Enhancing Decision-Making Consistency in Business Process using a Rule-Based Approach

Case of Business Intelligence Process

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Abstract: Decision-making in Business Process is a real challenge, given its technical complexity and organizational impact. Mostly, decision-making is based on business rules fired by an inference engine using facts reflecting the context of the current process task. Focus on a task alone and in isolation from the rest of the process can easily lead to inconsistency in decision-making. In this paper, we aim to improve the importance of consistency of decision-making throughout the process.

To fulfill this aim, our contribution is to propose Consistency Working Memory RETE (CWM-RETE): a Framework based on the Rete Algorithm as a pattern-matching algorithm to simulate inference; and MongoDB as a document-oriented database to serialize business rules. This framework enables the compatibility of decision-making throughout the business process. The experimentation is based on the Business Intelligence process as a case study and it is shown that the decision-making process can generate different results depending on whether consistency functionality is enabled or not.

Keywords: Decision-making in Business process, Consistency, Rete Algorithm, MongoDB, Business intelligence

Introduction

The new millennium is marked by the wide-spread use of Business Intelligence (BI) with all its subspecialties, such as data collection, data cleansing, data warehousing, data analysis, data

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analytics, reporting, dashboarding, and score-carding (Cheng & Cao, 2020). Different tasks of a BI process involve various technologies, models, techniques, and approaches. Therefore, the implementation of a BI process must cover all the factors related to the panoply of choices which are constantly multiplying. This is due to the invasion of new technologies such as IoT, Big Data, mobile development, and others. Mastery of decision-making during any process and in particular a BI process aims to ensure alignment between the expectations of managers and the solutions proposed by IT: a key concept of Enterprise Architecture (EA), namely Business-IT Alignment (Dokhanchi & Nazemi, 2015).

The EA models any IT solution using four layers: business, functional, information and infrastructure layers (Winter & Fischer, 2006). Despite its importance, the business layer is usually neglected, leading to a gap between the request and the delivered solution. To overcome this gap, several models have been developed, such as the Business Process Model and Notation (BPMN) (OMG, 2014) and the Decision Model and Notation (DMN) (OMG, 2016). These standards are proposed by the Object Management Group (OMG) to contribute to business process modelling. Success of these two models has favoured the appearance of several Business Process Management Systems (BPMS).

In these BMPS, decision-making is restricted to business rules eligibility. This mission is well ensured by the Rete algorithm (Forgy, 1982). This inference algorithm, also called a pattern matching algorithm, allows the matching between facts forming its working memory and rules forming its production system. The working memory represents the different factors to take into consideration to make a choice in the current task of the process. The production system represents business rules related to the business process to generate, by inference, new facts leading to decision-making.

In addition to business rules eligibility, decision-making consistency is a high demand quality in business processes (Awadid & Nurcan, 2016). In the literature, this feature has been studied in different ways. In the medical sciences, a patient's history is tracked so as not to prescribe drugs that may have undesirable effects with the current situation and previous prescriptions. The optimal decision is therefore to prescribe the right drug that best suits the patient's antecedents (Shariff *et al.*, 2022). By analogy, decision-making in business processes must check the characteristic of consistency to consider, at a given step, all the decisions already made in the previous steps, so as not to try to excel in the current task, even in a contradictory way, with what already exists.

Consistency requires, on the one hand the retention of all decisions taken throughout the process and, on the other hand, the ability to explore this repository to confront the decision in an ongoing task with those already taken.

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Indeed, it is considered in some contexts as a solution to impose ethics; in other contexts, as an approach to foster collaboration; and, in other cases, as a mechanism to achieve standardization.

We define consistency as a solution to ensure compatibility and synchronization of decision-making along the process. Decision-making in a process task must be ensured by covering at the same time factors relating to the task itself and factors resulting from the previous tasks. Thereby, decision-making should not be isolated and localized at the task level, but rather consistent. Consistency must be ensured by dealing with the intrinsic and extrinsic.

In this paper, our contribution is to extend the Rete algorithm to support decision-making consistency in a business process. This extension must be ensured without generating nuisances on the business, functional or technical sides. In a BI process, decision-making consistency is very much required and, if it is ignored, according to experts in the field, it can have a very costly impact on the outcome. That is why we chose this domain to test our model. The choice of BI domain is indicative and not exclusive.

The paper is organized as follows. In the Background and Related Works section , we present previous works on decision-making consistency in business processes. The next section, named Our Proposed Model of Decision-Making Consistency in Business Process using CWM-RETE, is devoted to presenting and validating our CWM-RETE model through a BI process, while emphasizing the importance of consistency of decision-making in this kind of process and the role that the Rete algorithm could play in this case. In the results section , we discuss the results obtained and the impact of this work on decision-making in business processes. The Conclusion section summarizes our findings and suggests future extensions of the current work.

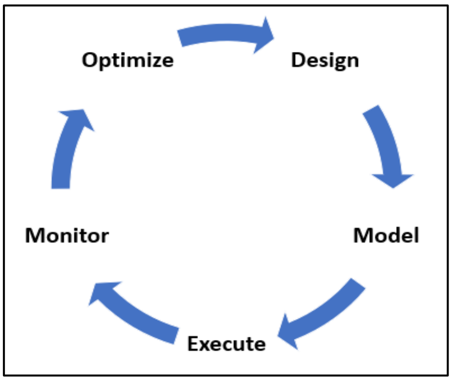


Figure 1. BPM Life Cycle

Background and Related Works

According to Gartner, Business Process Management (BPM) is a discipline that uses various methods to discover, model, analyze, measure, improve, and optimize business processes

(Gartner, 2017). Figure 1 illustrates the life cycle of a business process with its different phases. Each of them was the topic of several works to improve these business processes. The axes discussed in the literature are numerous, such as integration, distribution, collaboration, standardization, harmonization, and consistency. Improved decision-making is a key focus for improving these business processes.

Decision-making in Business Process

To identify the different works on decision-making in a business process, we can structure this section around three major axes: (1) the separation between business process modelling and decision-making modelling; (2) the various implementation scenarios and integration of business rules; and (3) improvement of inference engine handling these business rules.

Indeed, the first preoccupation was concentrated on the separation between decision-making modelling and process modelling (Batoulis *et al.*, 2015; Biard *et al.*, 2015). Research in this field is based on the collection, modelling and integration of business rules in business processes (Kluza & Nalepa, 2013; Bajwa, Lee & Bordbar, 2011). Overarching this work is the Decision Model and Notation (DMN) (OMG, 2016) which has become a standard in modelling decision-making in business process (Taylor, Fish, & Vincent, 2013). Figure 3 shows an excerpt from a BI process in which we use these standards to model decision-making at the online analytical processing (OLAP) task.

The second focus is the serialization of business rules and automation of their processing and exchange (Ghlala, Kodia Aouina & BenSaid, 2016). A range of choices can be adopted to achieve this mission, such as (1) programming languages (procedural or object-oriented) (Batoulis *et al.*, 2015); (2) exchange data formats (XML or JSON) (Biard *et al.*, 2015); (3) aspect-oriented languages (Taylor, Fish & Vincent, 2013); (4) databases using the relational model (Bajwa, Lee & Bordbar, 2011); (5) rules engines (Kluza & Nalepa, 2013); and (6) business process management systems (Ghlala, Kodia Aouina & BenSaid, 2016). Several open-source and proprietary software systems have appeared and are in competition to implement both BPMN and DMN standards, as well as support for business rules based on BPEL and FEEL languages (Skersys, Tutkute & Butleris, 2012).

The inference of business rules in BPMS represents the third focus. Indeed, the improvement of the inference engine represents a promoter track both on the tuning and the functional aspects. Since the Rete algorithm is the main used algorithm in BPMS (Gartner, 2017), several research works were intended to improve it. On the one side, reflecting the improvement of this algorithm on the performance axis, much research focuses on the indexing of the working memory, such as in Van De Water *et al.* (2015) and others, who propose the improvement of the matching algorithm (Yay, Martínez Madrid & Ortega Ramírez, 2014). On the other side, which focuses on the improvement of features of this algorithm, we can quote the distribution of the inference (Wang *et al.*, 2014) .

Consistency in Business Process

Consistency, our topic of interest in this paper, is considered in various systems as an advanced feature. It is defined as the fact that the information covered in each model in Business Process should not contradict one other (Awadid & Nurcan, 2019). It can concern two tracks: (1) consistency of the business process itself (Branco, 2014); (2) consistency of the decision-making in these processes (Argandona, 2008).

In the first track, where the focus is on the process itself, several works have dealt with the syntactic and semantic aspects of this consistency (Humm & Fengel, 2012). Other works are oriented towards the ethical dimension of consistency (Schweitzer & Gibson, 2008). Indeed, in many systems, such as banking systems (Branco *et al.*, 2014), healthcare systems (Finch, Geddes & Larin, 2005) or the judiciary system (Finlay & Ogden, 2012), consistency is considered as having the same behaviour in similar contexts. In the second track, consistency is related to the decision-making in business processes; some studies insist on cognitive consistency in collective decision-making, also called group decision-making (Mojzisch *et al.*, 2014).

In the literature, there are two approaches to ensure consistency: a rule-based approach which consists of ensuring consistency across business rules (Goedertier & Vanthienen, 2005) and a constraint-based approach that relies on programming by constraints (Runte, 2012).

Using a constraint-based approach, Piotr, Krzysztof & Antoni (2018) propose a user-friendly method of business process composition. They generate a set of constraints based on a log of the process, which details activities to be performed. The consistency in this work is considered as an intra-activity unification. Another research work in Mafazi (2015) uses a semantic-based approach for verifying consistency and correctness of process models. The authors propose a novel process abstractions' configuration with respect to a specific goal expressed as constraints. Their constraint-based framework shows that consistency can be used to improve conformity.

Using a rule-based approach, Torre *et al.* (2018) provide a set of UML consistency rules in UML Standard. This work emphasizes verifying and checking the models.

The concept of consistency is sometimes crossed with harmonization and standardization concepts. According to Romero *et al.* (2012), harmonization is considered as the degree of similarity between different business processes and the degree of adaptation of these business processes to their environment. In addition, Ross, Weill & Robertson (2006) proposed an operating model allowing the classification of processes into four categories (diversification, replication, coordination and unification) according to their degree of standardization, whereas Wüllenweber *et al.* (2009) define the objective of process standardization as making process activities transparent and achieving uniformity of process activities across the value chain and across firm boundaries. Harmonization and standardization are aimed at setting up procedures for bringing various business processes together based on standards or analogies. Recently, new concepts are emerging in the context of digital transformation. Baiyere, Salmela & Tapanainen (2020) propose to rethink the BPM logic and dissociate its dynamics. They identify three components: (1) light touch processes; (2) infrastructural flexibility; and (3) mindful actors.

Our observations contribute to a rethinking of the dominant BPM logic by unpacking its dynamics in the context of digital transformation. In this paper, our contribution is the improving of decision-making in business intelligence process by emphasizing consistency through rules-based approach. Our concern is to ensure compatibility between the different decisions made throughout the process.

Our Proposed Model of Decision-Making Consistency in Business Process using CWM-RETE

Decision-making consistency in business processes consists in making a choice in a task of the process while considering all factors related to the task itself, named the intrinsic factors, and legacy factors relating to previous tasks, named the extrinsic factors. The BI process can serve as a very representative case study to discuss this need.

The use case of BI process

BI development has encouraged companies to invest in this kind of project to implement IT solutions to help managers make the best decisions at the right time. These projects can be described as a data-driven Decision Support System (DSS) that combines data gathering, data storage and knowledge management with analysis to provide input to the decision process (Negash & Gray, 2008).

Nowadays, we note at least three types of BI projects: (1) Corporate BI Projects (Ghlala, Kodia Aouina & BenSaid, 2016; Mitrovic, 2020); (2) Data Visualization Projects (Lea, Yu & Min, 2018; Mei *et al.*, 2020); and (3) BI Projects in the era of big data (Saggi & Jain, 2018; Alnoukari, 2022). In this paper, we focus on the corporate BI process depicted in Figure 2.

Considering the different kind of BI projects and the diversity of decision makers 'profiles, in modelling processes, remains very complex. This complexity is due to several factors such as: (1) the different requirements of the managers; (2) the range of technologies in the market; and (3) the context of design, development, and deployment of the process (sequencing, parallelism, centralization, and distribution of tasks). In addition to these different constraints, through modelling decision making process, we must ensure coherence and harmonization in the overall project tasks, and enhance the consistency of decisions throughout the process.

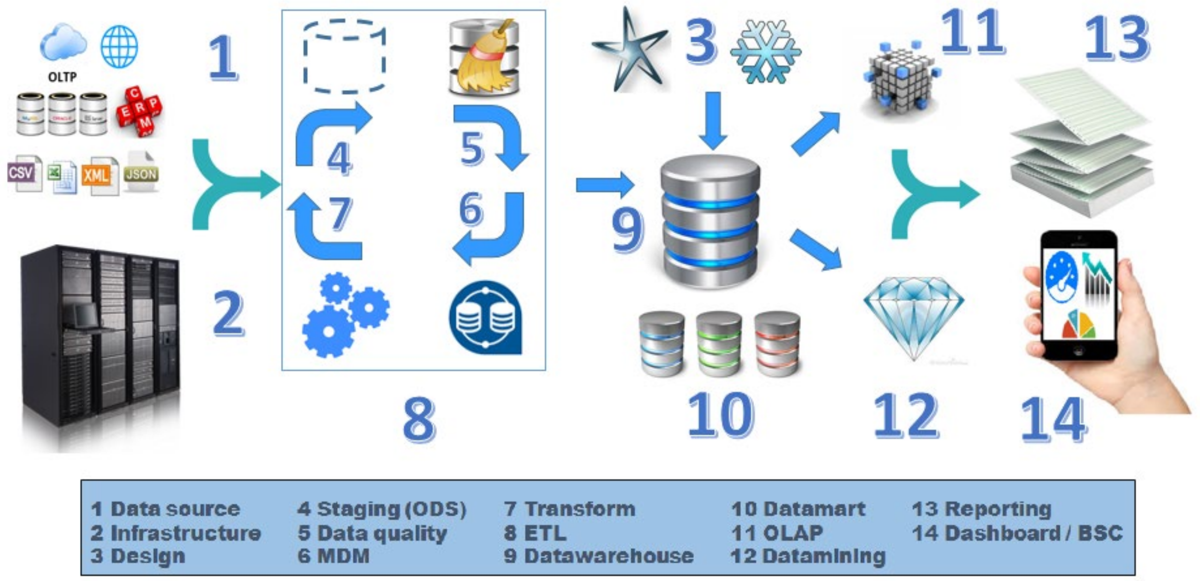


Figure 2. BI Process

3.2. Intrinsic and extrinsic factors

As shown in Figure 2, the BI process is composed of several tasks, each requiring decision-making that we want to be done with consistency. Among these tasks, we study the OLAP task that specifies the various choices relating to multidimensional cubes as a storage and refresh strategy. Figure 3 shows the design of this task with the OMG BPMN and DMN models. The graphical representation of the decision-making is well ensured by the DMN, while the eligibility of the various business rules is entrusted to the Rete algorithm. The latter is a very efficient algorithm which matches facts against the patterns in rules (Van De Water *et al.*, 2015). Also, knowing that the Rete algorithm is the most used as the inference engine in BPMS like Drools, Bonita Soft BPM, Oracle BPM and Red hat JBOSS BPM Suite (Gartner, 2017), we choose to extend this algorithm by the consistency feature.

The factors that directly affect the decision in a task are identified by intrinsic factors. These factors play a crucial role in decision-making at the task level but are not sufficient. In fact, the current task can be biased by some intrinsic factors of the previous tasks, which we consider as extrinsic factors. Thus, when deciding, we must consider at both these intrinsic factors and the extrinsic factors for our current task.

Consistency in a BI process is ensured by defining a set of business rules. These rules are formulated based on intrinsic and extrinsic factors relating to each task in process. In Table 1 and Table 2, we present, respectively, the intrinsic and the extrinsic factors identified for the OLAP task in BI process.

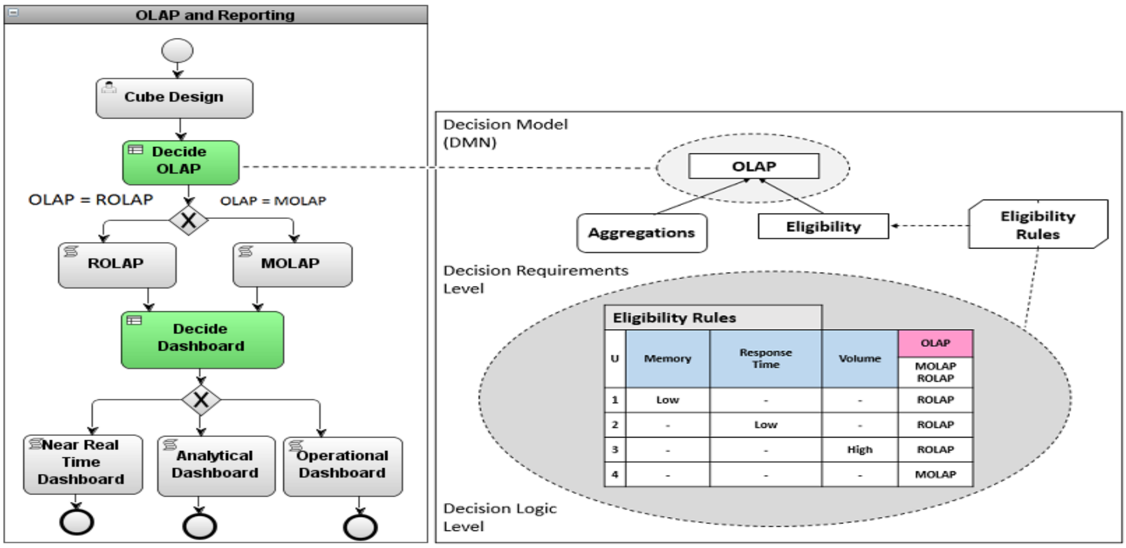


Figure 3. BPMN and DMN Design of OLAP and Reporting Task

Table 1. Intrinsic factors of OLAP decision related to OLAP and Reporting task

Factor Designation	Factor Description	Factor Nature
Memory size	Available memory size	Quantitative
Cube size	Cube size in gigabyte	Quantitative
Refresh	Need to access updated data	Qualitative
Response Time	Need fast access to the data	Qualitative

Table 2. Extrinsic factors of OLAP decision related to OLAP and Reporting task

Factor Category	Factor subcategory	Value	Description
Extraction	Mode	Periodic Continuous	Periodic extraction Continuous extraction
	Direction	Pull Push	Refresh managed by the BI system Refresh managed by the OLTP system
	Staging	Yes No	Staging No staging
	Transform	Fast Slow	Fast and minimal transformation Slow and multiple transformation
Design	Model	Star Snowflake	Star schema Snowflake schema
	Datawarehouse Architecture	Independent DM DM bus Hub-and-spoke	Independent datamarts Datamarts bus Hub and Spoke topology

Factor Category	Factor subcategory	Value	Description
		Centralized Federated	Centralized datawarehouse Federated datawarehouse
	Fact tables	Transaction	Exhaustive measures in the fact table
		Snapshot	Historical measures in the fact table
		Accumulated	Cumulative measures in the fact table

Our Contribution: Consistency Working Memory Rete Framework

Every decision made in a business process task must be remembered for future tasks. Memorization involves three main elements: the choice made; the factors that favoured this choice; and the choices to be avoided in the following tasks. The role of domain experts in setting up this strategy is essential, regarding the holistic nature of the skills needed for successful implementation of this approach.

Figure 4 shows the architecture of our model. It is composed of four parts:

1. ***Production memory***: repository containing business rules related to the business process.
2. ***Working memory***: instance of the memory containing the various facts introduced by the user through the graphical interface representing the intrinsic factors with, in addition, the facts generated by inference and, possibly, the extrinsic factors as facts injected following the access to the repository to ensure consistency.
3. ***Agenda evaluation***: instance of the memory where eligible rules to be executed are stored.
4. ***Legacy decision repository***: repository containing the different decisions taken throughout the process. The memorization of these latter items is encoded in JSON format to bring more flexibility, performance, and adaptation with the document-oriented databases.

The first three components ensure functionalities of the regular Rete algorithm components. The fourth one is our contribution as a repository containing the legacy decisions to ensure consistency.

A stored decision in working memory is characterized by different information describing the context of its adoption, namely:

- The chosen value;
- The factor(s) favouring this decision;
- A blacklist containing the choices to be avoided later in the process.

The considered characteristics of the stored decisions are heterogenous and multivalued. The origins of this variety are due to two anomalies concerning multivalued and missing data. Consequently, several formalisms are candidates to play the role of the representation of these stored decisions. Among these formalisms, we consider SQL, XML and JSON.

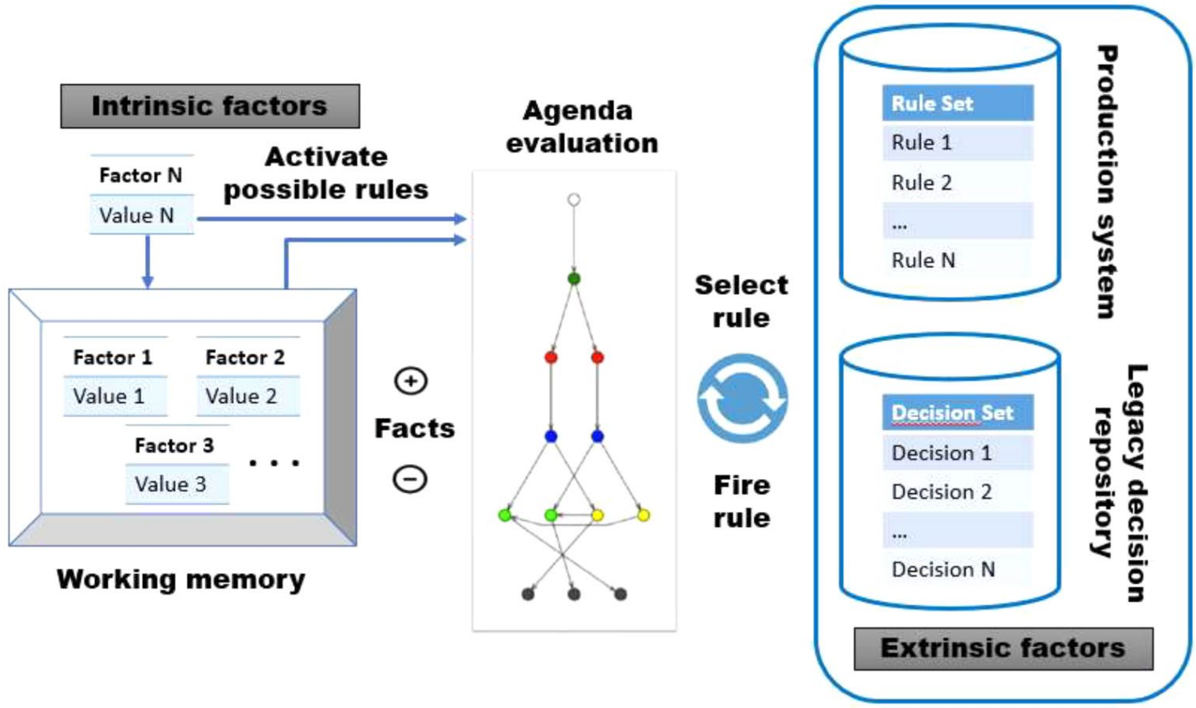


Figure 4: Consistency Working Memory (CWM) RETE Framework

Experiments and Results Interpretation

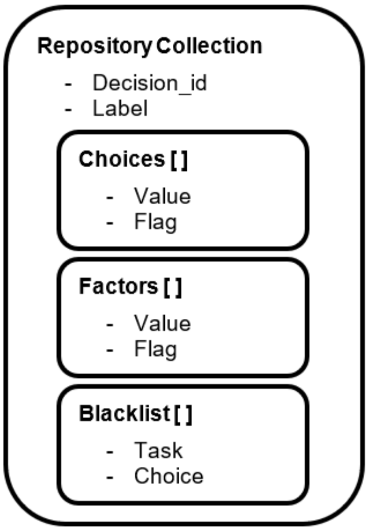
The experimental study of CWM-RETE relies on MongoDB as a decision serialization tool and Pyknow as a Python library to simulate the running of our model using the CWM-RETE algorithm. The dataset is the result of collecting and analysing business rules from groups of experts on BI in real companies.

The choice of MongoDB as a NoSQL database of the document-oriented category is explained by its flexibility of business rule modelling. This type of database is designed to store, retrieve, and manage semi-structured data. They are suitable for projects requiring data with a schema-less implementation. Indeed, in the same collection, documents can have different structures in terms of number, size, and content of their fields. Another handy feature of MongoDB is the ability to model multi-valued data. This feature simplifies the modelling of relationships such as (1: 1), (1: N) and (N: M) between different real-world entities. On the other side, the choice of Python is explained by its ability to innovate in several scientific fields. Indeed, it is a pluggable environment with a lot of libraries to cover several issues. In our case, we opted for the Pyknow library to simulate the execution of the Rete algorithm.

CWM-RETE implementation

To test our model, we implemented a framework with the following features:

- Creation of a MongoDB database containing the previous decisions. This repository contains extrinsic factors for the current task. Each decision is identified by an *Id*, relating to a task of the process, characterized by the list of *Factors* that leads to the chosen choice, and a *Blacklist*. The latter represents the choices to be avoided in the rest of the process, given the choice adopted in the chosen task. Figure 5 shows an example of a decision stored in this repository used by our framework to ensure consistency.




```
db.repository.insert (
    {'decision_id': 1,
     'label': 'extraction',
     'choices': [ {'value': 'Periodic', 'flag': 1},
                  {'value': 'Periodic', 'flag': 1} ],
     'factors': [ {'value': 'HA Feature', 'flag': 0},
                  {'value': 'HA Strategy', 'flag': 0},
                  {'value': 'HA Strategy', 'OLTP': 1},
                  {'value': 'Repository', 'flag': 0} ],
     'blacklist': [ {'task': 'OLAP', 'choice': 'ROLAP'} ]
    }
)
```

Figure 5. Legacy decision design and serialization

```
# Rules on Response time #
  @Rule(CWM_OLAP(response_time="High"))
  def RS1(self):
    self.declare(CWM_OLAP(OLAP="MOLAP"))

@Rule(CWM_OLAP(response_time="Midium"))
  def RS2(self):
    self.declare(CWM_OLAP(OLAP="HOLAP"))

  @Rule(CWM_OLAP(response_time="Low"))
  def RS3(self):
    self.declare(CWM_OLAP(OLAP="ROLAP"))

# Rules on Data Refresh #
  @Rule(CWM_OLAP(refresh='Yes'))
  def RS4(self):
    self.declare(CWM_OLAP(OLAP="ROLAP"))
    print("Rule RS3 Fired")

  @Rule(CWM_OLAP(refresh='No'))
  def RS5(self):
    self.declare(CWM_OLAP(OLAP="MOLAP"))
    print("Rule RS3 Fired")
```

Figure 6. Excerpt from the production memory

We use the Pyknow library to formulate business rules for the OLAP task. Each business rule of the production system is a static Python method. Business rules resulting from access to the repository are implemented as dynamic methods. Figure 6 shows an excerpt from the production memory.

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We have developed a GUI (Graphical User Interface) to interact with the software to introduce the facts and scenarios of execution (access or not to the repository, to activate or not to activate the consistency feature).

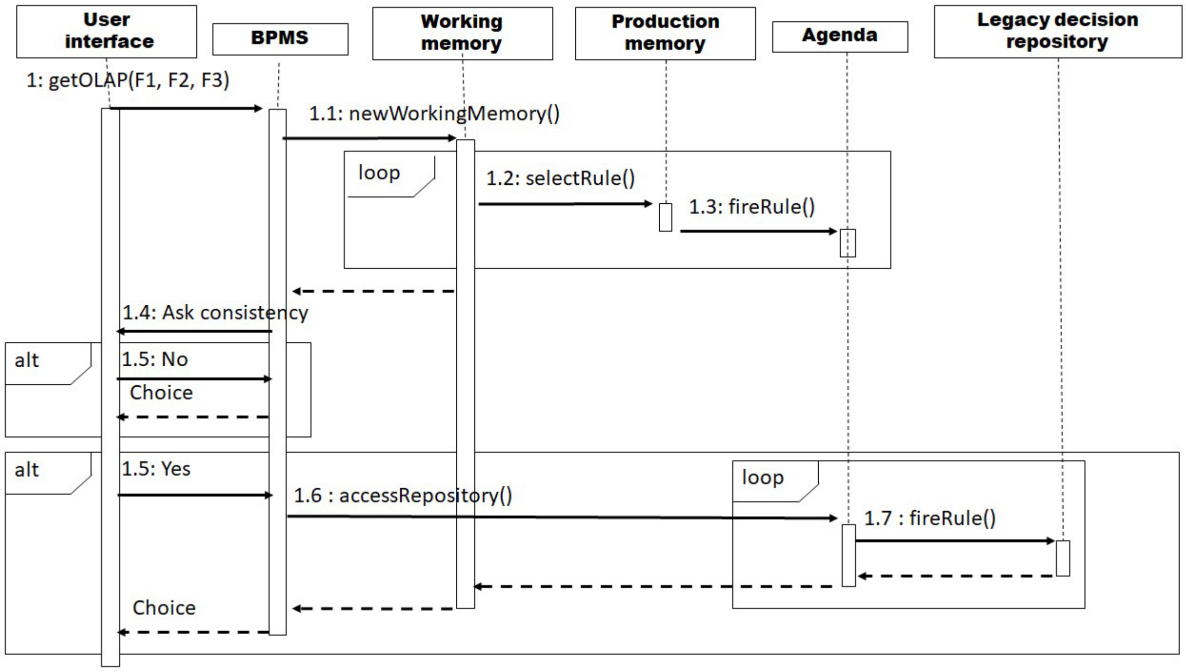

Figure 7. Sequence diagram relating to the execution of CWM-RETE

The extension of the Rete algorithm is provided by the implemented framework. The latter performs as showed in the sequence diagram, which details the CWM-RETE algorithm. As shown in Figure 7, our algorithm can be summarized as follows:

1. After collecting factors F1, F2 and F3 through the user interface, the BPMS generates a new working memory.
2. The working memory selects the activation rule and loads it into the production memory, which interacts with the agenda.
3. If the consistency functionality is enabled, an access to the repository is performed with the current task label as a keyword to search for the different decisions stored in this repository that relate to the current task.
4. The decisions are transformed into business rules and dynamically integrated into the production system of the algorithm.
5. The algorithm is re-run using the new production system.

Since the functionality of the consistency is enabled, the CWM-RETE algorithm has accessed the repository to identify the stored decisions in relation to our current OLAP task and generate extrinsic factors to load them into the working memory. The OLAP_Task class (Figure 8) contains the business rules for the OLAP task that are developed by the PyKnow library.

```
class OLAP_Task(KnowledgeEngine):
    # Rules on cube storage
    @Rule(CWM_RETE(response_time = "High"))
    def R1(self):
        self.declare(CWM_RETE(OLAP="MOLAP"))
    @Rule(CWM_RETE(response_time = "Midium"))
    def R2(self):
        self.declare(CWM_RETE(OLAP="HOLAP"))
    @Rule(CWM_RETE(response_time = "Low"))
    def R3(self):
        self.declare(CWM_RETE(OLAP="ROLAP"))
    # Rules on response time using comapre function
    @Rule(CWM_RETE(compare(memory,cube_size)=1))
    def R4(self):
        self.declare(CWM_RETE(OLAP="ROLAP"))
    @Rule(CWM_RETE(compare(memory,cube_size)=2))
    def R5(self):
        self.declare(CWM_RETE(OLAP="HOLAP"))
    @Rule(CWM_OLAP(compare(memory,cube_size)=3))
    def R6(self):
        self.declare(CWM_RETE(OLAP="MOLAP"))
    # Rules on data refresh
    @Rule(CWM_RETE(refresh = "Yes"))
    def R7(self):
        self.declare(CWM_RETE(OLAP="ROLAP"))
    @Rule(CWM_RETE(refresh = "No"))
    def R8(self):
        self.declare(CWM_RETE(OLAP="MOLAP"))
```

Figure 8. Extrinsic factors generation using CWM-RETE

Results and discussion

To integrate consistency into decision-making in business processes, our work is summarized in the elaboration of a framework for testing our new model, CWM-RETE. With this framework, decision-making in a business process is not necessarily done based on intrinsic factors only, but can be expanded to also cover the extrinsic factors already stored in a repository. Our work contributes to improving business processes by adding consistency in decision-making as a new feature to remedy the lack of this need detected in the state of the art. The study led to the following observations.

The experimental study showed that decision-making in the same task, in our case based on that of OLAP, provided different results depending on whether the consistency feature was activated.

The impact of choosing either MOLAP or ROLAP in a BI process is very crucial. Indeed, the MOLAP choice requires a high memory capacity to host data cubes in order to accelerate access to measures and dimensions. This acceleration comes at the expense of analysis freshness, since the MOLAP cubes do not access the data warehouse in real time, but, rather, they do a periodic refresh.

In the other case, the ROLAP choice does not require a large memory capacity but it requires real-time access to the data warehouse to ensure the freshness of analysis. The two strategies are totally divergent and the choice of one or the other does not depend only on the intrinsic factors relating to the OLAP decision, but it also depends on previously taken decisions, especially the type of the Extract, Transform and Load (ETL) process used to load data in the data warehouse from the data sources.

ROLAP can be a suitable choice if the type of ETL chosen previously was a continuous data extraction from source to data warehouse, whereas MLOAP would be an appropriate choice if the type of ETL was periodic.

These observations and results suggest that consistency in the decision-making process should be considered for many reasons.

Firstly, the simulation of the CWM-RETE model has shown that decision-making can lead to different results depending on whether consistency functionality is enabled. Indeed, in the OLAP task of a BI process, we can opt for a choice of MOLAP if we only use the intrinsic factors. However, we may be faced with a choice of ROLAP if we activate the consistency functionality.

Secondly, consistency must check at least the following characteristics:

- Flexibility: this characteristic allows the user to enable or disable this feature based on the task nature and the level of consistency required.
- Integration: the implementation of this feature must be ensured without additional technical or functional requirements.

Thirdly, new challenges have emerged to best cover this consistency feature, namely:

- Distribution: The implementation of this feature is further complicated in a distributed context. In this case, both decision-making consistency and consensus between users are required. This coupling leads to group decisions with consistency.
- Performance: This characteristic is the concern of all scalable systems. The explosion of the size of both working memory and production memory necessarily causes tuning issues.
- Genericity: The consistency feature should not be limited to a particular area. The BI process is chosen as a case study, but consistency can be generalized to any kind of process. The challenge is how to simplify the digitization of human expertise in these different areas.

Conclusion and Future Work

Consistency is a needed feature in business processes. It concerns both the process itself in its functional aspects and the decision-making within this process. This functionality is treated in different dimensions (ethics, collaborative, and coherence) and there are some implementation proposals based on two approaches (rule-based and constraint-based).

In this paper, we have discussed consistency as a feature enabling the compatibility of decision-making throughout the business process. To argue our idea, we proposed a novel model with a rule-based approach based on the Rete algorithm. The experimental study is ensured through a framework using Python's Pyknow library and MongoDB. This framework simulates consistency in a BI process and more precisely in its OLAP task.

The major conclusion to be emphasized in this work is the absolute necessity to consider consistency in decision-making in business processes whatever the area covered, the intended dimension and the applied approach. As future work, we plan to extend the introduced framework using a constraint-based approach and use this to further examine the agility of business processes and decision models.

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