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Open Innovation Participants Profiling: An Archetypes Approach

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Abstract. Organizations adopting Open Innovation seem to express slightly specific behavioral patterns, attitudes and values, which are beneficial and that can be perceptible in their interactions with outsiders. It would be useful to find a way to identify these characteristics and to perceive them in potential participants for Open Innovation consortia. This research work explores the concept of archetypes to provide an abstract way to express how companies engaging in Open Innovation look like. The adopted method applies web mining and preliminary results are presented, which show the potential of the approach.

Keywords: Open Innovation, Collaboration, Organization archetypes.

1 Introduction

Society has undergone profound changes, due to the progress in the varied technological, economic and social segments. Companies need to continually face new challenges, caused by new paradigms such as Social Networks, Internet of Things, and Artificial Intelligence or the convergence of technologies leading to Industry 4.0, which together yield a disruptive and fast changing environment [1]. At the manufacturing level, due to these multifaceted developments, we may be at the 4th industrial revolution. To adapt to these abrupt and unpredictable changes, companies feel the need to adopt new strategies, based on the paradigms of collaboration [2] and open innovation [3].

Open Innovation (OI) has been a strategy adopted by organizations, in which they share intellectual property and interact with outsiders (e.g. suppliers, customers, partners, research entities, retirees, etc.) which act as sources of ideas to create new and lucrative products and services. The success of OI projects depend, among other factors, on the attitudes and behaviors that each participant expresses, which are difficult to evaluate, given the variety and high-level complexity of the involved aspects. Therefore, there is a need to consider more abstract ways to characterize OI participants. In this regard, OI participants seem to express slightly specific behavioral patterns, attitudes, and values, which can be perceptible in their interactions with

customers, suppliers, partners, and society, and that appear to favor OI engagement. It is as if they have "special characteristics", which come as impressions of symbolic nature. In this research work, we pursue this idea exploring the concept of archetypes to determine how participants in OI look like, focusing on organizations.

For applying the notion of archetypes in OI, we need to address a number of questions through our research, namely: What are archetypes? How do they manifest in the context of organizations? What is the importance of archetypes in open innovation? These questions briefly are addressed in a literature review, in Section 2. In Section 3, we describe the research method used to identify the archetypes that best characterize OI participants, including an analysis of the obtained results. Section 4, the final one, contains the relevant conclusions and a suggestion for future work.

2   Background

Although the addressed topic would benefit from an analysis of different scientific areas, in this section we only emphasize the main aspects that contribute to the presented research questions.

2.1   The Notion of Archetype

The term "archetype" derives from the Greek compound word "*archétupos*", in which *arché* means "first principle" and *tupos* means "impression". The word refers to the creative source of things that cannot be perceived or observed directly, but which manifests itself through impressions or images [4]. Plato illustrated archetypes in his "allegory of the cave" to show that people could only see distorted shadows of objects of the real world. The original and real forms of these objects, the archetypes, are outside the perception of people [5].

Later in 1919, this idea of the archetype was used by Carl Jung in psychology. While studying ancient and actual myths and religions, he noticed recurring patterns, themes and symbols, and that these patterns also emerged in the dreams and fantasies of his patients. He proposed that there are elements in the human psyche that are pre-personal and transpersonal with the power to influence human thought and behavior, which he called archetypes [6].

Jungian archetypes represent primitive mental images inherited from our ancestors and resident in our collective unconscious. Archetypes consisted of archaic representations of primordial types and models, which are used to evaluate people, things, or situations. Examples of archetypes are the warrior, the hero, the mother... Archetypes can be represented through images, beliefs and myths. They are of indefinite nature and subject to many meanings [7]. A number of archetype structures used nowadays in people and organization realm are of Jungian origin [6,8].

2.2   Organizational Archetypes

As stated in [9], archetypes can be used to represent organizational structures and management systems that can be better understood by analysis of overall patterns as a function of ideas, beliefs and values. These archetypes can be used inside holistic interpretive frameworks for the classification of organizational structures and systems, according to the differences and similarities in these overall patterns. Furthermore, archetypes are also seen as "qualitative patterns of strategic thought linked to predispositions towards different kinds of reactive or proactive strategy" [10].

There is already significant literature on the use of organizational archetypes to model organizations. For instance, the work described in [11] proposed the use of archetypes as a way of explaining the response of large companies to organizational challenges that affect their probability of success. Some applications of organizational archetypes are focused on the characterization of organizational culture [12, 13]. In [14], archetypes are used to categorize sustainable innovative business models.

Archetypes have been heavily studied in the construction of brands for companies [8]. These archetypes are based on the Jungian ones and we adopt them in our research method.

2.3   Archetypes in Open Innovation

Open innovation has been a strategy used by organizations to explore new commercial opportunities, which would be more difficult to achieve in a traditional organization-centric way. Empirical evidence [15] shows that companies that practice Open Innovation require a set of network capabilities, namely capacity to absorb knowledge, ability to transfer knowledge and relational capacity (openness) regarding suppliers, customers, higher education institutions, competitors, among others [16]. In this sense, "organizations allow unused and underutilized ideas to go outside the organization for others to use in their business models"[17] and, in turn, they are receptive to external knowledge to incorporate in their own developments.

Several researchers and practitioners have elaborated the approach of OI, enriching the field with research focused on the way OI occurs. It is precisely by using the interpretive framework of the archetypes and the way companies claim to practice the OI model that we will try to fit these two concepts together. We may ask what archetypes prevail in companies that adopt this innovation model. That is, what values, beliefs and ideas are embodied in the rationale that describes OI practice?

These networking capabilities relate to several aspects addressed in the area of collaborative networks [2], such as mutual trust [18, page 11], the ability to collaborate [19], risk and benefits sharing [20], competencies fitness [21] and organizational values alignment [22]. Moreover, organizations are entities of a multi-faceted nature, encompassing several dimensions, namely structural, componential, functional and behavioral ones [23]. Due to these complexities, we may also ask whether there could be a more abstract and comprehensive approach to help characterize OI participants' networking capabilities. As such, we could rely on the organizational archetypes holistic interpretative frameworks mentioned before. Pursuing this way, we may

consider an approach for evaluating the networking capability of an organization through archetypes classification. But finding these archetypes has hardly been done, and it is the focus of our research method.

Nevertheless, this idea of exploring archetypes frameworks in OI contexts has already been approached in previous research works. To our best knowledge, they are few and do not explore the rationality proposed in this research work. Table 1 illustrates some examples and scope of such research works. In this table, the example more slightly close to our approach is the one described in [24].

Table 1. Open-Innovation archetypes identified in bibliography.

Application	Archetypes examples	Reference
Innovation patterns	Outside-in process; Inside-out process & Coupled process	[25]
Profiling OI participants	Professionals, Explorers, Scouts & Isolationists	[24]
Decision making	Under Radar, The Regulated Recipe, Follow the Directions, Directed Stumbling, "A New Way To…", Explore Problem-Solving Space; Fix MY House	[26, p.95]
OI ecosystem Management	Development, Workbench, Access, Insight	[27]
Project Management	The Supporter, The Information Manager, The Knowledge Manager, The Coach	[28]

3   Finding the Archetypes Displayed by OI Participants

3.1   Research Method Explained

As mentioned above, archetypes manifest themselves in subliminal way, through impressions, images and symbols that arise in the several ways organizations operate and interact, including the documents they put available on the web.

Therefore, one way of identifying which archetypes characterize companies, and in our case, those participating in OI projects, is to analyze the documents that they put online on their web sites. The rational is that if we can evaluate people from the way they express, through writing and speaking, using our archetypical references, it is also possible to perceive the archetypes of OI participants, from the web documents they use to "speak" with the market. By analyzing the words and expressions that are used in those documents, we can infer which archetypes lie behind them. For this, two important problems need to be resolved. The first one is how to infer that a document is connoted with certain archetypes. The second problem relates to the difficulty in associating archetypes to a large number of web documents, as usually such type of problems requires a large corpus [29]. Such an effort implies the utilization of

knowledge discovery techniques, in our case Web Mining, as described in a later section.

3.2 Inferring Archetypes from the Identified Documents

As mentioned before, the question addressed here is how to infer that a document is connoted with concrete archetypes, for example, "Revolutionary" or "Sage", as these archetypes do not manifest themselves directly in the documents, because they are of latent nature [30]. To solve this problem, we adopted a technique that is used in Text Mining. When trying to infer that a document is associated to a certain class, we can specify a set of "seed words" and look for them in the document. For example, to detect whether a document relates to the concept "car", we can use the set {engine, chassis, brakes...} as "seed words" [31].

Table 2. Association between latent archetypes and corresponding terms.

Archetype	Associated terms
Magician	synchronicity, serendipity, dreamer, visionary, coaching, consultancy, catalyst, positive, renovation
Caregiver	compassionate, loyal, generous, consistent, trustworthy, comforting, supportive, responsive, reliable
Hero	competent, courageous, responsive, directed, disciplined, focused, strong, brave, functional, productive
Explorer	independent, determined, active, exploration, adventurer, youthfulness, rebel, learner, experimenter, energetic
Innocent	peaceful, happiness, optimistic, tranquil, kindness, simplicity, consistent, altruism, unpretentious, natural, optimistic, unpretentious, supportive
Jester	playful, spontaneous, innovative, flexible, original, modern, fair
Revolutionary	radical, innovative, energy, energetic, challenging, creative, progress, transformation, growth
Ruler	leader, commanding, authoritative, expertise, controller, conservative
Sage	intelligence, knowledge, methodical, researcher, challenging, robust, devoted, trustful, thoughtful, classic
Creator	authenticity, imagination, organized, inventive, perfectionist, efficacy, persuasion, futurist, excellence, rebel
Lover	affection, emotion, hedonist, artistic, hospitality, openness, beauty, aesthetics
Every person	genuine, real, reliable, hardworking, trust, collaborate, honest, stable, sharing, democratic, authentic, peer

In a similar way, our approach also consisted in obtaining a set of seed words for each archetype. For choosing them, we looked for available examples of companies that were characterized through archetypes frameworks. For example, in the online document [32], it is suggested that the company with the "Ruler" archetype (e.g. Mercedes Benz) has the following characteristics: expertise, controller, leadership, and authority. Based on the suggestions from [8, 32, 33], we could identify and obtain

associations between archetypes and their related terms, which are later taken as "seed words" during the text mining process. The obtained associations can be seen in Table 2.

3.3   The Web Mining Phase

Web mining techniques comprise a particular category of Text Mining, in which the documents are available on the Web. Text Mining is usually applied in knowledge extraction, documents classification, topics modeling, opinion mining, sentiment analysis, and so on. Text Mining methods and tools are available in significant number and variety, and there is a continuous progress in this area. There are three kinds of analysis performed in Web Mining, namely web content mining, web structure mining, and Web usage mining [34]. In this work, we rely on the content analysis side of Web Mining.

Therefore, our Web Mining-based research method starts by obtaining a collection of web pages from companies that engage in open innovation projects. At an early stage, we tried to use Text Mining packages that were already available, for example the R Project for Statistical Computing [35]. But, as mentioned in the *OpenMinted* project [36], there are still issues in terms of interoperability for building more complex or more sophisticated Text Mining applications. In our case, we need that our custom-made Web Mining tool has got the following functionality: access web documents and extract their content; use the sub-links of each web document to see whether related documents are still relevant in terms of open innovation, and extract their content; process the collected documents with Text Mining techniques, as described in the next section; and use the WordNet semantic network to be able to identify synonymy and related words. The entire process is illustrated in fig. 1. For this, we developed a tool that includes a Java application for handling steps 1 to 3; and Prolog predicates which use WordNet during step 4.
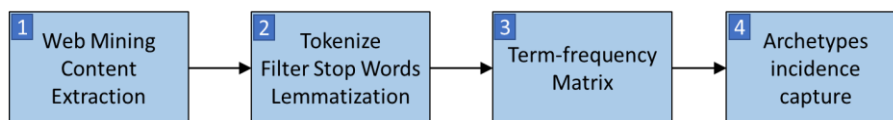

Fig. 1. Representation of the text mining process.

These phases are briefly described here:
1. Obtain a collection of web addresses with documents mentioning "open innovation". In addition, see whether sub-links contained in each document point to other documents that are also related to OI. This step resulted in a corpus of "Open Innovation related web documents" from companies. The obtained collection comprised 4675 documents.
2. The second phase consists of tokenizing the text, filtering stop words, and performing lemmatization. For each word, lemmatization is only accepted if the resulting word exists in the dictionary of English words, as we need to use WordNet in the last phase.

3. In this phase, a matrix term-frequency [37] is constructed, in which the lines of the matrix correspond to documents and the columns to words; each cell contains the frequency of occurrence a word in a particular document. Table 3 shows of a partial representation of the obtained term-frequency table.

4. This phase consists in associating the words of the documents to each archetype, which will be explained in the next section.

Table 3. Representation of Term-frequency matrix

Doc	corporate	create	energy	innovate	plan	…
1	0	0	0	13	2	…
2	9	0	1	19	0	…
3	0	5	0	3	0	…
4	1	0	0	2	0	…
…	…	…	…	…	…	…

3.4 Discovery of the Most Important Archetypes

Our approach to discover the associations between the words contained in the web documents and the archetypes in Table 2 is based on the work described in [38]. In this work, we define the concept words(c), as represented by all words associated with a concept c, which in our case corresponds to an archetype defined in the left side of Table 2. The words returned by this predicate correspond to the elements on the right side of the table. The predicate classes(w) provides the classes to which a word w of a document is associated, that is, it consists of the set:

$$\text{classes}(w) = \{c \mid w \in \text{words}(c)\}. \tag{1}$$

As mentioned in [38, 39], the incidence of a class or archetype c, can be determined as follows:

$$freq(c) = \sum_{w \,\epsilon\, words(c)} freq(w). \tag{2}$$

The determination of *freq*(w), in turn, is done as described in [31]. In such way, the terms in the right side of table 2, are used as "seed words" of the corresponding left-side archetype. Then, each word in the documents that corresponds to the seed words is accounted. Fig. 2 shows some seed words for the "Revolutionary" archetype. By using Wordnet, we can also account synonymous and related words of the seed words. For example, by asking WordNet which words are related to "innovative", which is a seed word of Revolutionary archetype, the answer includes "innovate", "invention", "innovativeness", "groundbreaking", etc.
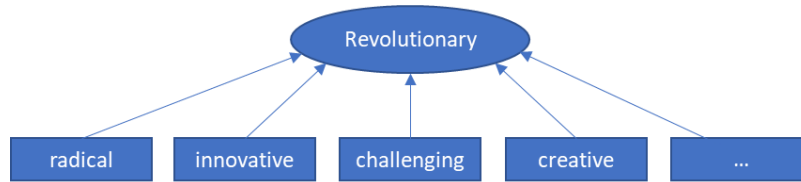
Fig. 2. Seed words of class/archetype "Revolutionary".

The determination of the frequency of each word in the documents was made using two levels of depth. At level 1, only the words that corresponded to the "seed words" are searched in the documents. At level 2, WordNet is used to consider synonyms and related words as well. With these approaches, we can find the incidence of archetypes in OI web documents.

Archetypes determination, search level 1:
At level 1, only the words that corresponded to the "seed words" are searched in the documents. Whenever a word matched, the value *freq* of matrix tf(*doc*, *word*, *freq*) is added to the archetype incidence. Proceeding with this search to each word of each document provides the determination of the more incident archetypes in the documents, which is illustrated in in Fig. 3.
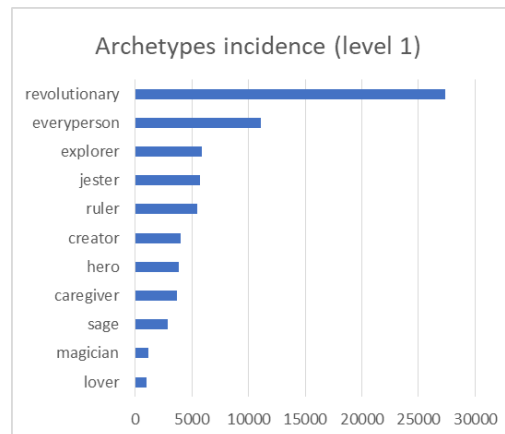

Fig. 3. Discovered archetypes, level 1.

Based on these results, we can state that the archetypes with more incidence in the documents are "revolutionary", "everyperson", "jester", and "ruler". A more detailed analysis of these results is done below.

Archetypes determination, search level 2:
In addition to the previous search level, we look for synonyms and related words to each seed word of each archetype, which as mentioned before, is done using WordNet. Our method is inspired in [39], which describes an approach based on the utilization of Wordnet to identify associations between words and concepts.

In search level 2, whenever a "seed word", any synonymous or related word matched, the value *freq* of matrix tf(*doc*, *word*, *freq*) is added to the archetype incidence. We add attenuation weights to adjust for the cases where the documents' words are farther from seed words, in the Wordnet graph ontology. Proceeding with this search to each word of each document provides the determination of the more incident archetypes in the documents, which is illustrated in Fig. 4.
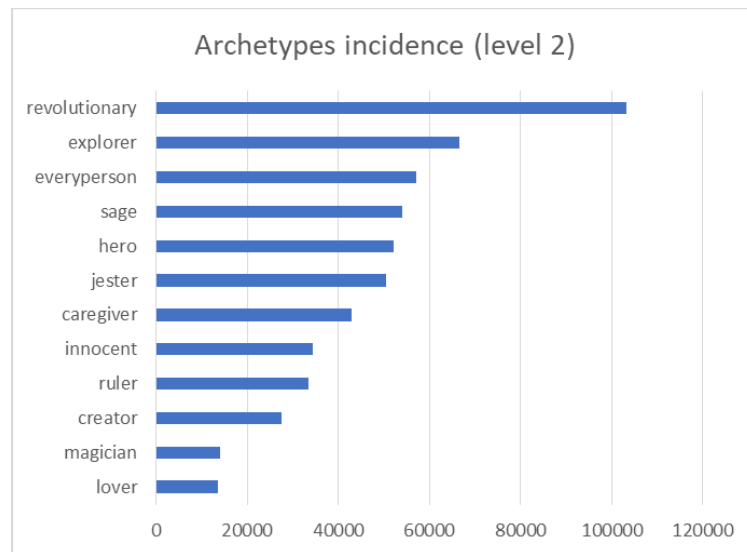

Fig. 4. Discovered archetypes, level 2

3.5   Results Discussion

The results obtained during search for level 1 show that archetypes with more incidence in the used documents are the archetypes "revolutionary", "everyperson", "jester" and "ruler". In the search for level 2, the archetype "explorer" moved from seventh to second position. This is because, in the previous search level, the seed words "determined", "exploration" and "youthfulness" did not get any hits. In level 2, correspondences were found through synonymy and derivations using wordNet, e.g., the words "ambitious", "expedition" and "juvenile", respectively.

In Figure 5, the elements more related with the resulting archetypes are depicted. The terms with more correspondences to the revolutionary archetype are: innovate, growth, energetic and radical. This is interesting because, as suggested in [33], organizations with the revolutionary archetype spend great energy pursuing radically different things, challenge the status quo, and the developed products lead to true innovations. The companies suggested as possessing the archetype of revolutionary were: "Apple" and "Harley Davidson".

The second identified archetype, the "explorer", allows to characterize independent companies that are very active and like to learn based on the experience. A suggested

enterprise with this archetype is "Starbucks" [32]. The last archetype, "everyperson", has the elements "hardworking", "reliable" and "collaborate". As suggested in [32], "everyperson" organizations provide comfortable spaces where everyone is treated equally and work in collaboration. The suggested companies with these archetypes are "Craiglist" and "The Associated Press".
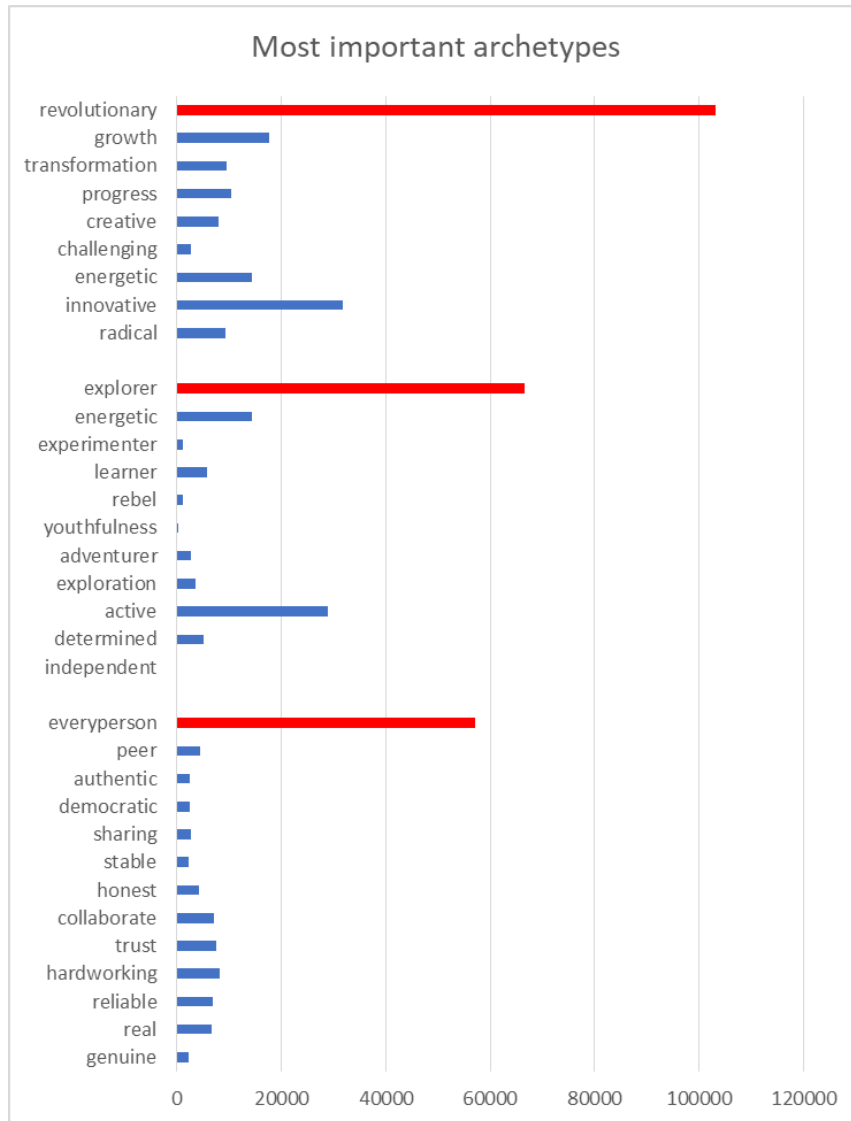

Fig. 5. More important aspects observed in each archetype.

The knowledge of these archetypes could be used to develop a holistic interpretive framework for OI participants' classification, and therefore, be used in OI projects management, for instance, in partners' engagement and assessing risk.

4 Conclusions and Future Work

This research work consisted in the discovery of the archetypes that best characterize the companies participating in OI. In section 2, we highlighted the role of archetypes in representing images, impressions, myths and symbols with the ability to both characterize influence people's behavior. On the part of organizational archetypes, we highlighted their role in interpretive schemas allowing the classification of the typology, structures, strategies, values and processes of organizations. As such, these schemes would also be useful in archetype characterization of OI participants.

The followed research method is based on web mining applied to enterprises' web documents with content mentioning "open innovation". According to the obtained results, the archetypes that seem to characterize OI participants are (1) the "revolutionary" that prefer radical development and likes to overcome challenges; (2) the "explorer", which likes to learn and explore new things; and (3) the "everyperson", which is hardworking, "reliable" and gives preference to collaboration. The results obtained with this work can be used in the construction of models for risk assessment, or in the characterization and classification of candidates for IO projects.

To our knowledge, the application of archetypes in the context of OI, using the proposed approach, has not received much attention from researchers. This is an exploratory study and as such there are still various aspects and limitations that need to be addressed. A difficulty initially felt, is that it was necessary to study and cross several concepts from distinct areas, without having a good conceptual reference matrix. While we tried to fill the gap, it is nevertheless necessary to make a more systematic and in-depth conceptualization of the definitions and application of archetypes into OI contexts.

As to ensure that we were collecting web documents only from companies and enterprises, and excluding other types of content, such as papers, essays, discussion forums, etc., the documents collection had to be done manually, resulting in a relatively small set of documents, approximately 4600. This part can also be improved through a more efficient retrieving approach. The Text Mining process could also be improved with the utilization of additional steps of knowledge extraction, including, statistical inference and use of alternative Text Mining methods. In this regards, we could for instance use Inverse Document Frequency [40], to weight the importance of a word according to its frequency in the documents.

Considering these limitations, interesting points to explore in the future work include further development of a more complete conceptual reference matrix for archetypes in Open Innovation. Additionally, we could then depart from the notion of archetype of the general context of organizations, to a more specific one in the OI context. It is also necessary to apply distinct methods of knowledge discovery and to improve the web documents retrieving process.

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