SBVR: Knowledge Definition, Vocabulary Management, and Rules Integrations

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Abstract- **The problem of collaborative work in open environment has become a center of academic and industrial attention. Creating, sharing, using, and storing knowledge in both tacit and explicit terms are essential to maintain competitive advantages in a highly competitive open market. This paper discusses the problem of work in collaborative and open environment where language is the main component of communication among people. Usually the concepts, terms, definitions understanding are missed or different between people and firms. Thus, sharing common understanding among all stakeholders is very crucial. The paper studies the problem of domain and adopt the Semantics of Business Vocabulary and Business Rules (SBVR) specification and draws a solution based on multi-user engagement to set up clear business language basis to share and use the knowledge as the best way.**

Keywords- Semantics of Business Vocabulary and Business Rules (SBVR); Ontology; Requirements Management; Business Modeling; Knowledge Management

I. INTRODUCTION

The progress in development of institutional business aims at reaching stability in organizations working internally and collaboratively in the economic model. The semantic of business vocabulary and business rules (SBVR) is one of the invented standards in this area full fused with Model Driven Development (MDD). The ultimate purpose of MDD is to transfer models from any type and any specific domain to any other domain, mostly transferring models from abstraction level to more detailed and executable level in information systems (IS's). There is a need to adopt tools to collect and define SBVR vocabulary and business rules in a practical manner to create real value for today's business. Now is the time. When is necessary to find a proper method to manage the huge number of vocabulary, as this research focuses on the vocabulary after collection? How vocabulary and business terms be managed in a complex system environment with their compound rules? How that vocabulary be used in different business applications? However, it is typically difficult to maintain and manage this vocabulary particularly across heterogeneous systems in complex ecosystems. The paper will discuss this issue deeply. It also aims to define the optimum way of using business rules formatted in SBVR specification to govern, control, and manage business processes and system functionality. Sometimes vocabulary and rules are defined, managed, and accepted by Taxonomy/Rules Managers. Nevertheless, when a system has a large number of users, the number of new vocabulary and terms may quickly overwhelm such formal procedures. That is why enterprises should consider avoiding overlapping and inconsistency, increasing reusability, and assisting in the collaborative work, which is important for different levels of business modeling driven IT to adapt quickly new terms and changes for using scenarios.

This paper is trying to propose ideas related to how we can present knowledge based on SBVR specification in the way people think about objects and the way they construct sentences to talk and think about them. We sort possible state of arts of SBVR usage in defining the different kinds of knowledge and vocabularies classification methods in information system's usage, which may contain several vocabulary repositories classified, based on business and IT system requirements. The paper analyzes issues related to the capturing and management of knowledge in the SBVR form specification, with respect to the top-down and collaborative approach which is both important to semantically clarify knowledge in systematic approach [1] and to develop a software architecture able to overcome the knowledge definition and business vocabulary problems [2]. In this paper, we will not deal with any ideas related to developing SBVR tool handling its meta-model and underlying components semantic, since these covered in many researches [3][4][5][6]. We are presenting how enterprise information systems can handle and use SBVR in a consistent way and insure logical interoperability in business applications. The first step in such a direction is the adoption of SBVR (Semantics of Business Vocabulary and Business Rules) meta-model [7]. To be used for business vocabularies as a main element of management business glossary, the design of the high-level requirements, architectural components and governance procedure of enterprise information systems in a tool aiming to handle SBVR in a collaborative business enterprise is level for their definition and management.

This paper organizes as the follows. The second section is background and related work. The third section describes the knowledge can be defined and captured by SBVR formulation. The fourth section is talking about vocabulary management approaches, which will explain in details the methods used to manage and organize SBVR vocabulary and terms. In addition, the fifth section is sorting of the methods related to using of SBVR polices and rules into particular areas in operational level. Finally, the sixth section is the conclusion and future work.

II. BACKGROUND & RELATED WORK

There are four basic branches of philosophy:

Epistemology: it concerns about what we know, some of the related knowledge can be expressed as procedures, rules and relationships. Furthermore, it includes science of methods (methodology).

Ontology: it is also called metaphysics, concerns what exists, what are the objects in our world.

Ethics: or moral philosophy, enquires into whether the systems we build are useful, legal or morally sound.

Aesthetics: it is relevant to ergonomics and is usability [8].

All other branches of philosophy, such as the philosophies of politics or language, draw on these disciplines to some extent. All of them are relevant to system development. In requirements, capturing characterizing the transition from spoken to written languages as its objective is to write down users' expectations using modeling languages. We take the SBVR as the logical form and the modeling language to express the language itself. This makes SBVR very close to the non-formal form as spoken language but have the features of the formal modeling language. since SBVR uses controlled natural language, thus making it easy to be understood by business people; and has logic formulation, which makes it compatible to be implemented and enforced in information systems (IS's). SBVR vocabulary contains cross-domain concepts, which will help to use vocabulary and the rules built from this vocabulary in different applications such as business processing management application, searching applications, classification application, tagging application, call-center, CRM, SCM applications so on and so forth without causing any conflicting in expressions meaning by an insuring high level of interoperability. It also helps to share a common understanding for terms and definitions between all stakeholders. It helps a lot in reducing human misunderstanding and mistakes, and bridges the gap between stakeholders and IS's designers. In [9] the authors uses natural controlled language to assess business process design, arguing that artifacts related to how, where, why, when, what, and who should be organized and understood by all stakeholders; they also propose a taxonomy supported by ontology tool to achieve their goals. A highly collaborative and concept-centric approach can lead to faster and more matured vocabulary and guidance development, therefore helps to gain better enterprise knowledge sharing and interactions. Many other researches [10],[11],[12] present methods to automat requirements and software development using natural language processing. Yet, these researches failed to express the language as semantic knowledge map with formal classification and took no advantage of the emergent specification the SBVR.

III. SBVR OVERVIEW

SBVR is an OMG (Object Management Group) [7] freely available specification that defining a meta-model for business level rules and vocabularies modeling. In fact, it is a combination of two specifications in one, for example, a semantic model for *terminological ontology (formal terminology), and behavioral guidance (policy, rules, etc.) [13]*. It is the most significant effort that addresses the issue of natural language formulation, modeling and meta-modeling. The specification obtained a wide acceptance both in the scientific and industrial communities. With no doubt, SBVR is synthesized from four disciplines: natural language and terminology science (TS), fact-oriented modeling in formal logic (FL), linguistics, and business consultancy [14]. Its main and distinctive characteristics make it an appropriate solution for the issues outlined in Section Ⅰ. Among all these characteristics, it is important to remember that SBVR identifies the concept of community as a source for any business vocabulary. Especially, the concept of semantic community is distinguished from that of speech community, where the former is defined as "community whose unifying characteristic is a shared understanding (perception) of the things that they (i.e. community members) have to deal with". Examples of communities of fundamental importance from a business perspective are organizations in which they operate, partners, third parties, standard groups, legislative authorities, etc. The set of concepts and elements of guidance for which there is a shared understanding in a given semantic community, is called body of shared meaning SBVR separates. The body of shared meaning signifiers use to represent (exchange, discuss and validate) its elements, allows different speech communities to share the same semantics, while preserving their own way to represent it using vocabularies expressed in their natural language, in artificial languages such as UML, or in subsets of natural languages such as those used in healthcare, education or finance.

IV. SBVR AND KNOWLEDGE DEFINING

Nowadays, Modern Organizations Are Looking Forward To Increasing Their Ability For Competition By Building Enterprise Information Systems In Order To Sustain Day-By-Day Activities And Real-Time Decision-Making. Managing Comprehensive Combination Of Files, Processes, Rules, Etc. (Common Explicit Knowledge) And The Experience That People Acquire Through Their Participation To Business Activities (Personal Tacit Knowledge) Represent The Knowledge Base Of The Organization. Information Systems Should Reflect And Operate According To Such Knowledge Because It Represents The Actual Structure And Behaviors Of The Enterprise [15]. The Organization Principles Maybe Described By Natural Language Or By Modeling Techniques. In Another Case, It Is Embedded In Information Systems And Mathematical Formats. Collecting Business Glossary Can Be A Good Start To Capture Business Definitions And Regulations, In Particular Business Vocabularies [1] And Business Rules [16][17][18] Are A Key Feature That Allows The Formal Definition Of Essential Business Information And Organization'S Core Characteristics. Global Competition Causes Rapid Changes Of Business Requirements' Guide To Innovate New Business Models To Characterize Current Scenarios And Future Business Trends. As A Result, Information Systems Should Support Such Dynamic Behavior Through A Flexible Business Oriented Approach That Allows Organizations To Modify Continuously According To The Rapid Changing Needs Through An Integrated And Dynamic Reconfiguration Of Its Business Rules, Processes, And Services. The Main Challenge Of Such Approach Derives From Two Kinds Of Issues.

The First Issue Regards To Business Knowledge Gathering And Management In The Current Scenario Of Knowledge-Based Economy [19] [20] [21]. Such Knowledge Is Usually Embedded (Sometimes Spread) Redundantly And Without Consistency Across A Variety Of Information Systems In The Form Of Documents, Executable Code, Configuration, Automated Workflow, Or In The Worst Case, Built In Tacit Knowledge Of People, Which Is Subject To Be Lost When Stakeholders Leave Their Positions/Work. Externalization And Sharing Of Such Knowledge Are Fundamental To Ensure And Maintain The Competitive Advantage, Especially When

Human Resources Depart Away Or When Technology Changes [22]. SBVR Supports Different Kinds Of Knowledge (Fig. 1) Like Business Vocabularies, Taxonomy, Ontology, Definitions And Rules Thus Will Enable Capturing And Sharing Of Many Aspects Of Tacit Knowledge, Classifying And Defining What The Organization Collectively Knows Related To Its Business.

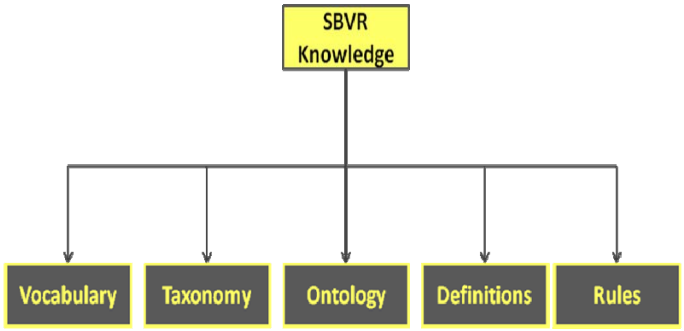

Fig. 1 SBVR knowledge types

The captured knowledge may create different practical values for organizations: facilitating communication between partners and stakeholders in the value chain, identifying and making clear of concepts for students and tutors in academic class, defining clearly the kinds of medicines and diseases in hospital and pharmacy; giving semantic foundations to requirements' specification of an Information System, and sharing a common understanding of the enterprise guidance principle inside the organization. Furthermore, SBVR has the ability to describe strategic knowledge needed to perform organizational tasks, for instance, the knowledge needed to fulfill a business process or knowledge need to be known by designers to perform a creative cognitive design. At the same time, it gives the ability to documenting the new knowledge after reflecting the previous knowledge in action. This, what is called as well experience where in some literature identifies it as tacit knowledge. However, most researchers agree that knowledge plus practice may be nebulous in the beginning. However, with time, it will guide new skills presented in experience, these skills can be gradually structured into the articulated knowledge. This knowledge emerged from interaction with the perception-action loop and called strategic knowledge, the other role of strategic knowledge is to govern and improve the reflection-action loop when organizational tasks execute [23].

Hori [23] also shows that, this strategic knowledge will play a role in changing the selection of requirements, changing the selection process of domain knowledge and its structure (static and dynamic ontology), changing the way of performing domain tasks and its structure(static and dynamic ontology)[34]. However, the effectiveness of SBVR knowledge-driven interactions is strongly limited when vocabularies are defined, chosen or composed by a limited number of people and when such people are not representative of the final users. Moreover, the propagation of many specific and heterogeneous (based on different meta-models) vocabularies is a primary source of difficulty faced vocabulary developers, who must be able to reconcile such conceptual complexity through an error prone and long-term work by taking advantages of strategic knowledge and structured in SBVR form to maximize its value.

The second kind of issues' concerns the availability of ICT solutions that enable the implementation of highly configurable and quickly modifiable business processes and IT services in order to allow their direct coupling to actual business requirements. In such a context, the emerging trend is focusing on the logical separation of process and business rules, while allowing their modular and dynamic composition [17][18]. Boden and Gero argued that moving from one conceptual space to other conceptual spaces is essential for creativity. That is explaining how transformation from model to model gives different knowledge perspective about business or the enterprise. While the knowledge network is growing, it will be easy to reflect the new knowledge on business activities by linking different models together, which helps in transforming the knowledge from tacit level to execution level [23]. All that emerge from the needs of defining knowledge in enterprise collaborative level, using intelligent techniques help in SBVR construction, or what we call it here SBVR learning, extracted from shared distributed knowledge in all forms, stored in SBVR repository as vocabulary, taxonomy, ontology, definitions and rules. Where should be validated and approved by policy makers from business analysis team responsible for enterprise development? The major challenge is nearby. What is really faced by AI scientists from long time ago? How it can interpret and make natural language text distributed and embedded in different locations and format, after which we need to transfer (formulate) the text automatically to SBVR format, which makes it easy to implement in IS's for execution? Other initiatives by ILOG software and IBM rational produced collaborative tools for rules and requirements management but not in the SBVR form yet. Our approach is to capture SBVR knowledge from any text format by policy maker/analyst in a collaborative tool to allow multi-view validation from other stakeholders, and then transfer it automatically to 1) definitions and vocabulary; 2) business rules and policies. The approach will be extended in the future to support direct and automatic transformation from OWL in the semantic web environment to SBVR types. If we are able to reach such a level, we will be able to realize the concept of dynamic information systems for dynamic business to adapt systems by continuous capturing and measuring business variables and knowledge. To explain the approach more in details: transforming natural language/text to ontology through ontology learning techniques and tools has been proposed in [24] and [25], the generated ontology will be crated with respect to semantic natural language map as in [26], which accelerates ontology learning and extends the semantic network by matching vocabulary and its synonymies. These methods will guide us to the next level of transformation where we need to extract SBVR from ontology; several rules and algorithm must govern and guide the transformation/parsing process to extract the vocabulary and rules from ontology. The wide used and well known method is to execute transformation between OWL and SBVR by direct mapping [5][6][27] and by creating transformation rules and methodology using model to model transformation techniques such as QVT and OCL constraints[28]. Or through Ontology Definition Meta-model (ODM) some effort has been done in[27], thus will guide to get SBVR formal model ready to be used as business vocabulary and as business rules in enterprise information systems as described in next sections[29]. The tool conceptual schema is shown in Fig. 2.

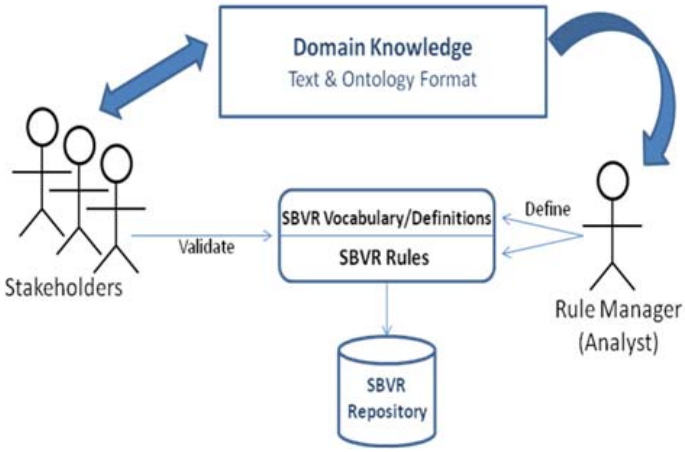

Fig. 2 SBVR tool management schema

V. SBVR VOCABULARY MANAGEMENT

SBVR vocabulary refers to conceptual SBVR formal logic, which can be machine-processed. It includes two specialized vocabularies:

- Vocabulary for describing business vocabularies, which deals with all kinds of terms and meanings;
- Vocabulary for describing business rules, which deals with the specification of the meaning of business rules, and builds on top of the previous vocabulary;
- Vocabulary and definitions for describing software components, reverse engineering and software modernization [30], [31]

Chen in [32] pointed to the issue of the existence of a gap between the collaborators in terms of the vocabulary used; it will be based on their fields or environment. It is a challenge for the designers of collaborative systems to overcome this issue. So he proposed an approach to overcome the vocabulary issue, it is called the "concept space approach". This includes algorithms that extract the vocabularies and link them. In particular, what has been illustrated by Chen [32] shows one way of building the business vocabulary, and it might be used by SBVR-based systems. The automation shown by his work makes it clear that there is a need to find efficient approaches that might serve the future complex systems (Fig. 3).

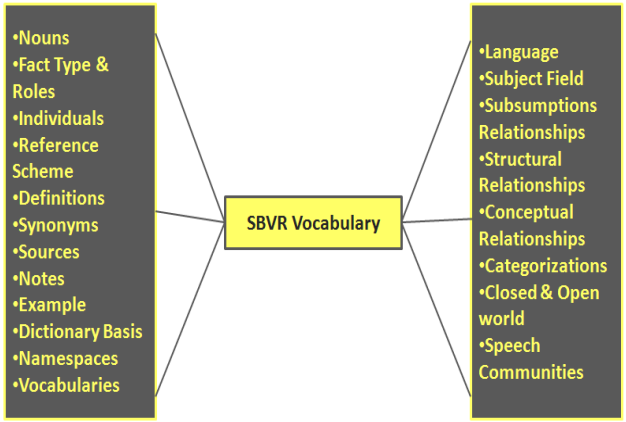

Fig. 3 SBVR vocabulary type

The challenge of using SBVR in enterprise systems is the difficulty of modeling the same concepts while keeping "true" to the intent of each modeling method (e.g. business-oriented versus IT-oriented) which is required to maximize the effort in merging methods. Vocabulary should be controlled because only terms from the vocabulary model may be used for subject area; also, if more than one person uses it, there should be control over who is adding terms or how terms can be added to vocabulary model. Since the list could grow but only under defined policies thus will insure consistency in indexed vocabulary, in tagging or categorizing to guide users to desired information. SBVR model provides several levels of controlling vocabulary by defining constraints related to vocabulary collection and defining relations between ontology. One of the reasons of using ontology in information systems (IS) is to increase the level of reusability. SBVR vocabulary needs to be managed into IS. The first step should be taken into consideration when design information system application is to categories the ontology (SBVR) in the IS's applications or for several applications integrated together within the enterprise. In this concern, the categories should align business goal and objective to information systems, as well as aligning application structure to information system goal and objectives, to ensure that the application should contain rules and constraints govern business activities in higher level. The beauty of using SBVR is that SBVR is a structured natural language easily can define ontology, thus making SBVR vocabulary already phrased and easy for being classified, categorized and parsed in IS's. We suggest classify SBVR in repository as the following:

- SBVR vocabulary to define vocabulary and terms;
- SBVR vocabulary to define Rules and Polices;
- SBVR vocabulary for specific application language;
- SBVR rules for organizational polices;
- SBVR rules of specific application

In Fig. 4 conceptual schema for classified SBVR repository for several is applications.

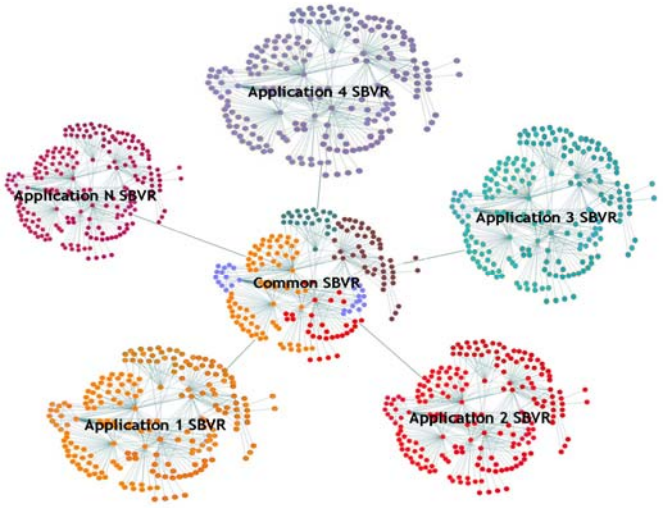

Fig. 4 Vocabulary model conceptual description

VI. SBVR RULES INTEGRATION

The Business Rules Group defines a business rule from a business perspective as "guidance that there is an obligation concerning conduct, action, practice, or procedure within a

particular activity or sphere". The primary subject of this guidance is the set of business processes performed by humans and potentially "partially" supported or automated by IT systems. From a business perspective, business rules ought to be motivated and may be subject to enforcement. In business activities, business rules are classified as: 1) known business rules and implemented in information systems; 2) known business rules and not implemented in information systems; 3) Unknown business rules not knowingly implemented in the Information Systems [33]. SBVR will not just automate business rules execution but also will help in documenting non-automated rules and policies, which are usually considered as tacit and are embedded in human interactions. SBVR distinguishes two different categories of business rules as follows:

- Structural (definitional) Business Rules specify necessities on business concepts. It is about how the business chooses to organize the things it deals with. They are considered necessity, i.e., they are "true by definition" and thus represent the form of definitions or conventions. As an example, a rule that specifies how the total price of a rental calculated is a structural business rule.
- Operational (behavioral) Business Rules specify business obligations and govern the conduct business activities. They are considered as directly enforceable, i.e., they exist in order to produce (or avoid) some effect in the business. Operative business rules may be violated and thus are usually enforced by some means. As an example a rule stating, "blacklisted customers must not be given a rental" is an operative business rule.
- Performance Controller Business Rules work to evaluate business performance by creating several key performance indicators (KPI's) and located as agents collect information from business activities and notify the user by the progress.

Business rules used in this category describe the business components. Usually business rules from a business perspective are based on noun concepts (also called object types) and verb concepts (also called fact types) formalized in a vocabulary. Such a vocabulary defines the semantics of these concepts as well as providing community-specific terms for those concepts (Fig. 5).

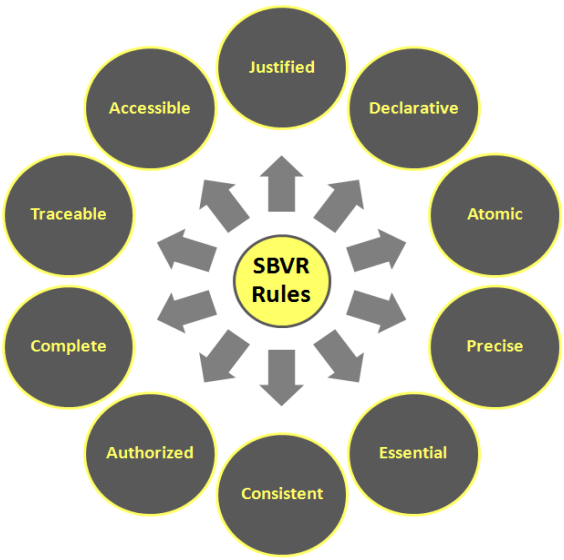

Fig. 5 SBVR rules types

Several methods for integrate SBVR into IS's, mainly adapting SBVR rules to control business processes and business services, some of the methods to ingrate SBVR with BPMN has been mentioned in many articles, and implementation initiative successfully completed by many. However, after the search we can classify the level of integration between BPMN and SBVR to three levels as the following:

1. High level governing and polices documentation such as managing risk and risk control, measurement and process polices can be done by locating agents in the business process system to gather process status information then compare it with policies and rules. It is very important to distinguish among decision model, business process constraints, and rule model, thus aiming at intersecting between some of the existing standards such as SBVR, BMM and BPMN with other business models being introduced in the future, as it will increase reusability of used cases and rules in support of *loosely coupled*-models-driven development.

Here is an example of the General Key Performance Indicator (KPI) Vocabulary in the service company:

Concepts

KPI
Definition: Acronym of Key-Performance-Indicator.
Definition: Key business statistics such as number of new orders, cash collection efficiency, and return on investment (ROI), which measure a firm's performance in critical areas.
Necessity: it is obligatory that KPI *is* quantifiable

Organization
Definition: Social unit of people systematically arranged and managed to pursue goal on a continuing basis.

Quality-Auditor
Definition: Independent and accredited person with certified qualification to perform quality audits for the organization.

Performance
Definition: Accomplishment of a given task measured against preset standards or accuracy, completeness, cost, and speed.

Lower-limit
Definition: The minimum value of a target-range
Necessity: Each target-range *has* lower-limit

Upper-limit
Definition: The maximum value of a target-range
Necessity: Each target-range *has* upper limit

Fact Types

Organization *has* Quality

Quality *measured against* KPIs

Each organization *has* at least one KPI

At least one KPI *is assigned to* each organization

KPI *is measured by* quality auditor

Rules

It is obligatory that each KPI is quantifiable

It is necessary that the organization has operational-KPI and financial-KPI

It is possible that organization *does not have* operational-KPI or financial-KPI

It is possible that each organization has 'individual' Quality-Auditor

It is obligatory that each KPI *has* Lower-limit and Upper-limit

Each organization *is determined* the upper-limit and the lower-limit for each KPI

Each target-range *has* upper-limit
Concept_type: is-property-of fact type

Each target-range *has* lower-limit
Concept_type: is-property-of fact type

2. Accessing into control and decision rules will make limited involvement in SBVR in business processes, aiming at reducing business process complexity. It may implement through transferring SBVR to PRR and integrate PRR with BPDM by standardizing behavior modeling or by serializing SBVR into Rule ML as executable rules format. It also may create conditions between BPMN and SBVR. When a condition is satisfied, it will call the assigned SBVR rule by loose coupling rules from the processes "assign on or more rule to govern the business process or by the preconditions and conditional event business process with a denotes modality that expressed as SBVR model. [5][34][35]. Many initiatives have been proposed before, and some tools are nicely developed in [36][37][38][39][40].

3. Business process is fully described by SBVR and generates BP from SBVR statements, as is proposed and developed in the OPAALS project [41]. In fact, the business rules play an important role in process quality. Several business rules (for example, a rule stating that product X can only be sold with product Y) constitute a business process such as order entry [33]. It is possible to define BPM notation by SBVR vocabulary, those definitions will map ontological to other definitions reflect the same meaning. Therefore, when we use any of those vocabularies in business rules, they will trigger the original BPM notations to represent the BPMN model. In addition, it can generate XPDL from SBVR rules, since these rules express breaking the process into its smaller components. For instance:

Employee is role for Shop

It is necessary that the employee *checks* the card-validity

After the employee *checks* the card-validity if the card *is valid* then the order *accepted*

After the sales *processed* the order then the distribution *packs* and *deliver* the goods

VII. CONCLUSIONS AND FUTURE WORK

We have defined the types of knowledge that can be presented by SBVR specification; we showed several examples related to business environment, and then we presented a conceptual framework to create, capture and use SBVR models in enterprise business environment. This includes describing several possible implementation scenarios for SBVR business rules. As described in Fig. 6, by transferring language to SBVR model supporting enterprise system's dynamism, sharing knowledge and overcoming the language barriers in the open business environment, we believe the work is not yet complete. Some theoretical and practical examples have been presented.

However, to take maximum value of the SBVR specification, we need to implement the proposed conceptual idea, which is still under development. This framework is to manage and transfer requirements from text to SBVR format. Implementing matured and controlling natural language processing to SBVR model tool can take advantage of other technical researches. Some references cited by this paper related to SBVR transformation can be a voluble input. Hence, studying and understanding social, organization and business barriers for implementing such as model are required before implementation. After all, the next step is to validate and apply the tool in a real environment that will allow us to put a hand on the real socio-technical challenge in modern business environment.

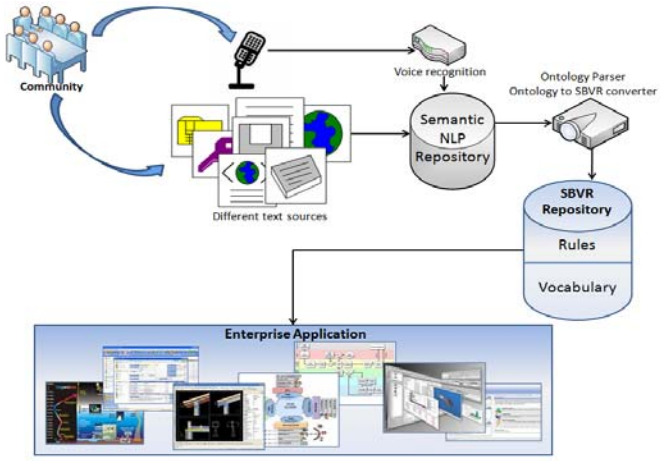

Fig. 6 Conceptual SBVR usage in enterprise systems

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