execute, monitor, and maintain the variety and complexity of decision logic that is used by operational systems within an organization or enterprise. This logic, also referred to as
**business rules**, includes policies, requirements, and conditional statements that are used to determine the tactical actions that take place in applications and systems. BRMS helps in automating operational decisions and enable business users to manage operational decisions. BRMS systems are emerging as a popular alternative to traditional implementation and extension methods that are either technical (program code) or difficult to control and enforce (office documents, human decisions based on tacit knowledge). The classical code extension mechanism is via customizing tables and code exits. Offering table driven configuration is very popular in application development due to the ability to generate standardized maintenance screens. Nevertheless, table driven configuration does not enable business analysts to take a lead in the customization activities and leaves it in the hands of technical resources. Even more important is that the approach assumes that kinds of changes can be exhaustively specified, which is not possible given the very limited expressiveness provided by configuration tables. Formulas cannot be expressed in a customizing table due to their unstructured natured. The same is true for any other data that is difficult to save in a structured DB table, such as Boolean conditions. To overcome those limitations, code exits in various forms exist, e.g. BADIs. While code exits provide a high degree of flexibility, they are usable for developers but not for business experts or business consultants. Obviously, everything that goes beyond simple Customizing tables and that requires visibility is better implemented by a BRMS. This has the great advantages of simplifying customization and allowing business analysts to play a more meaningful role in the customization activities.

Separating decisions from processes helps to simplify both the process as well as the decision service. Change can happen to decisions and process independently of each other. Decision making can be organized into meaningful sets of rules. Explicit decision services are more easily understood, optimized, tested, and reused as all those activities can be executed by business experts independently of the processes. Decision services can be associated with business responsibilities and objectives. Examples are master data validation, tax and eligibility calculation, account determination, marketing offers’ prioritization, suggesting next best actions, personalization, A/B testing, routing and more.

Hence, the typical expected benefits of using a BRMS are:

- **Better Business Management** - by separating data and logic, business users and domain experts are empowered to express the logic in their own terms w/o reliance on IT resources. This also provides enhanced control over implemented decision logic.
- **Business agility** - since the time to market for updating business rules is shorter than updating code and dependence on IT processes and software cycles. This simplifies IT processes for changes in live systems, although QA and Rules testing would still be needed in any enterprise system.
- **Enhanced readability and reasonability** since business rules express decision logic with more clarity and are easier to read than code. BRMS do that by using business vocabulary syntax and graphical rule representations under the form of decision tables, trees, scorecards and flows. In addition rule systems are capable of solving complex problems while explaining the reasoning process that can serve as an explanation of how the decision was arrived. Such explanation is key for decision support of a human being.
- **Legacy Preservation and Compliance** - extracting rules from legacy software prolongs the lifetime of legacy code and facilitates compliance to changing requirements and regulation.
- **Improved efficiency** of processes through decision automation. Handling decisions with dedicated and performant engines frequently provides better processing efficiency that is not dependent on the programming skills of a certain developer. In addition and when needed in extreme cases, decisions can be optimized in a systematic and easier than drilling into code optimization.
- **Cost Savings** - BRMS create the decision transparency that helps implement business processes faster, aligning business with IT and therefore cutting down the Total Cost of Implementation (TCI) and the Total Cost of Ownership (TCO). The cost of updating business rules is lower than updating code for applications and infrastructure changes.
1.2 Components of a Classical BRMS

BRMS typically consist of a rules repository, an execution environment and authoring tools abstracting concrete implementation details and therefore providing the capability for non-technical people to understand and change decision making, and to connect it with business applications.

This is depicted in dashed area in Figure 1, along with some other illustration of integration and typical persona:

- **Repository** allowing decision logic to be externalized from core application code, storing the logic and managing its lifecycle.
- **Rule authoring and management environment** that includes a set of tools allowing both technical developers and business experts to define and manage decision logic.
- **Rules Execution Environment** – typically referred to as the "engine" or the runtime environment, allowing applications to invoke the decision logic managed by the BRMS and to execute it.

![Figure 1. Typical Components of a BRMS](image)

In recent years, the term *decision service* has been widely used in relation to business rules management, reflecting the growing adoption of SOA-based architectures. A decision service is defined as a self-contained, callable service with a view of all the conditions and actions that need to be considered in order to make a decision. Decision services are part of the consumption interfaces depicted in Figure 1.

1.3 Operational Decision Management and Analytical Decision Management

Operational decision management complements strategic decision management, sometimes called *analytical decision management*. While strategic decision management deals with analyzing large amounts of information for making high impact decisions, operational decision management is about tactical decisions, typically based on processing of one or few transactions, which occur in high volumes in a daily business practice. Operational decision management, as a discipline, is not just a re-branding of the business rule approach. Instead, it stands for a better defined scope and clear integration points into processes and applications.

Having said that, with the rise of interest in Big Data and IoT, some of the above distinctions are blurred and require re-visit. For example, operational IoT systems are required to process large amounts of data in near real time for tactical decisions. In some cases data processing and decision making is distributed to the edge before this information is transformed into transactions, if at all. We address this convergence in more details below and in our roadmap discussion.
1.4 New Trends and Challenges

The proliferation of software and the internet into every part of our professional and personal life in the late 1990s dictated a more open, flexible and agile paradigm to software applications. Amplified by the frequent change requirements enforced by the environment in which the software functions such as new regulations, markets evolution, customer behaviors trends and new policies. This means that domain experts and even end-users need to be able to modify the software behavior without really going into IT departments and software vendors to make it happen. The use of BRMS enabled building applications that support modification of the application logic to comply with such change requirements by non-technical people. Process and application structures change less often compared with business rules, are usually more complex in definition, and therefore are better implemented with traditional programming or usage of BPM tools.

Until recently most of the BRMS solutions were standalone process centric engines that typically acted on transactional data. In such scenarios the engine is called at some point and provided with some relevant transactional data. Using this information and, optionally, some other historical data stored in a database or pre-loaded into the decision server’s memory, the engine makes decisions and returns an output and/or triggers some action.

In the next paragraph we touch some new trends that introduce new needs and expectations from BRMS that we need to consider for SAP decision management roadmap.

1.4.1 Big Data and IoT

The data flux around us has proliferated greatly in the last decade and created the interest in Big Data. Not only we generate and store today much more data, it comes under a variety of formats, much of it is unstructured, and in a growing speed. Beyond the challenges of storing and retrieving such data in economical and useful ways, many organizations try to make use of it in order to gain a competitive advantage. Many of the initial use cases for using Big Data were around insights, such as customer sentiment analysis based of text or audio analysis, identification of risk of equipment failure based on processing information from remote sensors, fraud analysis by correlating alerts from different fraud detection methods, etc. Note that most of these scenarios require not just collecting and storing large volumes of data or the capability to analyze them, but how quickly one can intelligently act on them. Using the examples given before, the intelligent “insight to action” may be to suggest the next best action to valuable customers that express bad sentiment, trigger actions and logistics to service systems that are prone to fail or act to minimize fraud risk and loss.

Furthermore, the growing interest in IoT scenarios created requirements for online and real time decisions that are based on melding transactional data with large amounts data available and/or stored just on edge platforms (e.g. mobile controllers that control performance and environment parameters on moving platforms like vehicles or humans). While Big Data is being collected the expectation is to process these large volumes of heterogeneous data on the fly melded with data recently acquired (“fast data”) from the edge and ultimately make real time decisions.

If classical transactional decisions were based on loading small amount of information into a rule engine, such as customer data, scenarios like these are only feasible if decision logic is distributed to where the data is, and not bringing all of it to a central engine. This means that part of the logic will be executed on the edge. In the example used before, if we are monitoring temperature on a component of the a vehicle in order to detect some abnormal heating pattern, there is no point of transmitting these measurements to a central location or even store them somewhere but this logic can be run at the edge along with other logic that will run on different platforms.
### 1.4.2 Cloud Platforms and SaaS

The adoption of BRMS in cloud deployments is growing nowadays in an order of magnitude faster than on-premise\(^1\). BRMS enjoys the trend toward public cloud services and cloud application platforms that renewed value in environments that provide productivity, agility and flexibility to circumstances. R&D investment in developer tools and the broad space of model-driven application platforms and tools, of which BRMS is a category, is one of the fastest-growing areas. The transformations taking place in the industry toward public cloud services have been contributing to the acceleration of this investment. The key advantage of cloud services for IT organizations is the capability to shift IT resources from maintenance to new initiatives. SAP and other vendors are building suites of developer services platforms that offer multi-paradigm application platforms under one roof, not the least of which is a suite of model-driven application platform offerings.

Most PaaS providers provide business rules functionality for configuration and administration as well as in services that provide a differentiating value. For the cloud applications developers’ community the separation of business logic from code and the cloud based services has a large benefit. BRMS and decision points callouts enable developers to easily provide advanced customization, personalization and deployment variation that should be greatly appreciated by their end customers.

### 1.4.3 Business User and End User Empowerment

Software is no longer considered the secret trade of IT department and programmers. The expectation is that software is accessible to end-users without any training over any device and without the need for technical skills and support. This calls for simplification, abstraction of technical capabilities and high degree of personalization. It is not just the ability to use but also the requirement for control and immediate adaptation of the software behavior and business logic. This is accentuated in fast moving competitive environments where a change is defined by a business user and one cannot wait for IT resources and release cycles.

A similar need for simplification, abstraction and personalization exists also for developers and implementers that use today software infrastructure and platforms that reside somewhere in the cloud and need to be handy and self-serving without any support or deep knowledge and without touching what should not be touched.

BRMS are expected to play an important role in abstracting and hiding the underlying technical infrastructure of applications and platforms and expose the relevant logic in a simple manner for developers, business users and end-users.

### 1.4.4 Optimization, Predictive Analytics and Dynamic Environments

In many scenarios we are looking into a combination of rules processing and optimization for the decision making. Optimization is required whenever we observe a statistic that may have some consequence. For example we observe the engine’s rising temperature and we can predict with a certain probability to fail in the next 24 hours due to this temperature trend and another, maybe lower, probability to fail already within the next hour. Such failure has an expected damage (downtime, damage to additional parts, cost of repair, etc.). Repairing it at different times and by different team may have an expected cost and the decision solution needs to find the right time, logistics source, spare part type, etc. to suggest an optimal solution. Optimization typically leverages use BRMS combined with predictive and forecasting algorithms.

Many SAP solutions interface with physical environments that are subject to continuous change. For example, supply sources and logistics cost may change, new fraud patterns may surface, customer purchase preferences change, climate impacts behavior of humans and materials, etc. Applying decision solutions in dynamic environments and making these solutions sustain for long duration implies two requirements: business user

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\(^1\) Worldwide BRMS Forecast 2015-2019 Gazing into the Cloud, IDC 2015
empowerment discussed before and, in some more extreme cases, automatic continuous adaptation. Adapting solutions automatically detect changes in behavior of the environment and optimize the decision strategy. A simplistic example can be to make statistics on the decision result and correct the decision logic to avoid unwanted results. We are in the midst of defining our roadmap for the integration of predictive analytics and optimization with rule based solutions and will report on it during 2016.

### 15 Standards

Several standardization initiatives tried to turn BRMS into an interoperable engineering framework. Decision management and rules management is one element in the landscape of systems interoperability standardization efforts driven by a number of groups and organizations such as: ISO, OMG and W3C.

As can be seen in Figure 2, there are three key standards that address the management and deployment of rules, namely SBVR, PRR and RIF. Rules management has taken an important part of other standards initiative especially in the area of Business Process Management (BPM) and mainly the Business Process Model and Notation (BPMN) standard. There is no specific standard for BRMS per-se, the success of BPMN has provided a major motivation for OMG DMN (Decision Management Notation) initiative, and business decisions described using DMN are expected to be commonly deployed in business processes described using BPMN.

In this paper we will not drill into these standardization initiatives but will just provide reading pointers\(^2\) for few of the relevant ones.

Besides PMML, which was already adopted by HANA Predictive Algorithms Library (PAL), we are closely monitoring these standardization initiatives and may adopt some of them when it makes sense.

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\(^2\) Pointers to some relevant standards:
- **RIF** (Production rule dialect), Ch. de Sainte Marie et al. (Eds.), W3C Recommendation, 22 June 2010, [http://www.w3.org/TR/rif-prd/](http://www.w3.org/TR/rif-prd/)
- **BPMN** (Business Process Model and Notation), version 2.0, January 2011, [http://www.omg.org/spec/BPMN/2.0](http://www.omg.org/spec/BPMN/2.0)
- **DMN** (Decision Model and Notation), version 1.0, OMG document, September 2015, [http://www.omg.org/spec/DMN/1.0/](http://www.omg.org/spec/DMN/1.0/)
- **PMML** (Predictive Model Markup Language), Data Mining Group, May 2014, [http://www.dmg.org/v4-2-1/GeneralStructure.html](http://www.dmg.org/v4-2-1/GeneralStructure.html); PMML is not directly related to BRMS but may influence decision management deployment that embed predictive components.
2  SAP BUSINESS RULES OFFERING

Acceptance and usage of a BRMS methodology in application development is directly proportional to how well they are integrated into the stack, specifically with the programming models and lifecycle management of the applications. SAP applications use a number of propriety BRMS solutions, where the three main offerings are:

- SAP Decision Service Management (NW DSM) / Business Rule Framework plus (BRFplus) – a transactional BRMS solution in the NW/ABAP stack
- SAP Business Rule Management (BRM) for the Java stack, as part of the SAP Process Orchestration offering - a transactional BRMS solution in the NW/JAVA stack
- SAP HANA Rules Framework (HRF) on the HANA platform; HANA add-on that is mainly used for adding decisions to HANA applications – an analytical BRMS solution embedded within the HANA platform.

These different rule frameworks emerged because of the required depth of integration between business applications and the BRMS engine.

Among other, the BRMS engine is required to

- Provide a performance level that is generally accepted in a technology stack.
- Tightly Integrate with lifecycle management processes and tools.
- Comply with applications’ versioning, audit, security and authorization models.
- Align with the base type system of the stack for rules vocabulary (e.g. Java Objects, XSD, ABAP DDIC, HANA objects, etc.).
- Support application callback for computations, data lookups, and other application specific actions that are not possible in the rule language, e.g. Java method calls in Java environments or BADIs (Business Add-In), methods, or function modules in ABAP environments.

Beyond these runtime and lifecycle related requirements, the ability to embed the rules management user interfaces with the native application user interfaces is important factor for adoption.

2.1  SAP Decision Service Management (SAP DSM) and BRFplus

BRFplus is a SAP homegrown BRMS component, in the NetWeaver ABAP server, created to address a wide range of use-cases in ABAP-based applications such as Master Data Governance, Tax and Revenue Management, or Utilities. Many of those rule-intensive scenarios benefit from a deep integration with BRFplus as business experts can manage the business rules. BRFplus supports various rule representation formats such as IF-THEN rules, decision tables, trees, flows, and formulas. BRFplus fits into the established concepts of the NW ABAP server:

- ABAP API
- Integration with Data Dictionary (DDIC)
- Integration with SAP Business Workflow
- Integration with Change and Transport System (CTS)
- Various exit points for modification-free customer enhancements (such as rule validation)

BRFplus is included in the NetWeaver platform license. SAP NetWeaver Decision Service Management (NW DSM) is a product that enhances the capabilities of BRFplus. It provides integration to all ABAP-based systems in the customer landscape for access to master data, transactional data as well as metadata. It enables functional experts within boundaries defined by IT teams (authorizations, mandatory service tests, and so on) to change and deploy decision services, implemented with BRFplus business rules, into the systems of a customer’s landscape, allowing
for rapid change cycles, other than CTS, to continuously optimize decision services. Deployment refers to the packaging of a decision service in a generated class that is transferred by RFC to the target system where service execution is required. NW DSM provides the option of usage with old systems without upgrades or installing support packages.

2.2 SAP Business Rules Management (NW BRM)

SAP BRM is an integral part of SAP Process Orchestration offering. SAP BRM supports central management of both sequential and inference rules across their entire lifecycle. SAP BRM enables business rules to be externalized and made available across application landscapes via reusable decision services (technically, Web services). In addition, NW BRM also allows rules to be embedded directly into business processes modeled in SAP Business Process Management (SAP BPM). A business rule can be invoked from NW BPM via an automated activity or via Enterprise Java Beans (EJB) functions. SAP BRM is also used to make process flow decisions in gateways and thereby increases the agility of the business process.

SAP BRM is tightly integrated into the Java stack for lifecycle management, monitoring, and so on. For example the development environment is Rules Composer which is part of NWDS, the lifecycle management is handled via NWDI, and monitoring is integrated into NetWeaver Administrator. Such a tight integration provides seamless user experiences for the different personas – the developer, administrator, and the business user.

SAP BRM also supports distributed rules execution scenarios with a lean deployment option, called Lean BRM. Business rules that are authored and managed centrally can be deployed into a lean rule engine running on a JVM on other systems and devices.

2.3 SAP HANA Rules Framework (HRF)

Both SAP BRM and SAP DSM/BRFplus bring all the data into the memory of the rule engine in order to run the rules on this data. HRF takes a different approach and runs the rules logic in the memory of the HANA database where the data resides so analytical rules can process large amounts of persisted data instantaneously. To do that, HRF complies end-user defined logic, under conventional forms of decision tables or textual rules, into optimal SQL statements and groups those into callable optimized rule services under the form of HANA stored procedures and views. To support rapid deployment, HRF provides tools to developers, implementers and business users, such as data mapping and rule creation tools in the HANA studio or Fiori based applications and UI controls that provide embedded logic editors for application development and lifecycle.

HRF is a platform capability of SAP HANA and therefore delivered as a HANA add-on.

2.4 Summary

The table below summarizes SAP’s main BRMS offerings:

<table>
<thead>
<tr>
<th>Target Group</th>
<th>ABAP</th>
<th>JAVA</th>
<th>HANA</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRFplus</td>
<td>NW DSM</td>
<td>NW BRM</td>
<td>HRF</td>
</tr>
<tr>
<td>Authoring UI</td>
<td>Web Dynpro</td>
<td>Web Dynpro</td>
<td>Eclipse</td>
</tr>
</tbody>
</table>

Applications on the ABAP stack

Distributed rules management for applications on the ABAP stack

Composite applications on Java stack

Applications that run analytical rules in HANA. Non-technical end-users.

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Distributed rules management for applications on the ABAP stack

Composite applications on Java stack

Applications that run analytical rules in HANA. Non-technical end-users.
3 VISION AND ROADMAP

3.1 Vision

SAP vision is based on the trends mentioned in detail in the previous chapters and assume the following:

- Rules and decision automation have growing importance and are expected to be a leading component in modern software solutions.

- Cloud and SaaS will grow the importance of providing rule management as service to applications’ developer with an easy to use configuration and consumption.

- Exploitation of Big Data for making decisions in the operational world requires that decisions will run on the storage platforms and inside storage management mechanisms to enable crunching large chunks of information quickly.

- Melding decisions on Big Data and Fast Data, which may even not be persisted, like in IoT scenarios with edge computing, requires decision frameworks that are distributed across platforms but are centrally managed.

- SAP has a number of rules management systems optimized for different technology stacks. This number may grow with adoption of open source software. SAP needs to enable the use of its different technologies but also embrace adoption of other engines into a holistic decision management framework.

- In many scenarios, there is a need to have a central decision management across platforms, technology stacks, operating systems, databases types, cloud and on premise

- Decision management proliferation beyond policy management to dynamic scenarios, such as Predictive Maintenance, requires attending the needs of domain experts that are expected to maintain and be on top of systems behavior. This extension, which may occur outside IT cycles and control, require simple UX and tools that will ensure quality.

- Other persona that require access to decision management are end users that need to personalize the behavior of software around them and application developers that need to embed decision management into their applications without the hassle to develop it from scratch; in the same manner as using a software library.
3.2 Roadmap

SAP currently sees importance in transformation of business applications to S/4HANA and cloud platforms such as the SAP HANA Cloud Platform (HCP). The programming model for S/4HANA core extensions as well as HCP defines extensive use of rules to support ease of configuration, personalization and extensibility.

3.2.1 Rules for S/4HANA on Premise and on Cloud

S/4HANA investments are geared towards optimal leverage of HANA performance and simplification. This is done by architecture simplification redundancy removal with the "principle of one" – to remove redundancy in frameworks as well as in application data. The programming model for core extensions and HCP According to "principle of one" there will be one BRMS framework that will serve S/4HANA compromising existing BRFplus and HRF functionality and potentially other engines’ functionality in the future. The framework will deliver HRF as a capability of NW DSM for data intense business rules processing in HANA.

The other simplification aspect for S/4HANA is the enhancement of the user experience with the Fiori/UI5 paradigm. The single S/4HANA BRMS will repose on one UX based on the latest UI and Fiori standards.

There are two key use cases for BRMS in S/4HANA requires BRMS functionality for the following two main use cases:

1. Decision management services for S/4HANA applications’ development, as embedded components.
2. A decision management application to deploy rules across S/4HANA applications, for example for data retention and archiving policies, data quality services, authorizations and access control, etc..

As such, S/4HANA architecture guidelines dictate that business rules should be used when a table-based customization is not possible or too complex. This is for example the case when relevant parameters are not known at the time of development or when many optional configuration tables have to be provided for a configuration task. In addition, business rules should also be used to implement BAdIs for behavioral extensibility.

The alignment of HRF and BRF+ will be based on a common transportable rules syntax, joint features set, common design time and REST based interfaces. As part of this alignment some advanced exotic capabilities that are not part of the joint feature set and intimately related to one stack only, may require access via the legacy UI.

Customers will be able to execute the same set of business rules on different platforms without the need to write rules again – "define once use everywhere". Typical scenarios are business rules created in Business Suite applications with NW DSM that need to be executed on big sets of data, such as check rules in Master Data Governance built with BRFplus for validation of new master data records that are also applied to existing records in HANA. For harmonized consumption of business rule artifacts, a common consumption model via ODATA/REST APIs across NW DSM/BRFplus and HRF will be provided as well as other consumption methods, e.g. views and tables inside a database.

A single framework will serve both S/4HANA on premise and on cloud. S/4HANA applications will use this framework seamlessly for SAP customers. SAP customers that will want to manage rules across applications and landscapes will do that via deployment of SAP DSM and will control the lifecycle of BRFplus and HRF rules via an enhanced Fiori UX.
3.2.2 Empowering business users and domain experts across platforms and technology stacks

The diagram in Figure depicts the target architecture for SAP’s BRMS framework and illustrating SAP’s current main business rule technologies: NW DSM/BRFplus, HRF and BRM.

As shown in Figure 3, we envision a unified framework (referred to herein as DSM*) that will

1. **Leverage existing and new transactional engines and add analytical processing in a single framework** by generating code into the relevant databases for analytical decision making in a similar way as done today with HRF in HANA. The HRF framework will be extended to generate code to other databases and edge platforms like Complex Events Processors.

2. **Provide a common business oriented UX** to the non-technical end-user. This UX will provide UI5 rule authoring controls that will provide a semi natural language experience with contextual online suggestions and guidance. As can be seen in Figure 4, rule authoring uses an English-like authoring user experience for writing expressions where the software suggests at every moment the more plausible operator or variable to extend the expression. Other common UI paradigms to be supported are Decision Tables, Rule-sets and predefined UI templates with dropdown selections to constrain end-user and speed his/hers work. The common UI will be offered as a BRMS UI for standalone use of the frameworks as well as UI controls that can be embedded in SAP and Custom applications that want to embed decision management.

3. **Centralize rules, administration data and metadata in a single repository**. This repository will enable distribution of decisions to systems and functional areas with a centralized management ensuring transparency, auditability, agility and trust.

4. **Optimal distributed execution** from a central repository to satellites to which decision services can be transferred for execution. The satellite consists of a minimal set of components including a remote connector, a runtime API and a basic repository.

In this target architecture we provide compilation and code generation services for analytical processing in HANA and other databases or edge platforms. Rule are centrally managed and distributed to the appropriate execution platform. Applications can use the APIs and tools of the respective stacks directly. For harmonized consumption of business rule artifacts, a common consumption model via ODATA/REST APIs across technologies and platforms is delivered.
The first step of harmonization was delivered for S/4HANA Cloud with NW 7.62 on November 2015. With that, DSM Web Dynpro users can invoke HRF controls, author and compile HRF rules into HANA SQL and services.

The next enhancement will be delivered towards the end of 2016 with NW 7.51, which will include an enhanced integration. This enhanced integration will provide UI5 Fiori controls for business oriented flows seamlessly for BRFplus and HANA. In addition to the harmonization of the user experience there will be alignment around a joint feature set, single repository and multi-target distribution infrastructure. The new UI5 controls will be delivered as part of SAP UI5 library of SAP UI add-on release. Other functionality which is unique to HRF and its tools will continue to be released with HRF releases and Service Packs. As can be seen in Figure 5, we will preserve the DSM/BRFplus UI for IT oriented / Expert user tasks and for backward compatibility. This UI will also be used for authoring rules that cannot be translated to HRF language or express features currently missing in HRF. Therefore the investment in common UI controls and feature parity will be guided by focus on business user oriented flows/tasks.

As part of this harmonization, SAP will provide the migration tools to ease migration from current deployments of BRFplus and HRF rules into the common new framework.

3.2.3 Rules as a Service

We intend to enrich SAP Cloud offering with decisions’ modeling, management and execution services, as part of the Platform Services infrastructure depicted in yellow in Figure 6. We will provide Rules as a Service (RaaS)

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3 HRF UI controls are currently delivered with the HRF Delivery Unit. With this planned innovation, the controls will be part of SAP UI5 library.
function for SAP cloud platforms with initial focus on supporting Cloud Foundry based platforms such as HCP and HCP Cloud Foundry Industry Edition.

This offering will include standard SAP Fiori UI decision controls and BRMS, full repository services, integration into different runtime engines and monitoring.

This offering will enable any cloud application developer to easily embed decisions in his/hers application. The developer will be able to embed hooks to RaaS in its application and at the same time build the vocabularies, the logic and the consumption patterns. The developer will be able to expose the logic to different end-users and enable them to configure and monitor it. RaaS will also serve internally platforms' services to enhance flexibility and customization options.

The effort towards RaaS will encompass componentization of SAP offering into Rule Services that can be consumed together or separately. There are four main services that we envision at this point of our development:

- **UI Services** based on SAP Standard simplified UX for defining dynamic, rule based business logic. This service supports both embedding Rules UI5 controls in proprietary apps and pre-delivered rules authoring Fiori application.

- **Repository Services** that stores standard rules design time artifacts. The repository also manages the decisioning related lifecycle of development and production systems.

- **Compilation Services** that compiles rules design time artifacts into executable runtime code/artifact. The target runtime platform is defined by the request and a single rule can be compiled into more than one target platform and runtime environment.

- **Consumption Services** that enable rules consumption through a library or cloud service based on application specific architecture (data storage location, performance, etc.).
Figure 7 depicts some of the target cloud environment currently developed by SAP. In order to maximize adoption and minimize risks, our current plan is to target Rules Services first to run on Node.js container on top of Cloud Foundry (CF). With that we hope to satisfy the needs of at least 3 platforms. As a 2nd priority we plan to eliminate the internal dependency of these services on HANA.

4 \hspace{1cm} \textbf{RECOMMENDATIONS FOR APPLICATION DEVELOPMENT}

\subsection{4.1 \hspace{1cm} Adopt decision management in relevant applications}

The use of BRMS has a lot of benefits in applications that require flexibility and frequent changes during their lifecycle. Separating decisions from processes and code helps simplifying both the process as well as the decision service. Change can happen to decisions and process independently of each other. Decision making can be organized into meaningful sets of rules. Explicit decision services are more easily understood, optimized, tested, and reused as all those activities can be executed by business experts independently of the processes. Decision services can be associated with business responsibilities and objectives.

\textbf{Recommendation:} Clearly separate decisions from business processes. Identify critical business decisions in code and process models and provision for decision service calls.

\textbf{Recommendation:} Strongly consider using the business rules management functionality provided by NW DSM/BRFplus, NW BRM, HRF and/or DSM* to simplify customization efforts of SAP applications.

\subsection{4.2 \hspace{1cm} Technology choice in homogeneous and heterogeneous stacks}

When a business application is designed to work with one technology, it is important that the BRMS, and especially the rule engine, integrates well with the technology stack and its lifecycle management requirements. In concrete terms, the rule engine should provide a performance level generally accepted in the technology stack, integrate with lifecycle management processes and tools, comply with applications' transactional, versioning, and authorization models. It must be possible to map the business vocabulary used in the rules to the specific programming models of the technology stack.

Adoption of a BRMS in the majority of the scenarios is directly related to how well it is integrated into the stack, specifically with the programming models and lifecycle management of the applications. This includes the ability to embed the rule maintenance UI into the application UI.

\textbf{Recommendation:} Applications that use a single stack should use the rule engine available in the native stack to benefit from the performance and integration with the stack.

\textbf{Recommendation:} In a mixed execution environment, minimize data transfer overheads by using a rule engine in the stack where most of the data is processed. Calls to rule engines in a different stack should be encapsulated into services that are callable from the native stack.
**Recommendation:** S/4HANA developers on premise and on cloud that embed decision management in their applications should aim for DSM/BRFplus for transactional decisions. If the application requires analytical decisions in HANA they should aim for DSM which will enable them to embed decisions in HANA via HRF. Until DSM is enhanced as described in this document and becomes DSM*, S/4HANA on cloud developers can use SAP DSM that was shipped with NW 7.62 and the embedded HRF UI controls. Later on they will be able to migrate, as the on-Premise developers, to the single DSM* framework.

### 4.3 Decision Management on SAP Cloud Platforms

Development of Cloud applications emphasize the benefits of BRMS use. The simplicity required from SaaS applications as well as the ease of customization/personalization and ease of maintenance are typical use cases for BRMS use benefits in SaaS.

**Recommendation:** SAP application developers on SAP Cloud Platforms can use HRF, BRFplus, DSM*, BRM, and/or 3rd party tools as appropriate for their use case and technology. For external developers, SAP will provide Rules as a Service on top of Cloud Foundry as part of the platform micro-services architecture.

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For more information please contact
Dr. Shuki (Yizhak) Idan
shuki.idan@sap.com