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Quantitative and qualitative study to identify the latent interactive pattern between ecosystems

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ABSTRACT

A business ecosystem consists of a network of interconnected organizations that compete with each other dynamically for the survival or growth of the business and evolve continuously. The research that has been done so far in the field of business ecosystems has not addressed the issue of the relationship between ecosystems. In this study, we seek to identify the impact of the interaction of the digital business ecosystem with the Social, Mobile, Analytics, and Cloud (SMAC) ecosystems, to examine the possibility of the interaction with the SMAC ecosystem. Because the concept of business ecosystems is related to the concept of networks, value-creating ecology has been used to establish interaction between ecosystems. To achieve a model for ecosystem-ecosystem interaction through meta-analysis; First, a systematic study of the literature reveals a thematic theme. The relationship between the foremost categories is improved through qualitative models and Pearson's correlation coefficient test. Identifying the hidden pattern and confirming the relationship between the main categories of the model, the method of structural equations statistically measures the interaction of the components of the DBE with the SMAC ecosystem through value-creating ecology (VCE). The test results confirm the existence of a relationship between the main categories and establish a complete interaction between all components of the DBE with the SMAC ecosystem using VCE.

Key words: Meta-Analysis, Digital Business Ecosystem (DBE), Value-Creating Ecology (VCE), Business Ecosystem, Ecosystem – Ecosystem.

INTRODUCTION

Due to the intensification of competition and the expansion of the economy, the business enterprise ought to focus on beyond its market, industry, and customers (Sboeva et al., 2019; Shahbaz et. al., 2019). With greater interaction and dependence of corporations operating in the marketplace with each other, more value is created through networks and less dependent on a single organization (Roser et al, 2013). Ecology is used as a metaphor for seeing information systems in organizations (Davenport and Prusak,1997 p22). Digital transformation is fundamentally changing all industries, and all industries are looking to their interests (Roser et al,2013). The ecosystem means that "Anything is associated with anything, anything from an ecosystem in which it's received feedback, and consequently, the relationship between components retains the total survival of the ecosystem". The open-loop of the ecosystem means that the ecosystem is adding new agents (customers, designers, entrepreneurs, stakeholders, small and medium-sized organizations, etc.) It adapts its inner pillars to environmental changes and is constantly evolving (Shaughnessy, 2014). In recent years; research in the field of convergence and communication of social, mobile, analytical, and cloud computing ecosystems has increased dramatically (Hurbean and Fotache, 2013 and Sugam, 2016). The relationship between "computing" and "ecosystem"; Social, mobile, and cloud computing are technologies utilized to create an open ecosystem among them. (Byun et al., 2017).The nature of businesses-businesses changing toward the ecosystem related to each other (ecosystem-ecosystem) (Shaughnessy, 2014) by converting value chains to network chains, attitude about the value of the product is modified to the value of the grid. In other words, the supply chain is transformed into the supply ecosystem. Value-creating ecology is a valuable network value chain. Therefore, it can be used to join different ecosystems together and thus create ecological values (Hearn and Pace, 2006). In numerous articles have described the relationship between community, mobile, analytics, and cloud computing, each separately, with a digital business ecosystem (Kache and Seuring, 2017). But in most of them, the SMAC connection is considered as computing and not as an ecosystem. Moreover, one of the main features of ecosystems is the migration of small and medium enterprises, which are considered as agents in ecosystems. However, the concept of supply chain and value chain, which are linear and one-sided and closed-loop, cannot be used to interact with ecosystems (Hearn et al, 2007). For this reason, in this study, the metaphor of value-creating ecology (VCE) has been used to interact with ecosystems. The VCE is a network's value chain and open-loop that allows agents to migrate. (Khali and Hassan, 2011). This connection is made through the value creation ecology. Finally, it may be stated that establishing interplay between ecosystems through value-creating ecology makes the ecosystem more solid and efficient (Hearn et al, 2007), and in preference to applying a value chain in ecosystem interaction, it should be used value creation ecology.

Digital Business Ecosystem (DBE)

The concept of digital business ecosystems (DBE), by integrating old-fashioned concepts, creates an environment across the platform. In other words, in the DBE, traditional collaborative concepts such as centralized models (client-enabled), distributed models (peer-to-peer), and hybrid models (such as Web services) are integrated and thus the synergistic capabilities of each model are developed. So, sharing the survival and growth of the DBE is very important, and it should be developed to sustain its survival (Khali and Hassan, 2011). Through the interaction, the DBE can add new organisms to its environment, and in this way, all members of the ecosystem develop together. This development also requires increasing social interaction and the high analytical power of the ecosystem members of the environment. Evolution in ecosystems is facilitated by the migration of agents between different ecosystems (Darking and Whitley, 2007). Thus, if a small and medium-sized company is located in a certain business *ecosystem, but* does not have the necessary customer or cannot add a special ability to other agents in the ecosystem, then it must migrate from this ecosystem to another ecosystem. To facilitate the migration of agents, they are needed to open-loop agent chains (Graça and Camarinha-Matos, 2018). Eight components have been identified for the digital business ecosystem:

• Economics: it's as an environmental counterpart. Factors such as social economy include a combination of the concepts of social and business ecosystems.

• Business: The concept of a business ecosystem has been accepted. That is, businesses are factors that affect the environment and influence it.

• Population: The concept of a business ecosystem is accepted. That is, organizations, individuals (customers, suppliers, competitors, and other stakeholders) evolve together with their capabilities and abilities.

• Community: Here, the concept of the social ecosystem is accepted to represent a social unit as a unit with common values between members.

• Multi-agent system: A multi-agent system includes the environment, objects and agents, the relationships between all entities, the set of activities performed by entities, and changes in society at any point in time.

• Ecology: The concept of a biological ecosystem is accepted.

• Evolution: It is derived from the concept of the business ecosystem and the theory of evolution and the evolutionary behavior of business organizations.

• Topology: The concept of the digital ecosystem is accepted. The members of the ecosystem communicate with each other through a digital network based on information and communication technology.

Value-creating ecology (VCE)

Value creation in business is shifting toward value ecology thinking and communicating between social and ecological systems (Glanville, 2013). Value ecological thinking has brought about a change in the five basic areas of value creation (Hearn et al, 2007), Customer has become a co-creator of value (customer participation in value creation of the company); Thinking about the value chain has become value networks (Tan et al., 2020); Simply thinking about being a competitor or a colleague has become a complex manner of thinking while competing; The idea that every company has its unique strategy become a link between strategy and value ecology as a whole. In explaining the latter, it's seen as a strategy as an ecology (Iansiti Levien, 2004). The value-creating ecology (VCE) creates a value network instead of a value chain; Table 1 shows a comparison between them.

Table (1): Comparison between supply chain, value chain and value-creating ecology (Hearn and Pace, 2006)

Strategy elements	Supply Chain	Value chain	Value-Creating ecology (VCE)
Customers	Consumers	Consumers	Consumers, Competitors and so on
Environment	Stable	Stable	Chaos / uncertain
Concentration	Either the supply side or the demand side and not both	Supply and demand-side (both)	Supply and demand-side (both)
Value creation	Limited emphasis on value creation	Adds value to each step	Emphasizing a holistic approach to creating values from within and outside the ecosystem
Communication type	Vertical integration	Limited grouping	Dynamic and evolving
Risk	Low	Average	High
Profit focus	Increase your profits	Increase your profits	Increasing the benefits of the ecosystem
Cost focus	Minimize your costs	Optimize your cost	Common costs
Knowledge leverage	Inside the company	Inside the company	Between ecosystems
Knowledge approach	Storage	Hoarding	Sharing
Source approach	Defensive	Protective	Sharing
Attitude to time	short term	long time	long time
Key drivers	Cost	Income	Knowledge

In the qualitative analysis performed in the articles in the field of value, there are five main ecological components of VCE, which are:

• Knowledge Ecology: containing network knowledge, knowledge storage, customer knowledge, inter-industrial knowledge, and social networking knowledge.

• Drivers in Information and Communication Technology (ICT) ecology: It includes economics and operations (government laws), growth and survival, social preferences, technological evolution, and power balance. These drivers lead to the growth of the business ecosystem through a co-evolutionary process.

• Convergence ecology: Information technology causes the convergence of knowledge, technology, industry, design (innovation), and customers through Co-evolution's relationships.

• Coopetition ecology: It includes accelerating and reducing the costs of research and development, a direct alliance of competitors, alternative sourcing through cooperation and competition relations and leads to competitive advantage.

• Co-Creating ecology: Ecologic interaction with all members of ecosystems, including customers through interaction that leads to mass customization. Social, Mobile, Analytical and Cloud ecosystem– SMAC ecosystem

The social, mobile, analytical, and cloud computing ecosystems have come collectively to form the term SMAC ecosystem. SMAC has four main domains, which we will describe below. The social computing ecosystem encompasses a full variety of digital worlds and possible styles of system computing (Hanna et al, 2011). The cloud ecosystem gives distributed technical infrastructure. This ecosystem, employing providing data storage as well as being online, affords the proper infrastructure for information interaction (Calheiros et al, 2011). Strong relationships with key people of the organization expand the analytical ecosystem within the business. The analytical ecosystem inside the mobile ecosystem provides a means of measuring the user's approach and use of mobile ecosystem applications (Davenport and Harris, 2010). The mobile computing ecosystem is a complicated and extensive network of unconventional actors (including the private and public sectors) that interact directly or indirectly to deliver mobile products and services to customers. Besides, specific mobile ecosystems proportion several commonplaces and identical value networks, which means that the boundaries of the mobile ecosystem are fading, and different ecosystems are merging into one ecosystem (mobile) in addition to a new business model (Basole and Karla, 2011). In a study, identifies five separate ecosystems: automotive, block chain, financial, insurance, and IoT. Scholars are building clusters of these ecosystems to strengthen the conceptual model(Riasanow et al., 2020). This research; The social ecosystem, the mobile ecosystem, the analytical ecosystem, and the cloud ecosystem are clustered and shape the SAMC ecosystem.

Ecosystem-ecosystem (Eco 2 Eco)

By examining the articles in the area of the business ecosystem, there were signs of attention to the discussion of the relationship between ecosystem and ecosystem. Here are the most crucial ones. In this regard, some researchers (Shaughnessy, 2014) state that "the nature of businesses is changing towards complex interactive ecosystems." At the age of ecosystems, companies are desperately looking forward to growing their competitive advantage; For this reason, by way of connecting ecosystems, the stakeholders of these ecosystems (customers, innovators, partners, and various social groups) are connected, and thus the value is created by the interaction between them. Web 2.0 capabilities make it possible for different ecosystems to work together (Randall, 2014). Calheiros et al. (2011) recollect the marketplace to be a critical part of the cloud computing ecosystem; That is, market regulations must be used to modify online negotiations and transactions. Depending on the characteristics of the cloud ecosystem, this ecosystem can be linked to the digital business ecosystem (Calheiros et al, 2011). Basole et al. (2011) studied the evolution of the structure and strategies of the mobile ecosystem. The results of their research provide a foundation for showing that the convergence of the mobile ecosystem with other ecosystems could be very strong (Basole and Karla, 2011). Khalil et al. (2011) first analyze precisely different ecosystems. Then, for the Malaysian shoe industry, the DBE suggests that by connecting to the social ecosystem, it provides extensive information on consumer preferences and tastes for the digital business ecosystem (Khalil and Hassan, 2011). Kandogan et al. (2014) conducted interviews with 34 organizational analysts. The outcomes of the evaluation of this interview display that the analytical ecosystem, including tools, information, and individuals, *are* effective, whilst there are communication and interaction between companies. Their last solution is to link the analytical ecosystem to the digital business ecosystem (Kandogan et al, 2014). But then, as mentioned earlier, the ecosystem itself is intrinsic, receiving feedback from other elements within it (Shaughnessy, 2014), but the value-creating ecology emphasizes value creation from inside and outside ecosystems and from the interaction between Ecosystems make value (Hearn et al, 2007). This is the foremost factor in choosing the ecology of value creation for communication between ecosystems, which is the principal innovation of this article.

Research methodology

Since little research has been carried on the topics covered in this article, and most of the conceptual layers of these categories are hidden (digital business ecosystem, value-creating ecology, and SMAC ecosystem), qualitative analysis has been used to discover these themes. The distribution of the questionnaire and quantitative statistical analysis of their content explained the significance of the relationship between the principal categories of this research. For this reason, meta-analysis has been used as a research methodology. Meta-analysis is a major technique for summarizing empirical studies in many areas, including ecology and evolution (Nakagawa et al, 2015). In *a meta*-analytic methodology, which is also called mixed and descriptive-survey methodology, the first qualitative data after which quantitative data are amassed and analyzed (Rayat Pisha et al, 2016). Liu et al. (2019)؛ To perform Meta-analysis; First, through systematic study (qualitative analysis) of the subject, they have identified the influential variables in the model, and then through quantitative analysis; they have tested the relationships between these themes.

Qualitative analysis

The purpose of qualitative analysis is to identify the themes of the main classes. Content evaluation is a manner to identify and reporting qualitative data patterns. During this process, the analyzed textual data and the various scattered facts are accumulated in wealthy and detailed themes (Braun and Clarke, 2006). The Nvivo 10 software has been used to discover and encode themes. The search keys used to identify articles include value-creating ecology, ecosystem-ecosystem, ecosystem interaction, digital business ecosystem, SMAC ecosystem, SMAC ecosystem communication, and SMAC computing. The most important and principal scientific databases have been also looked for articles.

At the beginning of the search for articles and resources, no restrictions were defined through the researcher, and 324 sources were gathered primarily based on the announced search keys. Then, according to the criteria introduced in Figure (1), the sources of refining, and at the give up of coding the topics were accomplished with 104 related articles in all three categories (classes) of the digital business ecosystem, value-creating ecology, and SMAC ecosystem. The coding matrix query shows the relationship between the issues of the principal classes. The NVivo software provides this matrix based on the similarity of the words utilized in coding the themes of the primary categories. However, via the software, the Pearson correlation index of the main categories was calculated based on the similarity of the words used in coding their contents (Bazeley and Jackson, 2013) and offered in Table (2).

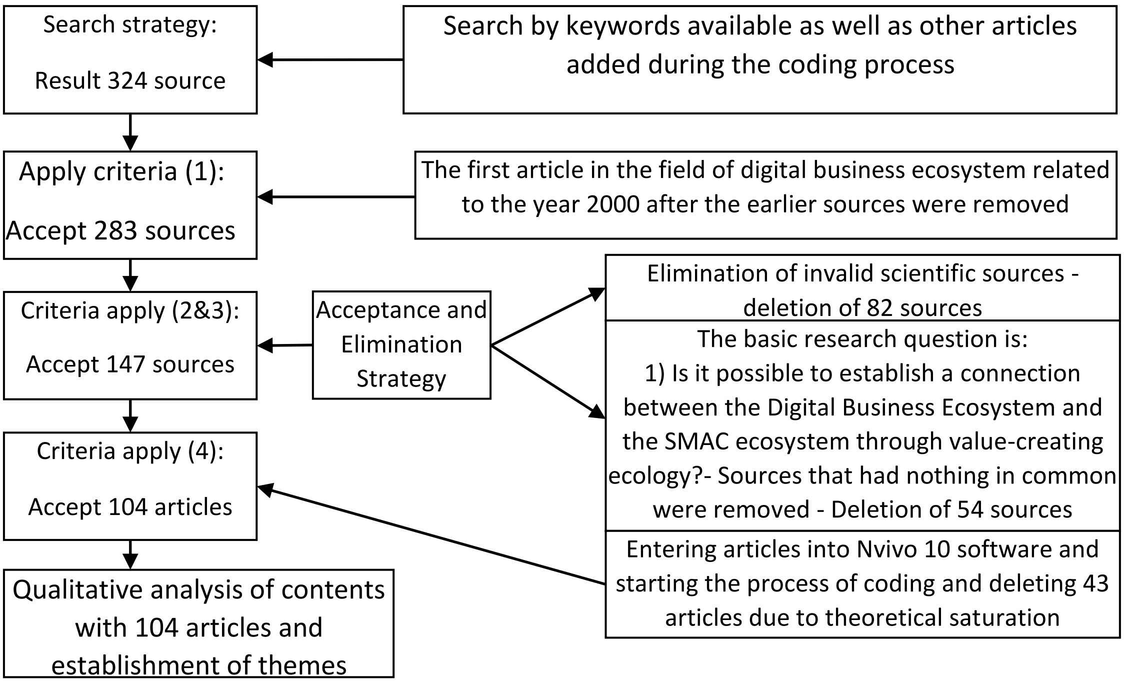

Figure (1): Article selection strategy for coding

Table (2): Pearson correlation coefficient of the main categories

	Digital Business Ecosystem (DBE)	**Value-Creating Ecology (VCE)**	**Social, Mobile, Analytical, Cloud (SMAC) Ecosystem**
Digital Business Ecosystem (DBE)		0.251264	
Value-Creating Ecology (VCE)			0.247834
Social, Mobile, Analytical, Cloud (SMAC) Ecosystem	0.142578		

The Pearson correlation analysis of the discovered content theme has been utilized to expose more patterns or essential measurements within the data(Vourvachis & Woodward, 2015). The result of tables (2) appears that there's a relationship between the main categories of subjective examination. Even so, the thematic substance shaped after qualitative examination can be seen in Figure 2. This subject is gotten after subjective investigation and coding of topics. Indeed; To identify the hidden communication pattern between the model themes (DBE, VCE, and SMAC), a test was performed through the Pearson coefficient in Nvivo. Thus, a systematic study of the literature confirms the existence of a relationship linking the themes of the model(Rossolatos, 2019).

Quantitative statistical analysis

In this section, the model of the connection between the digital business ecosystem and the SMAC ecosystem is explained. A questionnaire containing 135 questions was designed. Each of these questions is the subject of qualitative analysis. The questionnaire becomes distributed electronically among experts operating in knowledge-based companies active in the field of information technology in three provinces of Isfahan, Qom, and Tehran. The purpose of choosing student companies is due to their relationship with the sphere of ecological value creation and the business ecosystem (Kim et al, 2010).

Research Hypothesis: The interaction of ecosystem-ecosystem has arrived with the relationship between digital business ecosystem (Business, Population, Communities, multi-agents systems, Economics, Ecology, and Topology) and SMAC ecosystem (Social ecosystem, Mobile ecosystem, Analytic ecosystem, Cloud ecosystem) through Value-Creating ecology (Convergence ecology, cooperation and competition ecology (Coopetition ecology), ICT ecology drivers, co-creation ecology and knowledge ecology).

The software of the third generation of Smart PLS linear equations of version 2 (Wong, 2013 p. 252) however, used the software analysis statistical software of SPSS version 23 for statistical analysis. Among the structural equation software, SmartPLS is the most popular in information systems research (Henseler, 2012 p147). The main feature of Smart PLS be in data analysis with a small sample size. It is, likewise, variance-based in contrast to covariance-based (like the software of the second-generation structural equations) (Ringle et al, 2015). We need to recall that smart PLS is typically used to test relationships caused by hypotheses.

Table (2): Themes derived from coding the main categories

Digital Business Ecosystem (DBE)	**Value-Creating Ecology (VCE)**	**SMAC Ecosystem**
Categories Themes	Categories Themes	Categories Themes
Business	**Convergence Ecology**	**Social Ecosystem**
• **keystone**	• Knowledge	• social value co-creation
• **Loosely coupled**	• Technology	• Interactive web
• **Quality**	• Industries	• Sharing platform
• **Negotiation**	• Co-evolution relationships	• Knowledge Communities
• **SMEs**	• Co-Design	• Social Intelligence
Co-Evolution	• Customers	**Mobile ecosystem**
• **Complex Evolving System**	**Coopetition Ecology**	• Functionality
• **IoT**	• Accelerate R&D	• Knowledge sharing
• **Cross-industries**	• Alliance direct Competitors	• Complex platform-based
• **Peer-to-Peer (P2P)**	• Complementary Resourcing	• Mobile Services
• **Query-Cycle model**	• Co-opetitive Relationships	• Inter-firm relations
Community	• Competitive Advantage	**Analytical Ecosystem**
• **Socio-Technical Infrastructure**	• Diversified portfolio services/product	• Business Intelligence (BI)
• **Geographic**	• Lock-in	• Intensive Computing system
• **Regulatory**	• Reduces costs	• Data lake (Big Data)
• **Culture**	• Technological Innovations	• Data Exploration
• **Big-data**	**ICT Ecology drivers**	• Data Preparation
• **Trust**	• Economic & Regulatory	• Modeling/Scoring
• **Engagement platforms (EPs)**	• Grow & Survive	• toolkit
Ecology	• Societal Preferences	**Cloud Ecosystem**
• **Ecological Environment (EE)**	• Technological Evolution	• Cloud Services
• **Ecological Idea (EI)**	• Balance of Power	• Cloud infrastructure provision
• **Ecological Network (EN)**	**Ecological Knowledge Creation**	• Cloud characteristic
• **Ecological Relationships**	• Networked knowledge	• Cloud-based Supply Chain
• **Ecological strategy (ES)**	• Knowledge warehousing	
• **Social-Ecological systems (ES)**	• Consumer Knowledge	
• **Ecological collaborative**	• Cross-Industries Knowledge	
• **Ecological Thinking**	• Social Networking knowledge	

• **ICT Ecology**	**Co-Create Ecology**
• **Industrial Ecology (IE)**	• Mass Customization
• **Organizational Ecology**	• Actor-To-Actor (A2A)
• **Ecological behavior**	• Ecosystem-to-Ecosystem
Economy	• Everyone-to- everyone (E2E) Economy
• **Knowledge-based**	• Co-Create social network
• **Web2.0**	• Distributed value network
• **Web 3.0**	
• **Stakeholders centric**	
• **Cyberspace data manipulate**	
Multi-Agent Systems (MASs)	
• **Mobile-Agent systems**	
• **SOA**	
• **Software Agent**	
Population	
• **Co-Create Value**	
• **Stakeholders**	
• **Co-exist**	
• **Dependent resources**	
Topology	
• **ICT infrastructure**	
• **Network**	
• **Architectural shape**	

*Themes have coefficients factor loads 0.7 and more

Measurement criteria

At the beginning and before analyzing the structural equations, must be confirmed the existence of a linear relationship between the tested categories. Additive regression models provide powerful recommendations for data analysis. The main purpose of regression models linearly connect the independent variable X_i to the dependent variable Y. This means that Y value is measured by X. To estimate the regression parameters that estimate the slope and intersection of this line, the square method R is desirable. The R square (R^2) index, with a range of 0-1, is a good indicator for measuring the linearity of a relationship. Table 5 shows the results of the linear regression test. As it can be seen in Table (3), sig < 0.05 and on the other hand, the t-statistic for 120 samples, if more than 1.96; The relationship is 95% significant, and if it is greater than 2.58, the relationship is important at 99% (Zou et al, 2003). Therefore, according to the results of the regression test, it is confirmed that the relationship is linear between all variables.

Furthermore, the validity of the questionnaire was measured by Cronbach's alpha test. According to the calculations, the Cronbach's alpha value of the questionnaire was estimated to be 0.863, which is higher than 0.7 and indicates the desired validity of the questionnaire. To measure the internal strength of the data and to measure the model, the combined validity, Cronbach's alpha of the variables, the square of R, and the factor loads must be higher than 0.7. Also, the Average Variance Extracted (AVE) should be greater than 0.5 to confirm the model (Tavakol and Dennick, 2011). According to the study, factor loads are more than 0.7. It notes that out of one hundred thirty-five questions in the questionnaire, after quantitative analysis, the ten subjects with a factor load of less than 0.7 remove from the model, and the remaining variables give in Table (2). According to Table (4), presented as the result of the analysis. Figure 3 shows the structural equation model using SmartPLS software.

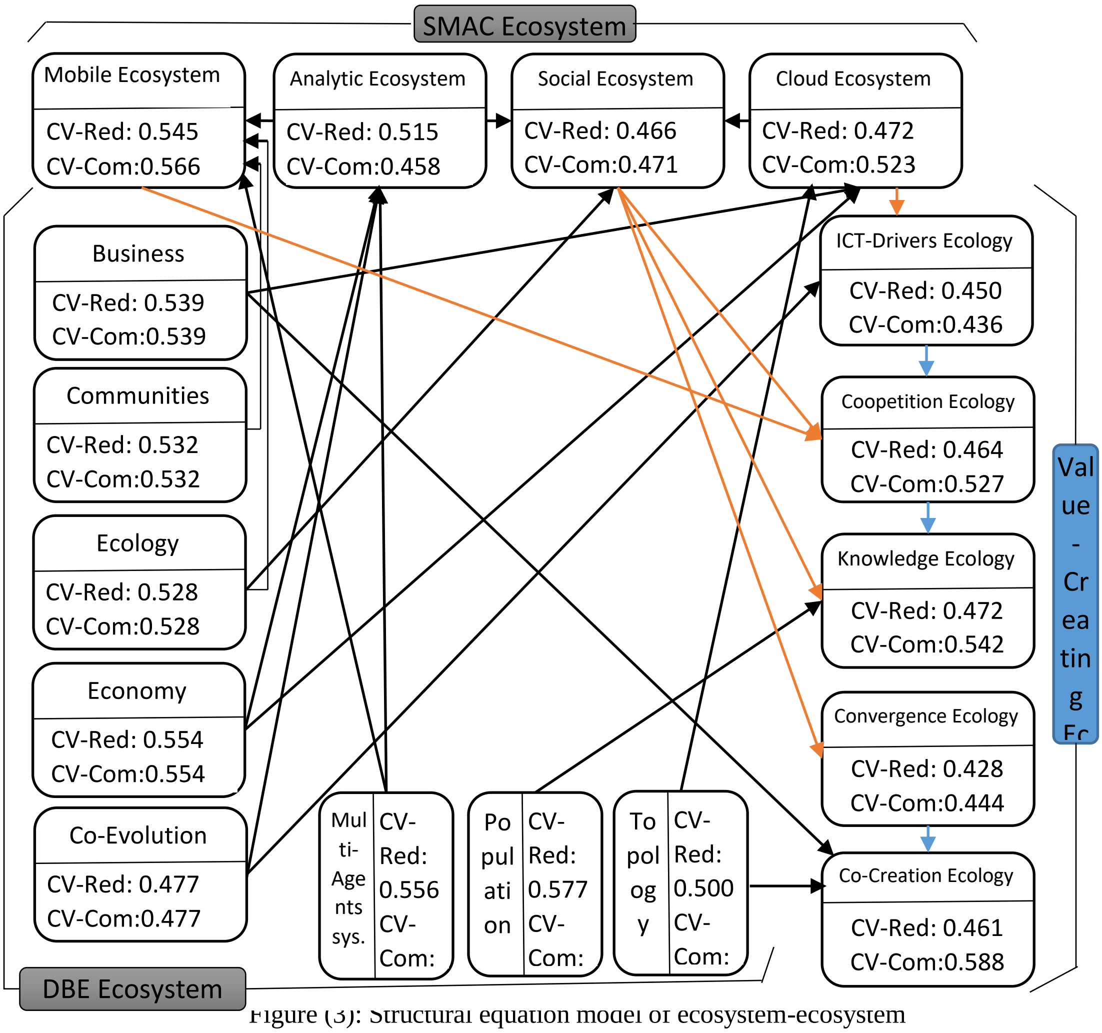

Figure (3): Structural equation model of ecosystem-ecosystem

Table (3): Quality criteria of partial minimum squares method (PLS)

Separate categories	**Concepts (Themes)**	**Average Variance Extracted (AVE)**	**Composite Reliability**	**R Square (R^2)**	**Cronbach's Alpha**
Digital Business Ecosystem (DBE)	Business	0.746168	0.936222		0.914639
	Community	0.685770	0.938480		0.923464
	Co-Evolution	0.705502	0.922875		0.895339
	Ecology	0.651685	0.953616		0.946401
	Economy	0.672375	0.948798		0.939149
	Multi-System Agents	0.797079	0.921724		0.872305
	Population	0.779384	0.933873		0.905411
	Topology	0.705317	0.922790		0.895187
Value-Creating Ecology (VCE)	Co-Creation Ecology	0.758276	0.956422	0.690771	0.946780
	Convergence Ecology	0.703697	0.904506	0.752671	0.858326
	Co-opetition Ecology	0.670679	0.942187	0.780402	0.929740
	ICT Drivers Ecology	0.679761	0.894555	0.764670	0.842588
	Knowledge Ecology	0.620052	0.954945	0.901947	0.948871
SMAC Ecosystem	Social Ecosystem	0.684678	0.915532	0.772398	0.884292
	Mobile Ecosystem	0.697684	0.954015	0.880785	0.945656
	Analytical Ecosystem	0.784468	0.915812	0.789196	0.860328
	Cloud Ecosystem	0.636505	0.960732	0.844014	0.955839

Proposed model for the interaction of the DBE with the SMAC ecosystem through the value-creating ecology (VCE); the SMAC ecosystem, along with the DBE input variable, and the value ecology is the variable output model. The important point in the analysis of endogenous and exogenous variables of the model is to pay attention to this point that based on the bootstrapping test and significant path coefficients, the minimum required t-statistics at a significance level of 95% and α = 5% and also; Significance level 99% and α = 1%, It should be 1.96 and 2.58, respectively (Doan & Phan, 2020). Table (4) shows the bootstrapping and the significance test of the path coefficients.

Table (4): The bootstrapping test and significance of path coefficients - Based on the relationship of Figure (3)

Exogenous	→ Endogenous	Path Coefficient	T-Test	Standard Error	Average sample
Co-Evolution	Analytical Ecosystem	0.382961	3.580638**	0.106953	0.376259
Mobile Ecosystem	Analytical Ecosystem	0.544385	5.385063**	0.101092	0.540446
Business	Cloud Ecosystem	0.270513	2.152526*	0.125673	0.276297
Economy	Cloud Ecosystem	0.444270	3.441057**	0.129109	0.442304
Topology	Cloud Ecosystem	0.261853	3.037786**	0.086199	0.259906
Cloud Ecosystem	Co-Creation Ecology	0.386197	3.064237**	0.126034	0.397308
Multi-agents System	Co-Creation Ecology	0.214782	1.983621*	0.123182	0.209182
Topology	Co-Creation Ecology	0.289020	2.060041*	0.140298	0.282630
Community	Convergence Ecology	0.223938	2.030984*	0.110261	0.228444
Population	Convergence Ecology	0.291845	2.736479**	0.106650	0.288195
Social Ecosystem	Convergence Ecology	0.419351	3.702026**	0.113276	0.418425
Convergence Ecology	Co-opetition Ecology	0.203582	2.127638*	0.072184	0.190126
Ecology	Co-opetition Ecology	0.705635	5.277516**	0.073523	0.709122
Cloud Ecosystem	ICT Drivers Ecology	0.581794	5.477366**	0.106218	0.580176
Co-Evolution	ICT Drivers Ecology	0.327872	3.224381**	0.104787	0.339820
Economy	Knowledge Ecology	0.623052	5.936297**	0.056971	0.624867
ICT Drivers Ecology	Knowledge Ecology	0.381872	6.211062**	0.061483	0.677591
Business	Mobile Ecosystem	0.224206	2.141381*	0.090692	0.215738
Ecology	Mobile Ecosystem	0.505565	4.744930**	0.112871	0.500104
Multi-agent's system	Mobile Ecosystem	0270827	3.579103**	0.075669	0.264302
Analytical Ecosystem	Social Ecosystem	0.253929	2.204527*	0.115185	0.251690
Ecology	Social Ecosystem	0.482700	4.343831**	0.111123	0.484474
Topology	Social Ecosystem	0.218355	2.129947*	0.093127	0.200166

* Significant level: if α<0.05 and t ≥ 1.96 as a result significance level= 95%

** Significant level: if α<0.01 and t ≥ 2.58 as a result significance level= 99%

Discussion & Conclusions

Since the AVE for all variables (themes) is more than 0.7 and the factor loads are higher than 0.8, on the other hand, t-statistics at 95% level are quite significant and also according to the figure (3). The CV-Redundancy as the quality and the index of CV-Communality or cross-values validation of the structural model has positive values; Therefore, it can be concluded that rejected the H0 hypothesis and confirmed the H1 hypothesis. In other words, it can be confirmed that ecosystem-ecosystem interaction can be related to the relationship of the digital business ecosystem (business, population, communities, multi-agent systems, economics, ecology, topology) and SMAC ecosystem (community ecosystem, mobile ecosystem, analytic ecosystem, and Cloud ecosystem), Through value-creating ecology (convergence ecology, cooperation and competition ecology (Coopetition ecology), the drivers of ICT ecology, co-creation ecology and knowledge ecology) were achieved. Also, in this test, the efficiency of value creation ecology has been confirmed as the value network for joining ecosystems to each other and creating the ecosystem-ecosystem. Consequently, in this test, the efficiency of value creation ecology has been confirmed as the value network for joining ecosystems to each other and creating an ecosystem-ecosystem. In other words, in all research on the relationship between the DBE and cloud computing, mobile, analytics, and community, first; None of them has addressed the issue of the relationship between the SMAC ecosystem and the digital business ecosystem in a specific and objective way (as in the present study) And most of them have studied SMAC Computing. Secondly; None of the research focuses on the components that make up a digital business ecosystem and how they interact with each of the components of the SMAC ecosystem. Furthermore, based on the results of the research and the proposed model, "population" as one of the main components of the digital business ecosystem; It is not related to any of the components of the SMAC ecosystem and is associated with it only after contact with the value-creating ecology. The Briscoe (2010) states that if there is a distributed technical infrastructure, it will take place interaction between ecosystems. In this way, the interaction of DBE with the SMAC ecosystem is exactly established through value-creating ecology. In Briscoe's view, topology is a distributed technical infrastructure in the DBE (Briscoe, 2010). As seen in Figure (3), Topology is related to the cloud ecosystem. Further, cloud computing is an emerging solution to the problem of information technology infrastructure(Sunyaev, 2020). This means that the cloud ecosystem can be used as the distributed technical infrastructure to connect the SMAC ecosystem and DBE. Therefore, the value-creating ecology (VCE) is critical to establishing a link between the digital business ecosystem and the SMAC ecosystem.

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