International Journal of Knowledge Processing Studies
(KPS)
Homepage: http://kps.artahub.ir/

ORIGINAL RESEARCH ARTICLE

Taking the Long View of Cluster Ecosystem Model Case Study: Iranian Native Search Engine

Sahar Kousari[1*], Alireza Yari[2]

1.Faculty Member, Assistant Professor, Department of Technology and Innovation Policy, National Research Institute for Science Policy (NRISP), Tehran, Iran. saharkousarion@gmail.com, 0000-0003-3226-7175
2.Faculty Member, Associate Professor, Information Technology Department, Research Institute for Information and Communication Technology, Tehran, Iran. a_yari@itrc.ac.ir

ARTICLE INFO

Article History:
Received: 2022/09/25
Accepted: 2022/12/31
Revised: 2023/01/26
Published Online: 2023/05/25

Keywords:
Cluster
Ecosystem
Search engine
Value management

Number of Reference: 51
Number of Figures: 4
Number of Tables: 10

DOI: 10.22034/kps.2023.367232.1070

Publisher:
Ayande Amoozan -e- ATA (AAA)

ABSTRACT

Innovation and economic growth is mainly formed by a unique combination of the companies that are interconnected in the field of knowledge and process. Such connections can be based on different goals among the service provider companies while two common methods for this objective include the cluster and ecosystem. The main objective of this article is to develop the cluster ecosystem of Iranian native search engine. In the ecosystem, relationship between the actors are formed based on the function-oriented complementary relationship of cluster of Iranian native search engine. This article aims at understanding the relating concepts of high-tech clusters and business ecosystems. Thus, while studying the existing literature, identified the different functions of native search engine clusters and different types of the actors and stakeholders of ecosystem by related experts. Then considering the role of each actor in the general functions of the native search engine, we tried to identify the relationships and interactions among those actors. Finally, the cluster ecosystem development model for the Iranian native search engine was designed based on the value network among the actors of Iranian native search engine. The findings of this research included: 1. identifying the ecosystem actors of native search engine, 2. developing the cluster of search engine functions, 3. designing the value network of the mentioned ecosystem.
Originality/ value: the proposed model, makes it possible for the actors to begin the interaction and value flow based on their roles in the cluster. **©authors**

►**Citation:** Kousari, S., & Yari, A. (2023). Taking the Long View of Cluster Ecosystem Model Case Study: Iranian Native Search Engine. *International Journal of Knowledge Processing Studies (KPS)*, 3(3): 45- 63. Doi: 10.22034/kps.2023.367232.1070

1. Introduction

Since the positive experience of Italy (known as the Third Italy), the clusters were paid more attention by the governments and development institutions as the important tools for the innovation development. Moreover, the experience of the southeastern countries of Asia in the development of network between large and small companies was considered as a successful experience of networking. Such experiences showed that the governments can invest on the clusters development through the implementation of different policies .

Of course the market signs have not to be replaced by government interventions for the clusters development. In other words, the government must participate in the development of those clusters whose first signs of successfulness have been provided by the market (Brown & Mason, 2014).

According to cluster theory, clusters are comprised of 'business, academia and government', often described as a 'triple helix model' for clusters.

It is widespread in cluster thinking to consider clusters as close collaborations between companies, knowledge and educational institutions and the public sector. Such collaborations are also described as open innovation; where business innovation is externalized and developed in collaboration with other stakeholders (Leydesdorff & Etzkowitz, 1996; Leydesdorff & Zawdie, 2010). But it is important to understand how various cluster stakeholders contribute more specifically to cluster development and value creation. And which dynamics between stakeholders characterize strong clusters.

A cluster´s ecosystem comprises different sets of actors (companies, knowledge institutions, BDS[1], investors, etc.) that influence the development of a given cluster. The closer collaboration and interaction between the actors in the ecosystem, the stronger the cluster and the more competitive the companies in the cluster (Dalziel, 2010). Strong clusters attract talents. Capital and these strong cluster ecosystems can be found in mature clusters like Silicon Valley in Palo Alto, the ICT cluster in Stockholm, and Medico Valley in Copenhagen.

For a deeper understanding of cluster dynamics and the roles between stakeholders, we have developed a model for a 'cluster ecosystem'. The cluster ecosystem model addresses this void.

The cluster ecosystem model argues that the subset of firms that have the potential to become high-growth firms are located completely in different sectors, where the complexity of doing business, and creating growth requires frameworks different from those that are generally seen as supportive for new start-ups.

The model conceptualizes a sophisticated set of resources that ideally support high-risk businesses aimed at the global market.

To grow and succeed, a young firm in this subset needs to obtain access to a number of vital resources such as capital, customers, markets, human capital, know-how, etc. To obtain any of these resources, the company must approach and relate to other people, companies and institutions. In our model, a conceptualization of these resources is made within the context of a cluster ecosystem.

As a result, there is a growing interest in understanding cluster ecosystems. Although strong cluster ecosystems are not easy to replicate, it is important to understand the dynamics, driving forces, value creation and collaborations in the ecosystems. Thus, the main objectives of this research are:

1. To specify the actors who play roles in the development of ecosystem cluster of the native search engine.

2. To specify relationships of this actors for the purpose of synergy around the cluster functions. Accordingly, the most important questions addressed in this study are as follow:

- What are the functions of the cluster of native search engines?
- What actors play roles in the formation or development of the business ecosystems?

[1]Business Development Services

- How is the value flow among the actors of the native search engine?
- How does the overall plan of development of the search engine ecosystem cluster work?

Based on the cluster literature, in this research, we extracted different types of functions and requirements of the development of high-tech clusters. Then using theoretical background of the business ecosystem and related theories on identifying the different stakeholders we proposed a complete set of all types of actors who can play role in the native search engine ecosystem. Moreover, there was an attempt to introduce the criteria that can be used for classifying the actors in order to explain the relationships between them; and then, relying on the opinions of the relevant experts and the value network among the actors, we will draw the ecosystem of the search engine cluster based on the functions of supplementation and complementation and the main function of the search and cluster organization management. Finally, the overall plan and the expected time and output of each stage were offered. The obtained results of this research can be used in defining the required policies for the formation of business ecosystem and helping the policy-makers of the field to increase the success of formation of such ecosystems.

2. Literature Review

Definitions and typology of the clusters

Innovation and economic growth is formed indeed by the combination of the companies that are interconnected in the field of knowledge and process. This is a fact being emphasized in the connections impact theory. The connections can be formed among the agencies in very different form, while based on the experience of other countries, one of the most efficient ways of such connections is the cluster (focusing on the complementary functions). The theoretical background of the cluster formation or agglomeration was first proposed by Alfred Marshall (Caldari, 2007). in his agglomeration-based economic efficiencies. Then, Porter, Altenburg and Stammer, UNCTUD[2], and UNIDO[3]proposed their own definition of the concept of cluster while there is no fundamental and essential difference between their definitions. Porter's definition of the term is more common due to its universality and popularity.

According to Porter's definition, "a cluster is a group of companies that face common opportunities and threats. These companies produce and sell a set of related or complement products. The main goals of the cluster formation are to achieve the collective efficiency, to occupy the market, to accelerate the learning process, and to develop collaboration common skills along with the competition" (Porter, 2000). UNIDO definition refers to the geographical proximate of the companies as well; while the main goal of such proximate is to optimally use the capabilities and collective technological learning (Bhushan, 2006).

Porter's definition itself is a rather broad one; consequently, the category of clusters is somewhat heterogeneous. The literature studying clusters suggest that the most important variables along which to classify such diversity are: (Ketels, 2013a; Ketels, 2013b).

- The geographical extension – existing very large and very small clusters;
- How they were formed – spontaneously vs. thanks to the determined effort of policy makers;
- The role of policies to develop them, once formed – being very strong or rather marginal;
- The specialization – high-tech vs. low-tech;
- The size of firms – being mostly small firms or having also an important share of medium or large firms;
- The presence or absence of a cluster management organization (CMO) and of a cluster strategy;
- The presence or absence in the cluster of knowledge institutions such as universities and technology transfer centers ;

[2] United Nations Conference on Trade and Development

[3] United Nations Industrial Development Organization

• The type of prevalent inter-organizational relationships – e.g., Quasi-hierarchical vs. relational ones;

• The stage of the cluster development – e.g., Mature vs. developing-ones;

• The existence of common cluster services and cluster projects.

In the literature, several models of cluster have been proposed, representing an attempt to reduce the complexity emerging from these axes into a small number of general instances. Among the models proposed, those for which an adequate number of empirical cases have been observed are: (Martin & Sunley, 2003; Martin & Sunley, 2011)

- Marshallian industrial district ;
- High-tech cluster ;
- Hub-and-spoke cluster

The first model is the so-called Marshallian industrial district, first studied by Alfred Marshall in the latter half of the 19th century and then discovered again by Giacomo Beccatini in Italy a century later. Such a model, however, has been observed also in other European countries, such as Spain, France and Germany (Becattini, 1990).

Marshallian districts differ from other clusters for two peculiarities: first, they occupy a geographically circumscribed, naturally and historically bounded area (being therefore concentrated in a narrower area); second, within them there is a strong interpenetration between the production domain and the social domain. This overlap between production activities and daily life reduces frictions (transaction costs) in the relationships between the firms located within the cluster, and facilitates the circulation of knowledge (especially tacit knowledge) at the local level (Becattini, 1990).

According to the literature, a second type of cluster is the high-tech one, specialized in high-tech sectors and characterized by a significant interaction between firms and research centers, classic examples being the Rhône-Alpes medical technology cluster, and the clusters in Baden-Württemberg. The average size of firms in this second type of cluster is much larger than in the Marshallian districts, and so is the geographical extension of the cluster. Moreover, the role of policies is by far more relevant and knowledge codification process is more intense (Keeble & Wilkinson (eds), 2010).

A third model, less studied in the literature but well-spread in Europe, especially in the South and East regions, is what Markusen named hub-and-spoke and other scholars defined hierarchical or also captive cluster, since the governance of the cluster is mainly driven by one large firm or a handful of key firms, which may be located within or outside the cluster, so that the other firms are mostly working as sub-suppliers for them. Figure 1 draws the three clusters model described (Feser, 1998; Hallencreutz & Lundequist, 2013).

It is important to notice at this point that this list of models is not a prescriptive but rather descriptive: each model has its own evolutionary path, advantages and disadvantages, also considering for different geographical areas and no one-best-way is available for regions. Similarly, it is not to be considered complete but rather indicative of the variety of cluster (Vlaisavljevic, Medina, & Van Looy, 2020; Grumadaitė, Jucevičius, & Staniulienė, 2022August; Chen, Wu, Huang, & Chang, 2022).

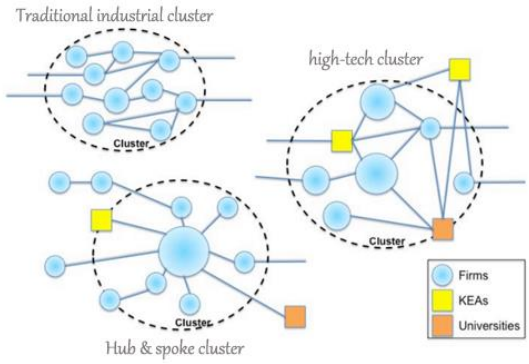


Figure 1. Models of clusters *(Steinbeis-Europa-Zentrum, 2011)*

In the development of native search engine cluster, we recognized the high-tech cluster model as the appropriate and suitable one. The main functions of the cluster are as follow: (Roeland & den Hertog, 1999).

• Supplying function

• main activity of cluster (function)

• Complementary functions

•Cluster management organization (function)

The new cluster concepts identified to support the development of emerging industries include four categories: (Steinbeis-Europa-Zentrum, 2011).

- Smart Specialization Strategies (S3) suggesting the importance to connect existing cluster or actors in new inter-sectoral ways at the regional level and supporting transnational cooperation as a mean to achieve the regional S3 .
- Key enabling and other relevant actors – suggesting that other than firms (small, medium and large-sized) and universities, also KEA[4] and KIBS[5] have to be involved in clusters specializing in emerging industries ;
- The demand side of emerging industries – supporting that the supply need to be integrated with the demand one, with the creation of contexts where they can interact so that new markets needs and innovation potentials are discovered and exploited;
- Entrepreneurial Cluster Management Organization (CMO)– proposing that CMOs should increasingly perform more complex activities, identifying and proposing to cluster partners opportunities of intra-cluster, cross-cluster and trans-national collaboration in the field of emerging industries so as supporting new ventures.

Differences between cluster and other relevant concepts

In reviewing the literature, one can find several references to the similar and related concepts such as "cluster", "cluster initiative", "consortium", "holding company", "value network", and "business ecosystem"; but in order to prevent any confusion and misunderstanding, we explain the main differences between the mentioned concepts .

The main difference between cluster and consortium is that no new legal entity will not formed after the formation of the (traditional) cluster, and the collaboration is not limited to a specific time period, while in the formation of the consortium, the legal considerations must be paid attention and the formation of consortium is limited to a specific period of time and a specific goal. In Iran, the laws and regulations on consortium have several bugs and weaknesses .

Compared to the concept of "clustering", cluster initiative refers to the organized attempt for developing the cluster ecosystem. In this regard, cluster is not formed naturally and organically but it requires policy-making (Lindqvist, Ketels, & Sölvell, 2013).

On the other hand, holding is different from cluster because holding acts as a mother that form a number of firms, while in cluster, a number of firms look for a strong and reliable mother who conduct them toward their vision.

The main differences and similarities of the concepts of cluster and value network are summarized in Table 1 (Boja, 2011).

Table 1. *Differences and similarities of the concepts of cluster and value network (updating of* (Boja, 2011)*)*

	Cluster	**Value network**
Innovation strategy	**Imitative**	**Conservative**
Geographical proximate	✓	×
Common field of activity	✓	×
Similar services	✓	×
Limits of the number of actors	×	✓
Being based on legal contract	×	✓
Competition while collaboration	✓	×
Necessity of the presence of large companies	✓	✓

The essential difference between clustering initiative and ecosystem development lies in the analysis units. In clustering initiative, the analytical base is the functions while in development of business ecosystem, the actors are the basic unit of analysis. Thus using the benefits of clustering initiative and business ecosystem, their combinational concept, i.e. "cluster ecosystem" is considered in the field of the development of native search engine (Werling, Lemieux, & Wittek, 2015).

While too narrow a definition of a cluster could have implications on development policies, not every agglomeration of firms can be labelled as a cluster as under:

[4] Key Enabling Actor

[5] (Institutional) Knowledge-intensive Business Services

Table 2. *Agglomeration of firms that is not a cluster (updating of (Murali & Banerjee, 2011))*

S. No.	Not a Cluster	Reason
1	A "sector" that is present in various places all over a State or a country	Too large a geographical area deprives the units across the area to exploit advantages of proactive joint action.
2	An industrial estate or an industrial park having multiple products	Too wide a product range means no common opportunities and threats. Hence, little scope of joint action
3	A network (small group) of enterprises producing similar products.	Too small a number for enabling significant and variety of joint actions. These are often part of a cluster.
4	A cooperative, which promotes cooperation among a number of enterprises under some norm, rule or public schemes of assistance.	A central feature of dynamic cluster is "competitive cooperation". In case of cooperative, competition does not exist. It is often a part of a cluster.
5	A group of villages, town or city consisting of enterprises producing a diverse range of products or services	These are clusters in a different sense and are not enterprise based clusters, which are being discussed in this document.

In previous sections we explained the concept of cluster and in the following section the concept of ecosystem (focusing on actors) will be explained in brief.

Definition and different types of ecosystem development models

Business ecosystem terminology was first proposed by Moore (Moore, 1996). The definitions of business ecosystems are mainly based on a principle stating that a network of actors (including the organizations, customers, dealers, complementary service providers, governmental organizations, incubators, investors, research institutes and universities) are all interconnected and their members are dependent to each other for their own survival (Anggraeni, Hartigh, & Zegveld, 2007; Hartigh, Tol, & Visscher, 2006 ; Karhiniemi, 2009). The mutual relationship among the ecosystem actors is vital because when an actor leaves the network, the network value will be reduced for the other actors. By contrast, entering a new actor to the network will increase the network value for other actors. On other words, the actors in the ecosystem collaborate to create synergy while they compete to each other for winning more shares of the resources. (Jahanizadeh, Moshabaki, Korde Naeej, & Khodade Hoseini, 2015) (Falah Tafti, A., Khodade Hoseini, & M., 2015).As a result, each member of the ecosystem contributes to the destiny and survival of the ecosystem. Hence, such a collaboration and trustful relationship, win-win relationship, risk sharing, information sharing and interests sharing among the actors leads to innovation in presenting the product to the end customer (Camarinha-Matos, Afsarmanesh, & Ollus, 2005; Davidson, Harmer, & Marshall, 2015; Tian, Ray, Lee, Cao, & Ding, 2008).

An important measure for developing the business ecosystem is to identify different actors who play role in the process of innovation and making synergy for the product development. Identifying different actors and stakeholders and analyzing them help managing their behaviors in each of the available roles in the ecosystem and resolving the conflicts among them (while such roles are played in form of the complementary relationships of the cluster functions) (Wallin. J., 2015). In order to design the business ecosystem, Ziaoren (2014) has proposed some principles for designing the business ecosystem. Accordingly, the first step is to identify a set of actors and stakeholders. Then, the role and importance of each actor is explained using selected measures such as the power, impact, interests, etc., and the situation of each actor is specified against the situation of other actors such that the actors are classified based on their role and weight in the business ecosystem. Finally, the needed strategies are defined for organizing the relationships between the actors in order to design suitable mechanisms for increasing the synergy and interactions of the actors and for reducing the conflicts (Xiaoren, Ling, & Xiangdong, 2014).

Different models and frameworks have been proposed for prioritizing and classifying the stakeholders. The most famous models are summarized in Table 3.

Table 3. *Types of stakeholders proposed in the literature (self-compilation)*

Source	Stakeholders
(Mitchell, Agle, & Wood., 1997)	• Government • Media • Customers • Regulatory body • Trade unions • Social groups • Suppliers
(Freeman & Evan, 1990)	• NGOs • Employees • Educational institutes • Suppliers • Distributors • Media • Government, regulators and policy-makers • Communities • Associations
Cavana Model (2000) (Sharifi, Ghavami far, & Fasanghari, 2014)	• Staff (managers, administrative staff) • Associations • Social-interest groups • Trade banks • Competitors • Consumers (user, consumer institutes) • Media • Government • Suppliers (direct seller, contractors)
Hotch Model (2002) (Sharifi, Ghavami far, & Fasanghari, 2014)	• Supporters (policy-makers, insurance companies, media) • Professional users • Service providers • Suppliers (infrastructure suppliers, research organizations) • Private users (consumers)
(Friedman & Miles, 2006)	• Top managers • Partners • NGOs • Guilds • Employees • Government • Customer • The Public
(Friedman & Miles, 2006)	• Active • Passive
Switch Model (2006) (Feng, Crawley, Weck, Keller, & Robinson, 2010)	• Suppliers • Associations • NGOs • Consumers • Competitors • Service providers • Media • Customer • Government
Christian Nilsson (2011) (Sharifi, Ghavami far, & Fasanghari, 2014)	• Beneficiaries • Suppliers • Legislators • Managers • Creditors • Strategic partners • Media • NGOs and civil society
Internet society (2013) http://www.internetsociety.org	• Standard regulators • Policy-makers: the government • Equipment and service providers • Users: individuals, organizations, institutes • Educational institutes: universities, internet society • Service providers: servers, network operators, service sellers, internet exchange portals
Xiaoren (2014)	• User • Trade partners

	• Service providers • Suppliers • Research institutes • Governmental institutes
Leviäkangas, et al. (2014)	• Equipment maintenance • End users • Measurement and supervision • Communication services providers

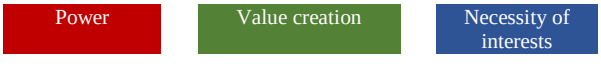
After identifying the stakeholders that can potentially be used for defining the roles and actors in the native search engine ecosystem, it is necessary to deal with the criteria that are going to be used in the classification of the stakeholders. Based on such criteria we can determine the position of the actors and their behaviors and performance in the ecosystem.

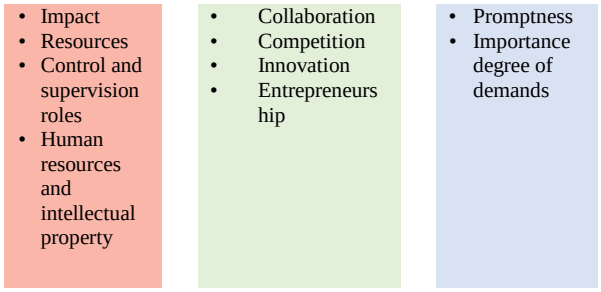
Table 4 shows the different criteria that have been used for classifying the stakeholders by different resources.

Table 4. *Criteria for classifying the stakeholders (self-compilation)*

Source	Criteria
Letimor, et al.'s model (Sharifi, Ghavami far, & Fasanghari, 2014)	• First class interests including the product and income • Second class interests including the law and politics • Third class interests including the credit and reputation of the organization
Optimal model of locating the stakeholders (Sharifi, Ghavami far, & Fasanghari, 2014)	• Power • Effectiveness force • Proximate to the decision-making center • Stability and continuity of effectiveness • Position • Visibility
Johnson and Scholes's model (Johnson, Scholes, & Whittington, 2002)	• Interests • Power
World Bank model (Sharifi, Ghavami far, & Fasanghari, 2014)	• Affectedness • Effectiveness
Mitchel's model (Mitchell, Agle, & Wood., 1997)	• Promptness • Legitimacy • Power (1. Based on physical forces; 2. Based on financial resources and tools; 3. Based on attracting the attention of media and impacting the media
(Friedman & Miles, 2006)	• Interests • Collaboration potentials • Power • Willingness to collaborate • Degree of independence

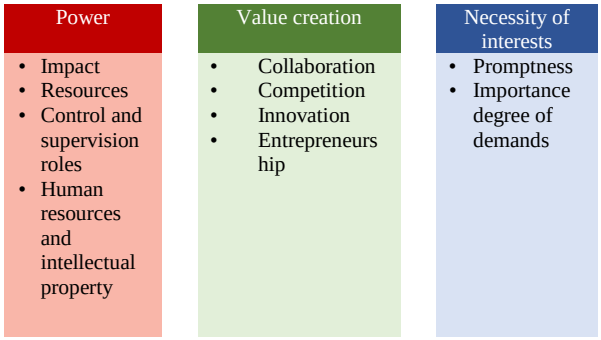
As Table 4 shows, most resources emphasize on two criteria, i.e. power (effectiveness) and interests, indicating the importance of these criteria for the classification of stakeholders. The factor of power results from the level of impact on other stakeholders, level of stakeholder's accessible resources, and power of control and supervision over the other stakeholders, and the knowledge and profession of the stakeholder as in this research we refer to this factor under the "human resources and intellectual property. The necessity of interests implies the promptness and importance degree of the stakeholders' demands to be paid attention promptly. Finally, the capacity of collaboration or competition with other stakeholders implies the scale of value creation by the stakeholder. In general, the level of stakeholder's ability of innovation and entrepreneurship is effective on the added value that is created by the stakeholder; accordingly, innovation and entrepreneurship are two factors that the researchers of the current article have added to the factor of "value creation".





shows the criteria for classifying the stakeholders.

Figure 2. *Criteria for classifying the stakeholders (self-compilation)*



After identifying the different types of stakeholders and extracting the criteria for their classification, all actors who play role in the creation or development of the native search engine ecosystems are specified based on the literature of the business ecosystem.

Then, when we manage to specify the actors in the business ecosystem, we have to classify them in order to explain the value flow among them (Weiller & Neely, 2013). In this regard, several models have been proposed for classifying the actors in the business ecosystems. Iansiti and Levien have introduced four actors including Keystone, Niche player, Dominator, and Hub whose activities and communications are based on the characteristics of business networks (Galateanu & Avasilcai, 2014; Iansiti & Levien, 2002; Iansiti & Levien, Strategy as ecology, , 2004). Amon all other proposed models, Iansiti and Levien's model was selected due to its universality and suitability for explaining the value flow among the actors of native search engine.

Keystone improves the assignment of resources among the actors and provides services for the ecosystem. Hence it creates value for the ecosystem and plays a vital role in survival and increase of the productivity and sustainability of the business ecosystem.

Niche players have a low impact on the performance of ecosystem and they mainly look for developing their own professional abilities and use the resources provided by the keystones.

Hub has not considerable role in the value creating within the ecosystem but it make relationships with other actors to define the standards and regulation for information and communication between the organizations. *Hub* absorbs and integrates the assets outside the ecosystem for being used in the internal operations.

Dominators tend to occupy those corners of the ecosystem that has not been occupied by other actors in order to capture the created value. These actors intend to increase their own power in expense of making problems for the whole ecosystem. In long term, they may cause the destruction of the ecosystem by interrupting the sustainability of the ecosystem (Iyer, Lee, & Venkatraman, 2011; Kastalli & Neely, 2013).

Considering the identified characteristics of the actors, we can conclude that the hub actor is indeed the dominant stakeholder in the literature of stakeholders' analysis. These actors who have the highest rate of communication with other actors have a high level of legitimacy and power, but the necessity of their interests are low; and considering their high ability of value creation, we have to pay attention to their interests in designing and developing the ecosystem. Dominator has lots of power without a high necessity for fulfilling its interests; and his ability in value creation is not high. The keystone has a high level of power due to its high level of knowledge, profession and resources. Moreover, due to its collaboration with other actors, it can lead to innovation and entrepreneurship and hence, it has high level of value creation for the business ecosystem. Considering the high level of power and value creation of the keystone, the necessity of its interests is very important. On the other hand, the niche player has little resources and due to its low impact on other actors, it has a low power. Since this

actor usually uses the value created by the keystone, it does not have considerable value creation and hence the fulfillment of its needs is not the main priority. Finally, the hubs have an average level of value creation and the necessity of their interests is low. Table 5 summarizes the mapping of actors and stakeholders.

Table 5. *Mapping of actors of business ecosystem in the stakeholder's theory (self- compilation)*

Ecosystem actor	Characteristic	Strategy	Stakeholder
Dominator	High power, average necessity, low value creation	Defending the interests of other actors	Dangerous stakeholder
Niche player	Low power, low necessity of interests, low value creation	Compromise and devolution of advantages to the actor	Dependent stakeholders
Keystone	High power, high necessity of interests, high value creation	Preserving the relationship with the actor	Absolute stakeholders
Hub	High power, low necessity of interests, high value creation	Satisfying the actor	Dominant stakeholders

3. Methodology

The literature on the business ecosystems and high-tech clusters is new and in practice, there are few researches on this subject. So, this research is qualitative and exploratory in nature. In order to collect the needed data, we have used library (for collecting the information and determining the general foundations of the research) and non-library (benefiting from the experts' opinions). The main objective of the research is to design the value flow among the actors of native search engine ecosystem. Hence the statistical population of the research includes those experts who are knowledgeable about the native search engine ecosystem and its high-tech clusters. Since the literature on business ecosystem in general and the native search engine ecosystem in particular is a new subject, thus the knowledgeable experts with the needed profession and knowledge on the subject are very few.

Thus with regard to the objective of the research, the sampling method has been purposeful; so we selected the samples among those who have enough knowledge or profession in the field of the study. The data collection instrument was the questionnaire. In interviewing the experts of the field of native search engine ecosystem we asked the interviewees to classify the actors based on the criteria of classification of stakeholders, and then based on the general functions of the cluster (such as the supplementation and complementation, and the main function and function of the organization of managing the cluster) explain each function and state their own opinion about the value flow among the actors on the basis of four flows, i.e. the flow of service, flow of information, financial flow, and the intangible value flow.

By and large, 17 interviews were conducted with the accessible and acknowledgeable experts of the field of search engine in order to design the search engine ecosystem. The related details of the interviewed experts are presented in Table 6. Each interview lasted between 30 to 60 minutes and the interviews were continued until obtaining the theoretical saturation and richness.

The collected data if the interviews were analyzed using content analysis method for identifying the needed themes and patterns on designing the native search engine cluster ecosystem. The analysis of data of respondents' questions led to detection of the research codes and themes. Accordingly, the significant and key parts relating to those questions on the development of native search engine ecosystem were recorded in form of the qualitative codes and related concepts or themes. Table 6 shows the information of the experts who were interviewed.

Table 6. *Experts' information*

Goal of the interview	Expert	Role of expert in the project	Experience of knowing the business ecosystem

Classifying the actors based on the criteria of stakeholders' classification and extracting the specific functions of native search engine cluster	1	Member of the Steering Council of Business Development of Native Search engine	3 years
	2	Senior expert of the Business Development of Native Search engine	2 years
	3	Senior expert of the Business Development of Native Search engine	1 year
	4	Executor of plan	3 years
	5	Project supervisor	3 years
	6	Senior Advisor	8 months
	7	Project consultant	3 years
Designing the model of value flow of search engine cluster ecosystem	1	Member of the Steering Council of Native Search engine	3 years
	2	Member of the Steering Council of Native Search engine	3 years
	3	Project consultant	3 years
	4	Project supervisor	3 years
	5	Senior expert of the Business Development of Native Search engine	6 months
	6	Senior expert of the Business Development of Native Search engine	6 months
	7	Executor of plan	3 years
	8	Senior expert of the Content Platform of Native Search Engine	2 years
	9	Senior expert of the Content Platform of Native Search Engine	2 years
	10	Senior expert of the Content Platform of Native Search Engine	2 years

4. Findings

The **first part** of the findings deals with the classification of actors of native search engine ecosystem. Based on the analysis of the findings from the interviews, different types of actors are specified in the determined classification of the actors. Mapping of the actors and related stakeholders in the native search engine initiative are shown in **Table *7***.

#	Code	Concept
1	Search platform	Keystone
2	Content providers	
#	Code	Concept
1	Search platform	Keystone
2	Content providers	Niche player
3	Startups	
4	Content holders	Niche player
5	NGOs	
6	Infrastructure providers	Hub
7	Education and research institutes	
8	User's facility providers (browser, applied program developers)	
9	User (private companies, governmental organizations, end user)	
10	Advertisement interface	
11	Electronic mail	
12	Payment service providers	
13	Service providers (map, social network, email)	
14	Competitors	Dominator
15	Network operators	
16		
3	Search platform (news, job search, data base)	Keystone
4	Content providers	Niche player
5	Service providers (translation, news, job search, data base)	
6	Governance (policy maker, regulatory, standard body, guilds, NGOs)	Niche player
7	Infrastructure providers	Hub
8	User's facility providers (browser, applied program developers)	
9	User (private companies, governmental organizations, end user)	
10	Educational and research institutes	
11	Advertisement interface	
12	Electronic mail	
13	Payment service providers	
14	Service providers (map, social network, email)	
15	Competitors	Dominator
16	Network operators	

Table 7. *Mapping of actors and related stakeholders in the native search engine ecosystem (self- compilation)*

As seen in **Error! Not a valid bookmark self-reference.**, the technology forces, market forces and their effects on different functions are considered in this model.

The considered model in the native search engine development is a combination of ecosystem and cluster, and it is called the ecosystem cluster. In this model, the relationship between the actors is formed by the function-oriented complementary relationships.

The **second part** of research findings relates to the cluster ecosystem development model that is to be confirmed for completing the structure of functions. The main base for designing the components of cluster development model is the function analysis. In cluster ecosystem model, the functions make complementary relationship with each other to meet the user's need.

The **third part** of the findings focuses on the value flow mapping model. After specifying the actors based on the native search engine ecosystem model and determining the functions based on the cluster model, using the results of analyzing the interviews and focusing on the value flow mapping model, we try to identify the flows that can exist among the actors based on the roles and functions. The value flow model not only manifests the suggested values and

interactions of an organization and its customers, but it shows the value flow among different members of a single ecosystem.

A network value model shows the specific interactions within the network visually such that it can present a view for understanding

shows functions of native search engine cluster in a schematic form. The functions in the model of native search engine cluster ecosystem development are as follow:

- Supply function (enabling services):
  - Basic services needed by the platforms (content services, value-added services, data center services);
  - Infrastructure (network, network infrastructure, end user's devices); and
  - Services provided by other clusters
- Main function of search including:
  - Search resource platforms;
  - Communications platform;
  - Buy-and-sell platform; and
  - Map services platform
- Complementary functions include:
  - Governance / public sector services
  - Research / innovation services
  - BDSs services
- Cluster management function include:
  - Monitoring the goals
  - Economic development plan
  - Quality management of services and standards
  - Monitoring the cluster ecosystem development
  - Trade agreements
  - Physical infrastructures management
  - Conflicts management and facilitating the relationships
  - Trust building

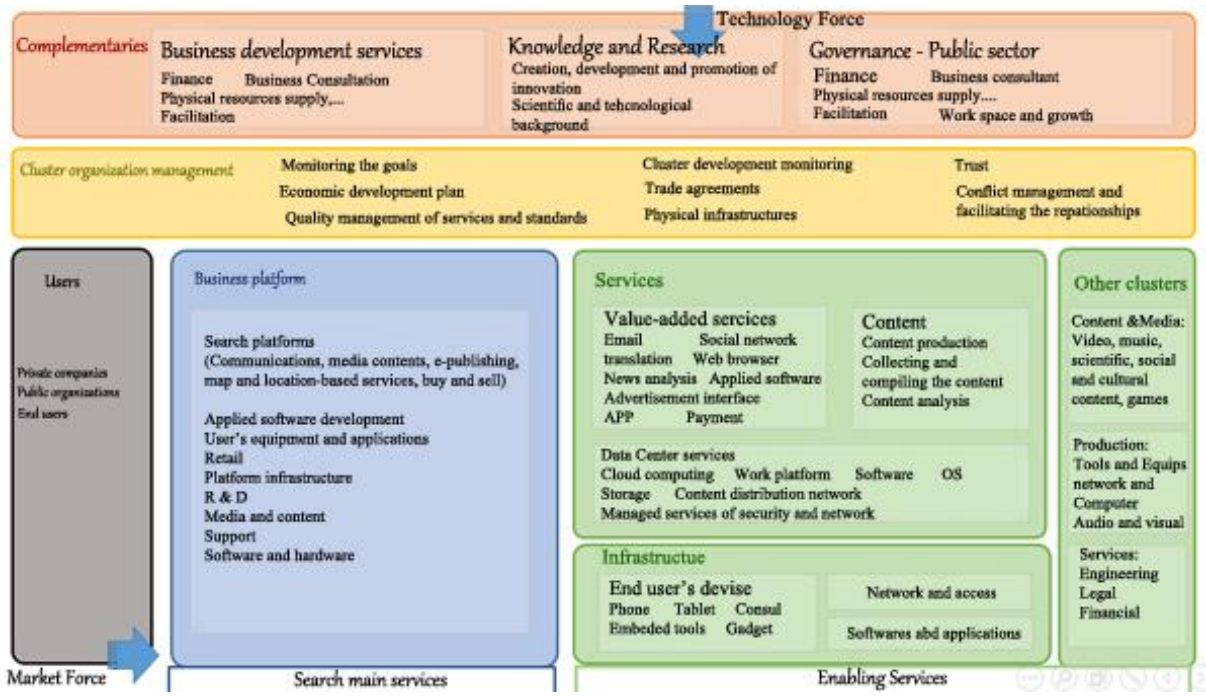


Figure 3. Overall framework of the native search engine cluster ecosystem (self- compilation)

As seen in **Error! Not a valid bookmark self-reference.**, the technology forces, market forces and their effects on different functions are considered in this model.

The considered model in the native search engine development is a combination of ecosystem and cluster, and it is called the ecosystem cluster. In this model, the

relationship between the actors is formed by the function-oriented complementary relationships.

The **third part** of the findings focuses on the value flow mapping model. After specifying the actors based on the native search engine ecosystem model and determining the functions based on the cluster model, using the results of analyzing the interviews and focusing on the value flow mapping model, we try to identify the flows that can exist among the actors based on the roles and functions. The value flow model not only manifests the suggested values and interactions of an organization and its customers, but it shows the value flow among different members of a single ecosystem.

A network value model shows the specific interactions within the network visually such that it can present a view for understanding

the roles that create value and relationships. Such a model presents a dynamic view showing how financial and non-financial assets are changed into different sorts of values. This model explains how we can fulfill the value for each role (function) efficiently and how we can use the tangible and intangible assets for creating the value. Value models offer a level of abstraction that is critically useful for exploring new business networks and their characteristics and for understanding the risks of designing the inter-organizational business processes. A main strength of this model is that the ecosystem actors are categorized in three groups: main actors (who provide the main offered package of value); actors who provide enabling services; and actors who provide complementary services. Accordingly, referring to the position of each actor in the ecosystem, we can suggest suitable strategies for managing that actor and the relationship among the actors. According to this model, the flows that can exist among the actors of native search engine ecosystem typically include the services flow, financial flow, information flow, and intangible value flow (Iyer, Lee, & Venkatraman, 2011).

The **services flow** can include financial support, discounts, statistical services, user's experience, reduction of production costs, infrastructure management, solution and work plan, media services, integrated platform, access services, value-added services, and work ground. The **financial flow** includes major purchases, copyright, certificates, premium services, buying the services, access costs, commission, share of advertisements, high volume orders, service/product development costs, handing fee of service/product sell, and the right of information subscription and sell. **Data and information flow** includes content, personal information, personal recommendation, technical/sell/business information, business idea, knowledge of production (hardware, software), users' preferences/ customization, data log/ large data, and conferences and seminars. Finally, the **intangible value flow** can include reputation, ease, services channel, awareness, users' community, wide support/ services coverage, happy citizens, precision and quality, customer satisfaction, sale context, integration, and security/ confidence.

For example, **Error! Reference source not found.** shows the service flow, financial flow, information flow and intangible flow among the developers of applied programs (hub) and content provider (keystone) in native search engine using the mapping model of business ecosystem value flow. Due to the limitation of showing value flow among all actors, this table shows only the value flow among a limited number of actors.

Table 8. Value flow among the developers of applied programs (hub) and content providers (keystone) in native search engine ecosystem cluster

Keystone / Hub	Content providers
Applied programs developers	• *Service flow*: infrastructure management, integrated platform • *Financial flow*: costs of service development • *Information flow*: technical information, customization • *Intangible value flow*: easiness, integration, security

All types of value flows among the actors were extracted using cluster functions (Fig. 4). The services flow among all actors of the native search engine cluster is illustrated in **Error! Reference source not found.** using the mapping model of value flow of the native search engine ecosystem.

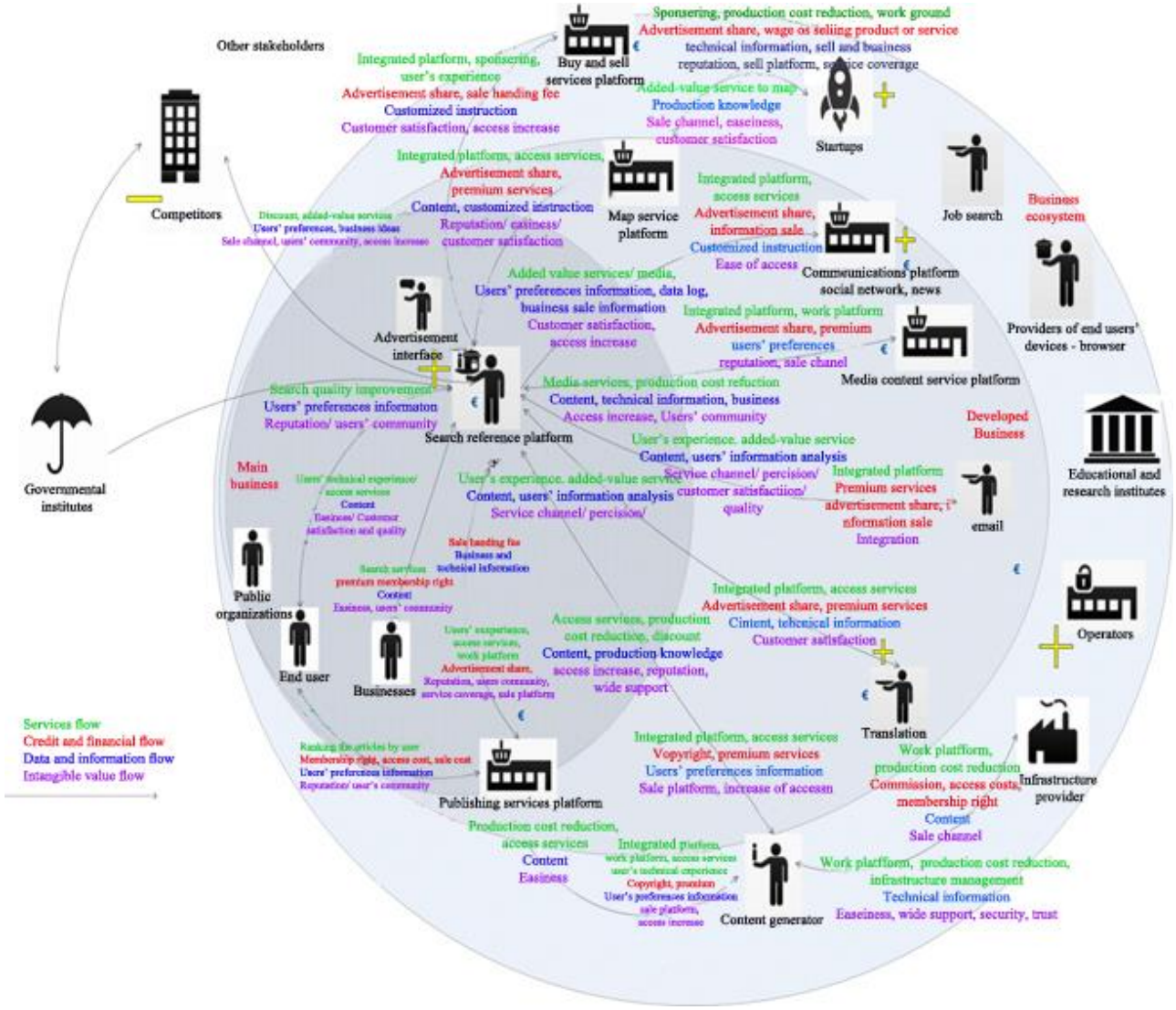


Figure 3. value flow in the native search engine ecosystem model (self- compilation)

According to **Error! Reference source not found.**, any keystone can have effects on other keystones. For example, image search can provide statistical services, user's experience, software services, hardware services and business services flow for the content providers. Moreover, as a financial flow, image search service can leave effects on the content providers through the copyrights, premium services and information sale. On the other hand, the image search can provide other information such as content, personal information, information on the users' preferences/ customization, and customized instructions for the content providers. In line with the mentioned flows, as an intangible flow, the image search service can potentially lead to creation or increase of reputation, easiness, awareness, citizens' happiness, precision and quality and customer satisfaction for the content providers.

5. Overall plan for the development initiative of native search engine cluster ecosystem

Table ***9*** shows the overall plan of the development initiative of native search engine cluster ecosystem in a step-by-step method. This plan includes four steps. In each stage of each step, the applied method and tools are suggested. In what follows, the contents of each step of

Table *9* are explained.

First step – creating the value-centered map of the clustering initiative: in this step, the main values of clustering initiative and pressure points (common challenges and threats) and the resulted advantages are extracted.

Second step – assessment and development of clustering initiative strategy: in this step, the gap analysis is conducted based on assessing the current situation and desirable situation; and then the needed strategies are offered for filling the gap.

Third step – performing the strategies, policies and analyzing the actors of clustering initiative: in this step, the regulated strategies

of the previous step are performed and operationalized; thus the tasks of each actor are mapped using actor analysis method and then the executive limitations are resolved and if needed, the policies are reformed.

Fourth step – post-project sustainability of cluster ecosystem initiative: the ultimate goal of this step is to offer the future-oriented measures aiming at preserving the sustainability and survival of the cluster ecosystem through self-organization and evaluation of the cluster ecosystem.

Table 9. *Overall plan of the native search engine cluster ecosystem development (self- compilation)*

First step: creating the value-centered map of the clustering initiative		**Second step: assessment and development of clustering initiative strategy**		**Third : performing the strategies, policies and analyzing the actors of clustering initiative**		**Furth step: post-project sustainability of cluster ecosystem initiative**	
Steps	**Methods**	**Steps**	**Methods**	**Steps**	**Methods**	**Steps**	**Methods**
Making a comprehensive cognitive map of economy for identifying the value orientation of cluster	Benchmarking Cognitive map	Evaluating the market trends, value chains and competitive situation analysis	Market trends Value chain analysis Competitive situation analysis	Prompt implementation of strategies through institutional mapping	Old and new institutes for collaboration (actors analysis)	Encouraging the cluster for being assured of the survival of life cycle in future after clustering initiative	Foresight Scenario making Monitoring and evaluating (P.A.I.D framework)
Identifying the stakeholders and conducting the cluster	Stakeholders analysis	Coordinating with the supportive stakeholders related to clustering initiative	Benchmarking Institutional analysis	Mobilizing the resources and executive facilities of the conducted theoretical studies	Stakeholders panel Interview	Financing for the needed resources and conducting the cluster toward its vision	Roadmap Monitoring and evaluating (P.A.I.D framework)
Session with stakeholders and extracting the key aspects of cluster competitiveness	Panel Interview	Data collection for evaluating the studies of Centers of Excellence (growth) at international level	Benchmarking Institutional analysis	Resolving the executive limitations and consolidating the long-term strategies and reforming the policies	Stakeholders panel Interview	Official support of the cluster institutional structure	Roadmap Monitoring and evaluating (P.A.I.D framework)
Forming the different parts of work groups and making agreements	Face to face sessions	Organizing the studies of benchmarking in order to develop the business model for strategies of cluster competitiveness	Competitive situation analysis Gap analysis SWAT analysis				

Dividing the tasks and ownership between stakeholders and collaboration based on learning from the supportive clusters	Actors analysis Workshop						

7. Time and expected output and the key actors of each step

The predicted times for the first, second and third steps are 3, 6 and 18 months respectively. The needed time period for the last step in which the evaluation is continuously done for assuring the achievement of previous outputs will 3 to 5 months. The expected outputs of each step are shown in Table ***10***. In sum, the expected output in the first step is to extract of value-orientation of the cluster with the participation of stakeholders; the main output of the second step is to extract the strategies of ecosystem development of the cluster initiative of native search engine; and the expected result of the third step is to operationalize the strategies and to make collaborations among the public and private sectors. The main output of the last step is the continuous evaluation of the function of native search engine cluster ecosystem. The key actors of each step are mentioned in Table ***9*** along with each step.

Table 10. *The time and expected outputs and the key actors of the overall plan of ecosystem development of the cluster initiative of native search engine (self- compilation)*

	First step: creating the value-centered map of the clustering initiative	**Second step: assessment and development of clustering initiative strategy**	**Third step : performing the strategies, policies and analyzing the actors of clustering initiative**	**Furth step: post-project sustainability of cluster ecosystem initiative**
Predicted time	**3 months**	**6 months**	**18 months**	**3-5 months of continuous monitoring**
Expected outputs	1. Justifying the cluster initiative and extracting the value-orientation 2. Assessing the main actors of the cluster initiative along with the common challenges and opportunities 3. Making agreement between selected companies of the search engine cluster ecosystem initiative	1. Building a strategic collaboration in sub-clusters based on the goals of the search engine plan 2. Analyzing the current situation of sub-clusters 3. Developing the strategies of the native search engine cluster development	1. Strategic operationalization of cluster ecosystem development projects 2. Improving the business environment of the cluster development 3. Effective collaboration of public and private sectors in line with the search engine goals 4. Assigning the financial resources and investment	1. Building a suitable organizational structure for continious evaluation 2. Continious evaluation of the function of cluster and subclusters 3. Keeping the long term investment
Main actors	Steering council Search engine initiative	Cluster development agent	Cluster development agent	Cluster development agent Representatives of the sub-clusters

8. Conclusion

Based on in-depth and comprehensive studies of the valid international articles, available literature of the business ecosystem and cluster, in this research we attempted to explain the phenomenon of business cluster ecosystem to be used in the search engine industry. In this regard, first we introduced and explained the concept of cluster.

According to the cluster theory, clusters are comprised of 'business, academia and government', often described as a 'triple helix model' for clusters. It is widespread in cluster thinking to consider clusters as close collaborations between companies, knowledge and educational institutions and the public sector. Such collaborations are also described as open innovation, where business innovation is externalized and developed in collaboration with other stakeholders. But how do the various cluster stakeholders contribute more specifically to cluster development and value creation, and which dynamics between stakeholders characterize strong clusters? The answer is cluster's ecosystem. A cluster's ecosystem comprises a different set of actors (companies, knowledge, institutions, BDS, investors, etc.) that influence the development of a given cluster.

Then we dealt with the theoretical literature of the ecosystem in detail. Based on the related literature and the opinions of acknowledgeable experts of the native search engine initiative, different actors and their role in the native search engine ecosystem was identified. This background led to the identification of keystones, niche players, dominators and hub. Accordingly, the **dominators** in the native search engine initiative include the competitors and network operators; **niche players** include the providers of services such as translation, search engine and data bases and the content holders. Moreover, the **hub** in the native search engine initiative includes startups, governance (e.g. policy-maker, regulatory, standard body, guilds and NGOs), infrastructure providers, providers of the end user's facilities (such as browser and applied program developers), payment services providers; educational and research institutions; **users** (private companies, public organizations, and end users), advertisement interface, electronic mail and services providers such as map, social network and email. Finally, the keystones of the search engine initiative that play an essential role in value-creation include the search platform and content providers.

Then the search functions were extracted based on the cluster ecosystem model (Fig 3). Then we tried to investigate the communications and interactions among the actors. In this regard, four value flows including services flow, financial flow, information flow, and intangible value flow were identified based on Apple search engine cluster ecosystem. Finally, benefiting from the mapping of stakeholders and actors along with the services and participants of the native search engine initiative we designed the value network among the actors of business ecosystem and then, based on the four mentioned flows we offered the overall plan of native search engine cluster ecosystem development.

9. Acknowledgement and Sponsoring Information

Authors thank ITRC for their expertise and assistance throughout all stages of this research.

Future work

For the future studies, it is recommended to compare and contrast the two fields of mature realm and emerging realm.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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