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Towards an Ontology for Islamic Finance

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Abstract *- Islamic finance is a close combination of conventional finance, ethics, Islamic law, and jurisprudence. It has developed in an unprecedented way over the past half-century and has attracted the attention of Western central banks. It has been adopted by several countries, including non-Muslim countries, to deal with the excesses of conventional finance. The difference between Islamic banks and conventional banks lies in its five (5) principles, namely: the prohibition of interest, speculation, and uncertainty, the prohibition of illicit investments, the principle of profit and loss sharing, and the backing of a tangible asset. According to figures from the Institut Nationale d'Etudes Démographiques (INED), the population of the African continent is expected to reach 3.6 billion by 2100.*

This finance, despite its success, so much observed on the other surfaces of the earth, is still struggling to gain a foothold in the world and particularly on the African continent. This is due to the fact that it is not well known by the public, as its concepts have Arabic names. It is in this perspective that we propose in this paper to build an ontology of Islamic finance. The aim of our work is to design an ontology of Islamic finance. This ontology will group the key concepts of Islamic finance, define the relevant relations between them in order to popularize this finance from a platform based on a semantic wiki.

Keywords *- Islamic finance, Sharia, Banking, Halal, Haram, Riba, Ontology.*

I. INTRODUCTION

At the opening of the second French Islamic Finance Forum in November 2008, Mrs. Christine Lagarde, French Minister of Economy, said: "Islamic finance has many advantages, in that it condemns speculation and in that it condemns chance". This statement proves that Islamic finance is an important pole of international finance.

The financial crisis that hit the world in 2008 highlighted the positive aspects of the Islamic financial system. To this end, Islamic finance is seen as the most comprehensive model to address the ills of conventional finance. All this will contribute to opening up controversies around it, such as its Capacity to restore confidence in the financial system.

According to figures from the Institut National d'Etudes Démographiques (INED), the continent's population is expected to reach 3.6 billion by 2100[1]. However, the weight of Africa in Islamic investments represents only 1.5. Sub-Saharan Africa is not expected to reach 0.5%, as the Maghreb will obviously account for more than half. Africa in general, and Burkina Faso in particular, should not remain on the sidelines of this much-heralded success, given that no Islamic bank has yet been established there. Thus, Burkina Faso may or may not miss a historic opportunity to significantly increase its weight in the recycling of the world economy.

Despite its success on other continents, Islamic banking is still struggling to establish itself on the African continent. This is because it is foreign to a large number of financial actors, and therefore also foreign to the general public, given that its concepts have names in Arabic, despite the attempt of banks such as Coris Bank International to open windows onto it. With this in mind, we wanted to set up a computer tool that could recognize all the products of the said finance by highlighting the different relationships that exist between them. The idea is, therefore, to set up a system for sharing knowledge on Islamic finance so that it can benefit the actors of finance in particular and the general population in general. In recent years, ontologies have emerged as an essential tool for knowledge representation. As such, an ontological solution fits this description perfectly.

Thus, in this paper, we propose an ontology of Islamic finance to raise awareness of the key terms and concepts of this finance essentially drawn from Islamic law.

The rest of the paper is organized as follows: Section 2 presents the basic concepts of Islamic finance. Then in Section 3, we present the process of constructing the ontology of Islamic finance, and we end with a conclusion and perspectives in Section 4.

II. ISLAMIC FINANCE: BASIC CONCEPTS

A. Definition

Islamic finance is a (new) form close combination between economics, ethics, and the *sharia*, the Muslin law(whose sources are the Koran and the *sunna)*

B. The principles [1]

- Prohibition of interest: The first basic principle of Islamic finance is the prohibition of interest, which means to increase a thing by itself.
- The prohibition of Ghara: Refers to uncertainty, ambiguity, risk, and deception.

- Prohibition of Maysir; Pure speculation for the purpose of profit, which is prohibited by sharia law.
- Prohibition of illicit investments: Sharia also requires that Muslims not engage in illicit activities.
- The principles of Profit and Loss Sharing: This is based on the principle of Profit and Loss sharing, commonly referred to as the 3Ps principle. This principle emphasizes the "participatory" side of Islamic finance as well as the "participatory" side of Islamic finance.
- Asset Backing: This principle stems from the first principle of the interest rate prohibition. Since no possibility of profit is realized by the exchange of two units of currency of the same denomination, profit is only justified in the case where an object of intrinsic utility is sold for money.

C. The products [2]

The main products are :

a) Mudarabah

This is a financial structure where the entrepreneur has full management of the business. The profits from this activity are shared between the entrepreneur and the investor on the basis of an agreement at the outset.

b) Moucharakah

It is an operation that offers the possibility of investment to the parties where the profits will be shared according to the invested capital: It is an operation that offers the possibility of investment to the parties where the profits will be shared according to the invested capital, as for the losses, they will be shared between the two taking parties always according to the invested capital.

c) Salam

It refers to a forward sale. It is characterized by a sale for cash while delivery is to be made at a future time.

d) Istisna'a

This financial contract allows a buyer to have goods delivered to him at a future date;

e) Ijara

It is a transaction that is akin to hire, purchase or lease;

f) Sukuk

The Sukuk contract is an Islamic BOND BACKED BY A TANGIBLE ASSET. SUKUK represents a right to claim for a defined period of time;

g) Takaful

Takaful is derived from the Arabic verb "KAFALAH," which means a guarantee. It is a concept of insurance based on cooperation and protection and mutual aid between participants;

h) Qard-Hasan

This is a short-term interest-free loan. It has the appearance of aid rather than a commercial credit because it is used to finance studies, marriage...

III. METHODS FOR ONTOLOGY CONSTRUCTION

Before dwelling on the methods of construction of ontologies, we have defined what ontology is and the languages of representation that they use.

A. Definition

Gruber defines the term ontology aS: As for us, we can propose as a definition: An ontology is the set of concepts related to a specific domain while defining the relevant relationships between them in order to establish a vocabulary that can be accepted and shared by all.

Alluding to the conceptualization of a domain, i.e., a choice of how to define a domain. And the specification of this conceptualization, in other words, its formal description.

As for us, we can propose as a definition: An ontology is the set of concepts related to a specific domain while defining the relevant relationships between them in order to establish a vocabulary that can be accepted and shared by all.

B. Knowledge Representation Mechanism

a) RDF/RDFS

Resource Description Framework (RDF) is a metalanguage used to frame the description of resources, making it possible to make more "structured" the information necessary to search engines and, more generally, necessary to any computer tool analyzing Web pages in an automated way. RDF uses the Uniform Resource Identifier (URI) principle to uniquely identify resources. An RDF schema with basic concepts can provide this capability by using resource classes[3]. In other words, RDF triples are instances of RDFS. RDF and RDFS thus allow the description of resources as Graphs of triples. However, they suffer from some limitations since they do not allow to express some properties such as: transitivity, symmetry. For example, SameNoteQue is symmetrical, BetterScoresQue is transitive. Thus, these two languages do not allow other types of axioms to be represented and used to make inferences. Instead, another language, OWL (Web Ontology Language), has been proposed to fill this gap.

b) OWL

Web Ontology Language (OWL) allows for the representation of rich and complex knowledge about things, groups of things, and relationships between things. OWL is based on computational logic for checking the consistency of knowledge and making implicit knowledge explicit. OWL documents can be linked together.

C. Similar work

The ontologies explored the field of Islamic finance in 2011 by Mamadolimova et al.[4]. The actors memed their work on the modeling of a vocabulary specific to Islamic finance in order to confront them with the different types of risk management.

In 2014 Mamadolimova et al. proceeded to model a bilingual ontology. For this purpose, they described the concepts, the relations between concepts in order to achieve an opulent terminology and more robust semantics.

The methodology used by the actors of these two(02) methods is the spatial modeling technique, and the tool used for the implementation of the ontology is Top-Braid.com.

International Shariah Research Academy (ISRA) has developed an ontology called I-FIKR9. This ontology maps the hierarchy of Islamic finance concepts, the methodology used for which remains unknown.

In this paper, the authors have proposed an ontology construction approach for Islamic finance based on the NeOncite methodology with the Protégé tool. The authors followed a process by making the ontology specifications, conceptualization to the data dictionary, classification tree, concept attributes...

The methods presented do not take into account the formalism of an ontology. The formalism allows to ensure modeling of the knowledge of a domain by using the LDs, and it is necessary to take into account the two levels of this logic. The first level is the terminological level or TBox, which has for objective the definition of the general knowledge of a domain. The second level is the assertional or ABox level representing a domain-specific instantiation [14].

A TBox describes concepts and roles, while an ABox defines individuals by calling and indicating in terms of concepts and roles, assertions about These individuals are named [15]. For example, the definition "a text must have at least one child" can be written in description logic as

$$\text{Parent} \equiv \exists \text{ parent Of}.$$

Also, the logic of the descriptions can be built around the specification of the subsumption relations that exist between the different concepts/roles; for example, to specify that the class Person is subsumed by the Class Teacher, we write :

$$\text{Person} \subset \text{Teacher}$$

D. The process of constructing the ontology

In the literature, several methods [5], [6], [7] and [8] and tools like protege 2, Text2Onto [9], Terminae[10] have been proposed for the construction of ontologies [10]. According to [11], the construction of an ontology in a specific domain follows the following steps:

- Identify key terms in the domain;
- Manually link key terms to SENSUS;
- Inclusion of all concepts between the key term and the root of SENSUS;
- Adding new terms related to the domain. This involves manually adding all the terms that give meaning to the domain and that are not already present. Steps 2 and 3 are repeated to take into account new concepts up to the root;
- The addition of the entire subtree. 6.

In the ENTERPRISE method [12], [13], the authors identify the following four steps:

- The definition of the role and what the ontology will provide;
- Building the ontology: This is divided into three(03) sub-activities:

a) Identification of concepts and relevant relationships between these concepts by defining them succinctly, three (03) approach strategies were proposed by the authors one year later, namely:

- We will go from general concepts to specific concepts. This is a top-down approach;
- On the contrary, we start from specific concepts that we organize better to obtain generic concepts. This is a bottom-up or (Botton UP) approach;
- We will identify the key concepts, and from these, we will find the most general and the specific ones that will serve us. This approach starts from the middle to the ends (or MIDDLE OUT).

b) encoding the ontology in a language understandable to it;

c) The integration of the existing ontology is also the stage where the ontology would be built.

- Ontology evaluation;
- The drafting of documentation and the traceability of the various actions carried out during the different stages.

Most of the methods propose a step-by-step ontology construction. In this paper, we focus on the method METHODOLOGY [16], which is the most adequate for the construction of our ontology because it also has the technical tools necessary for the construction of the ontology.

The main steps of the METHODOLOGY method are :

- Specification: The objective of this first step is to frame the scope of the ontology as well as its domain. This will raise questions such as: what is the domain of the ontology, its objectives, its use, and maintenance;
- Conceptualization: In this step, the identification and structuring of domain knowledge will be addressed, using a set of intermediate semi-formal representations, due to their simplicity and ease of use by domain experts;
- Implementation: This step is the place of the formalism of the design acquired in the second step using an ontology formalism, encoding the ontology into a formal ontology language to finish.

Of the three (03) methods presented, It is clear that they had a bias towards the activity of ontology development and implementation. On the other hand, with the exception of the METHODOLOGY method, SENSUS

and ENTERPRISE have been devoid of activities related to the management, evolution, and evaluation of the ontology.

Among the tools, we will use the Protege tool, which is currently the most used ontology editing environment. In this section, we will build OntoFIS based on the criteria of the METHONDOLOY method. This construction did not follow a linear process, as we had to go back and forth several times by including terms, sometimes including others that we judged not necessary or not.

E. Ontology for Islamic finance

a) Specification of OntoFIS

The construction of an ontology begins with the specification stage, which is very crucial. It is a question of elaborating a document that brings out the various needs of the ontology through the five (05) following aspects.

Table 1. Specification of OntoFIS

Knowledge area: field of Islamic finance. **Gols:** allow the population to have a common tool fot sharing knowledge on Islamic finance in order to popularise the latter. **Users:** The population as a whole and professionals in the economy in particular. **Source of information** Scientific documents and websites related to Islamic fiancé. **Scope of ontology** : Sharia, IsHaram, IsHalal, isBackedBy, MustRespect.

b) Conceptualization of OntoFIS

This section consists of the following tasks:

1) Constructing the Glossary of Terms

This is the first stage of the design, which consists of collecting all the terms by making their descriptions in natural language. The terms recorded in the table are those specific to Islamic finance that we have come to consider relevant and interesting.

Table 2. The glossary of terms

Term Name	Description
Qur'an	Source of Muslim Law
Hadith	The Secondary Source of Muslim Law
Sharia	Legislation based on the Quran and Hadith
Halal	Shariah Compliant Product
Haram	Sharia incompatible product
Ouleman	A Theologian
is backed	Any Halal product must be backed by a tangible asset
IsCompliant	All products must be Sharia compliant
Respect	All products must respect the principle of profit and loss sharing.
Participatory	This is the class of products that are intended
Funding	Financing
(....)	(....)

2) Construction of the Binary Relationship Diagram

The objective of this task is to represent in a general way the existing relations between the various concepts belonging or not to the same hierarchy. A binary relation allows making the link between two concepts, namely a source concept and a target concept. If R is a relation between two concepts C1 and C2, then for any pair of instances of concepts C1 And C2, there exists a relation of type R, which links two instances of C1 and C2.

3) Constructing a Dictionary of Concepts

This step is done after the concept taxonomy and the binary relations diagram has been done. For each concept, we will have to define its relations and instances. (See Table III}

Table 3. A dictionary of concepts

Concept Names	Instances	Relationships
sharia	-	establishing the principles
Asseting Backing	Supervising	-
Quran	-	rendHalal,rendHaram
Riba	Haram	-
Hadith	-	makesHalal makes Haram
Ghara	Haram	-
Qiyas	Sharia	-
Ijtihad	Sharia	-
Maysir	Haram	-
Investment illicite	Haram	-
3P	Halal	-
Ijma'a	Sharia	-
Takaful	Participatory	-
Fatwa	Sharia	to issue an opinion
Musharakah	Particular	-
Mudarabah	Particular	-
Halal	Principle	-
Haram	Principle	-
Ijara	Financing	-
Istisna'a	Financing	-
Qard_Hassan	Financing	-
Salam	Financing	-
Murabaha	Financing	-
Oueleman	-	emetUnFatwa
Suduk	Assurance	-
Shari'ah	-	Overpervise

4) The Table of Binary Relations

This task consists in building the binary relations table in detail. The objective here is to highlight the name, the name of the source and target concepts, the name of the inverse relationship, and the cardinalities for each relationship used in the binary relationship diagram.

5) Constructing the Attribute Table

The table shows the different attributes of OntoFIS. This table shows a detailed description of the attributes defined in the concept dictionary.

Table 4. The attribute table

	Attribute name	Type of value	Card (min/ max)	Value per default	Domain of value
	id_produ	int	1..1	-	-
	nom_produit	string	1..n	-	-
	reference_coranic	string	1..n	-	Number of the surate and the verse
	reference_hadith	string	1..n	-	Name(s) of preporter(s)
	commissionning date	date	0..1	-	. -
	(....)	(....)	(....)	(....)	(....)

6) Construction of the Table of Instances

Table V highlights the created instances. To do this, for each instance, we must specify the name of the instance, the name of the concept where it belongs, its attributes, and the values associated with it.

Table 5. The table of instances

Instance name	Concept name	Attributes	Values
Quran, Hadith, Ijtihad, Fatwa, Ijma'a	Sharia	-	-
Halal, Haram	Principle	-	-
3P, Asset Backing	Halal	-	-
Riba, Ghara, Haram... Mayssir, Illicit Investment	Haram	-	-
Istisn'a, Murabaha, Salam, Qard Hassam...	Financing	-	-
Suduk, Takaful	Insurance	-	-
Musharakah, Mudaraba	Participatory	-	-
(....)	(....)	(....)	(....)

7) Formalization of OntoFIS

The result of this section is a description logic knowledge base composed of the TBox (**Table VI**) and the ABox (**Table VII**)

- **Build TBox**

The TBox is defined as follows (see Table VI).

Table 6. The table of instances

Insurance ⊂ Product
Funding ⊂ Product
Participatory ⊂ Product
Haram ⊂ Principle
Halal ⊂ Principle
Ijtihad ⊂Sharia
Qiyas ⊂ Sharia
Qur'an ⊂ Sharia
Hadith ⊂ Shariah
Fatwa ⊂ Shariah
Ijma'a ⊂ Sharia
Riba ⊂ Haram
Ghara ⊂ Haram
Maysir ⊂ Haram
Illicit_Investment ⊂Haram
3P ⊂ Halal
Asset Backing ⊂ Halal
Suduk ⊂ Insurance
Takaful ⊂ Insurance
Musharackah ⊂ Participatory
Mudarabah ⊂ Participatory
Ijara ⊂Financing
Istisna'a ⊂ Participatf
Murabaha ⊂ Participatf
Salam ⊂ Participatf
Qard-Hassan ⊂ Participatf
Salam ≡ Product ∩(∃isDuHalal ∩(∃ ¬is*DuHarm*))

- **Build TBox**

The OntoFIS ABox is presented in the table **Table VII.**

Table 7. The table of instances

Alcohol (Illicit_Investment)
Pornography(Illicit_Investment)
Pork (Illicit_Investment)
gambling(IIllicit_Investment)
isCompliant(Product,Sharia)
must hold(Product,Asset_Backing)
must hold(Product,3P)
Is_established_by(Principle,Sharia)
mustn'tContain(Product,Haram)
mustFollow(Shariah,Product)

F. Operationalization

Building an ontology is a very tedious task that requires a lot of effort and time. Especially if the ontology designer is called upon to do it directly without the use of a tool; on the other hand, PROTÉGE offers this facility to the developer. The presents the ontology built using the Protected editor. The terms and relations of OntoFIS

have been validated by the experts of the firm "WHAT YOU NEED," specialized in classical and Islamic finance in Burkina Faso. The hierarchy of the different concepts.

a) Interrogation of ontology by SPARQL

Fig 1 illustrates our different classes(concepts) created on Protégé2000. The query launched lists all the classes of the ontology, specifying their superclasses and the relations linking them with other classes...

subject	
Mayssir	Haram
Haram	Prinicipes
Fatwa	Charia
Financement	Produits
Halal	Prinicipes
Coran	Charia
Istisna'a	Financement
Produits	neDoitParContenir some Haram
Riba	Haram
Prinicipes	estEtablitPar some Charia
Asset_Backing	Halal
Moudarabah	Participatifs
Produits	doitContenir some Asset_Backing

IV. CONCLUSION

Our work consisted in presenting an ontology model for a sector in full mutation, that of Islamic finance, where the notion of ontogeny is completely new, after having defined Islamic finance and through its principles and products in general. We thought about the different methods of constructing ontologies. Among the different methods that we have discovered, we have thought about that of METHODOLOGY because it offers a construction skeleton rich based on specification, conceptualization, formalization, operationalization, and evaluation.

After having followed the different steps of the method step by step, we gave shape ontology thanks to the Protégé2000 editor that we ended up calling OntoFIS. As future work, we wanted to set up a platform that will support our ontology built to allow users to further discover finance Islamic through its concepts. This was possible thanks to the tools of representation knowledge of ontologies such as RDF, RDFS, and OWL. In addition, we think that we will have to enrich the ontology with other concepts that probably exist that we didn't take into account. For this, we will have to use the technique of web scrapping through news sites. The web scrapping will consist of seeking information on specialized sites that disclose information on Islamic finance and adding it to our ontology. And proceed in particular to the maintenance of ontogeny. We have to use the technique of web scrapping through information sites. The web scrapping will consist in searching for information on specialized sites divulging information on Islamic finance and adding it to our ontology. And proceed in particular to the maintenance of the ontogeny.

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