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Evaluation of the Impact of Actors on Ecosystem Accounting

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ABSTRACT

Ecosystem accounting provides a comprehensive and integrated framework for organizing information on ecosystems' assets, services, and capital that directly address the purpose of sustainable development. This study aimed to evaluate the effect of type of actors on ecosystem accounting system using structural equations. The research was applied in terms of goal and causal regarding the type of research. The Study population included 84 activists in the field of environmental accounting (ecosystem), related to the period of 2017-2018, selected through convenience sampling. Subjects filled the 22-item questionnaire of components of actor network and the 25-item questionnaire of ecosystem accounting. According to the results, the main actors affecting the ecosystem accounting in the order of priority of each actor in this study were: in political-social actors, cultural organizations. In Technical actors, accountants. In organizational actors, research institutions. In economic actors, business companies, and in technological actors, professional associations. Improvement in the system of the accounting ecosystem and move of organizations toward the implementation of accounting ecosystem will be witnessed in case of serious attention to the main actors affecting the ecosystem accounting depending on being qualitative and quantitative. Ultimately, this enhancement results in measuring the relationship between ecosystems and human welfare for national planning.

Keywords:

Political-Social Actors, Technical Actors, Organizational Actors, Economic Actors, Ecosystem Accounting.

1. Introduction

Ecosystem accounting is a comprehensive approach to the analysis of ecosystem assets (Edens & Hein, 2013, 42). Specifically, ecosystem accounting is a comprehensive set of ecosystem services and explicitly deals with changes in the stock of ecosystem assets. In general, ecosystem assets are related to the capacity of ecosystems for the production of ecosystem services at present and in the future (European Commission, 2013). Ecosystem accounting monitors the changes made in the services of the ecosystem in biophysical and monetary conditions under the spatial approach to determine the spatial diversity of ecosystems and services provided. Creating ecosystem accounts for many years allows for a sustainable measurement of the environment, which means a reduction in the ecosystem as a set of points to reduce the capacity of ecosystems to protect the welfare of human beings over time. Ecosystem accounting is a coherent and integrated approach to evaluate the environment through measuring ecosystems and currents of services from ecosystems to economic activities and other human beings.

The accounting measures that may be carried out are different, and measured ecosystems may vary from specific areas of land cover (e.g., forests) to larger integrated areas (e.g., river basins) and might include areas that are relatively natural and extremely affected by human activities, such as agricultural areas (Bordt, 2018, 83). While these various approaches are different from each other at many dimensions (e.g., objectives and users

considered, biodiversity compared to the services of ecosystem, monetary criteria in comparison with biophysical criteria, and integration in the existing accounting systems in comparison with new decision-making tools), all of them have one thing in common, which is considering the official businesses and organizations existing as the central accounting units (Garton, 1999, 219). From this perspective, biodiversity conservation is essentially perceived as a problem that must be gradually integrated with new biodiversity information along with the development of the standard accounting rules of the organization. This issue considers the capacity of organizations separately, manages their relations with environmental systems, and improves their public responsiveness.

On the other hand, actor network theory (ANT) has attracted the attention of many thinkers of the field in the last few years as a comprehensive approach in the field of information systems. The theory's popularity is such that it is extensively used by a large number of information system researchers. While a considerable diversity is observed in these applications, all experts believe that this theory provides new beliefs and concepts to understand the social-technical nature of information systems. The ANT provides the opportunity to recognize the status of actors of the information systems and evaluate their ability and capacity inside the network, interpret their roles in the form of components of the social-technical network, form the network of human and non-human allies and interactions of network, re-define the information systems and how to use them and exploit individuals, society, and the environment by the information systems. In assessement of the formation, making applicable, promotion, acceptance, and use of information, the ANT logically illustrates the complexity and irregularity of the social system and explains the interaction of social network in the production process up to the stage of information use.

In ANT, the development of information is considered as a consequence of the interpretation of actors and their interests. Therefore, successful interpretation of the interests of human and non-human actors leads to the formation of a coherent body of allies and efficient acceptance and implementation of information (Bani Talebi Dehkordi et al., 2015, 120). These actors include an extensive set of human resources, including managers, accountants, auditors, and non-human resources, such as computer hardware and software, guidelines and instructions, analysis models, planning, control and decision-making and database, data, instructions and equipment, technical resources (e.g., methods to estimate the overall cost), technology resources, and social-political resources (e.g., culture, experience, gender, and level of education). Each of these actors can form financial and accounting information based on their objectives. Some of the acts performed by actors include change of shape, deviating information from their primary shape, surrendering to the information condition, adding to the dimensions and aspects of information, fitting the information and allowing information to exit the cycle.

Therefore, the complexity of ecosystem accounting, from production to use, on one hand, and involvement of institutions and individuals in the

production, dissemination and use of information on the other hand, as well as factors affecting the structure and content of messages in the ecosystem accounting system have more revealed the necessity of introducing and explaining the ANT as one of the theories addressed in the sociology field with a focus on ecosystem accounting, which deals with the recognition of different actors and their role in each ecosystem accounting system, showing the effective interactions between actors and components of each system.

Considering the mentioned information, we sought to answer this question: does the type of actors has a significant effect on the ecosystem accounting system?

2. Literature Review

2.1. Ecosystem Accounting

There is a general consensus that better and up-to-date information on the state and use of global ecosystems is needed in order to reduce and ultimately reverse their ongoing degradation; Furthermore, there is a widespread concern that decision making on renewable natural resources including ecosystems is biased by their lack of consideration in economic statistics including in indicators such as GDP. This is the motivation behind the development of the System of Environmental Economic Accounting, or SEEA. The SEEA is a systematic statistical framework to measure and analyse natural capital, and the use of this capital by people. The SEEA is connected to the System of National Accounts, used by statistical agencies world-wide to record economic production and consumption and derive macro-economic indicators like GDP. (Hein et al., 2020, 1).

Ecosystem accounting monitors the changes made in the services of the ecosystem in biophysical and monetary conditions under a spatial approach that determines the spatial diversity of ecosystems and services provided. Creating ecosystem accounts allows us to have a sustainable measurement of the environment for several years, which means a decrease in the ecosystem as a set of points to reduce the capacity of ecosystems to support the welfare of human beings over a long period (Lai et al., 2018). Ecosystem accounting is a comprehensive and integrated framework for the organization of information on the status of ecosystems and use of ecosystems developed in the direct relationship with the system of national accounts. Ecosystem accounting development is supported by advances in physical, biological modeling and access to conventional explicit data sources. Evidently, ecosystem accounting is an interdisciplinary topic that brings together a wide range of researchers in various disciplines such as statisticians, economists, ecologists, and GIS model builders. Connecting to a national accounts system facilitates the integrated analysis of the link between the environment and the economy (Hein et al., 2015).

Bottero et al (2020)in a study entitled Monetary Accounting for Ecosystem Services, addressed the issue that the purpose of this study is to provide a better understanding of ecosystem participation in the economy. According to the findings of this study, ecosystem services with the highest values were crop production, nature tourism and forage production

2.2. ANT and Social Networks

2.2.1. Social Networks

Social capital, as an important construct in social sciences, captures shared common beliefs and density of associational networks within a community. Regions with high social capital tend to have higher levels of mutual trust and display greater contract enforceability through the power of the community. Sociologists argue that communities with dense associational networks face a harsher punishment for deviation from norms, which deters individuals from acting opportunistically. In the long run, this results in fostering a norm-conducive environment that encourages cooperation among individuals and mitigates norm-deviant behavior. (Afzali, 2020,2).

Social networks are a set of various individuals and groups, who are in contact with each other and exchange information with other group members for different reasons. Since the board of directors and CEO, executive managers, investors, lenders, and other users of accounting information need accurate and reliable information to make logical decisions, social networks play an important role in providing information with the required quality and quantity. In addition, social networks can prevent misconducts and embezzlements (Salehi et al., 2015, 1). Social networks include t he relations between individuals and groups to exchange various information. In this regard, accounting information is a type of information that affects the decisions of relevant groups. Various

studies have been performed on social networks and their roles from different aspects, including the research by James Worrell et al. (2013) (analysis of social networks in the accounting information system), Mouritsen & Thrane (2006) (accounting, the supplement of the network, and development of organizational relationships and research), and Richardson (2009) (supervisory networks for accounting and auditing standards). Analysis of social network has been formed as a key technique in modern sociology. According to social networks, the product of convergence is three independent historical processes:

1) The information revolution,
2) restructuring capitalism, and planning-based economy, 3. Cultural movements of the 1960s.

These three processes lead to the growth and development of social networks (Manuel, 2001, 23). Analysis of social networks has been more recognized due to the growth and development of online networks. Social networks are a group of people or organizations with common taste or interest, gathered together to achieve a specific goal. Each member is identified as an actor, and one of the features of social networks is the presence of a complication relation and interactions among actors. In this view, people are known as vertex or node, and their relations such as friendship, kinship, business, and common interests are an edge. Walsham expresses that networks might include non-human actors, such as software, hardware, information systems, standards, and infrastructures. Considering social networks from this point of view, we concluded that socially stable structures are composed of actors amid the field as the main factor (Salehi et al., 2015, 2).

2.2.2. ANT

Contrary to other old theories, such as Rogers' theory, which suggests the discovery of pre-existing latent truths and is typically based on explorers or individual heroes (Rogers, 1995, 56). ANT includes the formation of successful networks from stakeholders and interpretation of their interests, in a way that these actors are eager to participate in specific thinking and practical practices with the goal of network sustainability. In ANT, reality formation is similar to a black box, created when the interests of human and non-human actors are regulated in a single set, and the network is formed depending on reliability. Nevertheless, the reality is not emitted in a classic way. Instead, beliefs are interpreted, consolidated, or weakened due to the other role of actors (McMaster et al., 1997, 56). In fact, ANT is a framework for the assessment of social act and actions of actors (human and non-human) in real life situations (Hepso, 2000, 56). The ANT encompasses three main components of actors, network, and a black box.

A: Actors

In research on ANT, node/actant/player/factor is a general concept for human and non-human artifacts, the act and movement of which lead to the moving of other components of the network. ANT theorists believe that the human and non-human components of a network have an equal function (Hermans, 2005, 41). In fact, actors are identities that try to perform an act. The distinction between actors in ANT and other views expressed in the social sciences is that there is more emphasis on performing an act than the actor himself (whether in the form of social or technical identities) in these definitions (Everitt Deering, 2008, 56).

B: Network

In addition to actors, the network is recognized as the second key concept of ANT. The network of social measures among actors is independent and forms its surrounding issues or programs (Hermans, 2005, 3). Some essential concepts at the network level include actors, relations, and rules, which are used to describe the network structure and form a space where relations between actors lead to specific consequences. Therefore, in assessment of accounting information system, the network can be considered as a context of heterogeneous components, including individuals, information producers, users, stakeholders, and accounting information of other fields, manufacturing, commerce and services organizations, society, equipment and furniture, computer, newspaper offices, software, decision-making procedures, units-universities, stock exchange, central bank and other financial institutions, audit court, and auditing organization to achieve specific goals such as acceptance and use of auditing information.

C: Black Box

Black box is a completely accepted network or a component of the network. In other words, there is no possibility of returning and revision for the idea,

element, or component. The black box is any type of structure in the network that, regardless of its complexity or background, is reliable and clear enough to be regarded as a certain fact. In accounting research, the accounting circle is known as the financial data production center, and software and hardware investments are made every year to equip these products. As such, accounting circles are accepted as realities similar to a black box. Furthermore, accountants transfer the latest financial data to computers in centers and accounting circles. All or part of the power of equipment and software and hardware is reduced when the connection between equipment and manpower is damaged or interrupted. On the other hand, information transferring tools play the role of the actor in the network, and each of the other existing and accepted equipment in the field of recognition, registration, classification, analysis and use of accounting information is known as the black box (Sharifzadeh, 2010, 438).

In a study, Bani Talebi Dehkordi et al. (2015) showed that this theory is able to assess and explain effective human and non-human actors in the accounting system. In addition, it includes the method of their interactions and relations in the form of a network of actors from the perspective of sociologists in a way that the existing networks, all effective actors in each network and their roles, type of reaction, the existing black box and the performed act can be recognized in any accounting system based on this theory. In addition, Sharifzadeh (2012) showed that from the perspective of ANT, the agricultural climate information system is a network including actors, acts, information-related processes (production, transfer, storage, retrieval, merge, distribution, application, control, and management) and systems' mechanisms (interaction and networks). Bordt (2018) assessed the services related to accounting frameworks and ecosystems and concluded that more work is required to create the necessary concepts, measures and processes to support a comprehensive and convergent evaluation framework for integration of values of the ecosystem in the national planning. In another study, Hein et al. (2015) assessed the progress and challenges in the development of ecosystem accounting as a tool for analysis of asset ecosystem.

Ecosystem accounting is a systematic approach for a combination of criteria of ecosystem services and assets of the ecosystem with an accounting structure. Ecosystem accounting requires explicit modeling of ecosystem's services and assets in both physical and monetary forms. A wide range of recent studies have tested various elements of ecosystem accounting, and the primary instruction has been prepared for ecosystem accounting under the supervision of the United Nations. The present research summarized the current information of key aspects of ecosystem accounting, analyzed its thinking model in the general system of economic and environmental accounting, and supported three examples of ecosystem accounting in sustainable development.

Research Hypothesis

1) Social-political actors significantly affected ecosystem accounting.
2) Technical actors significantly affected ecosystem accounting.
3) Organizational actors significantly affected ecosystem accounting.
4) Economic actors significantly affected ecosystem accounting.
5) Technology actors significantly affected ecosystem accounting.

3. Methodology

Since the goal of the present research was determining the causal relationship between the variables of type of actors and ecosystem accounting, the research was applied in terms of objective and descriptive-correlational regarding data collection method. In addition, the study was specifically based on the structural equations model. After evaluation of the relationship between the variables and testing the research hypotheses, data analysis was carried out in PLS. In this study, the main data collection tools were two 22 and 25-item questionnaires to assess the components of the network of actors and the ecosystem accounting, respectively. The statistical population included activists in the field of ecosystem accounting. In this context, 84 questionnaires were collected from the evaluated society using convenience sampling, and the analyses in the fourth chapter were carried out based on this data.

4. Results

4.1. Measurement Model Tests

We used the structural equations test in PLS to answer this question. In this respect, the diagrams of (quality of structural modeling and measurement, standard model and significance t model) were presented. It is notable that five types of actors (i.e., political-social, technical, organizational, economic, and technology) were included based on the former stages of the research. In addition, the ecosystem accounting variable encompassed four components of need, concepts, scope and feasibility. The measurement model tests were in line with the confirmation of the questionnaire's items, and this section was assessed in two stages (reliability and validity tests).

4.1.1. Evaluation of Observed Variables (Factor Loads)

A factor load greater than 0.5 in the model is indicative of appropriateness of a load of items, and the load above 0.7 shows the high item quality. On the other hand, the significance of the items was assessed applying the t statistics. The items were regarded significant and there was no need to remove the item from the analysis process if the t statistic was not in the range of -1.96 to +1.96.

Table 1. Factor load of items related to the components of actors

Variable	Indicators	Factor load	T coefficient
Political-social actors	Government	0/923	1.1.1.1. 28/084952
	Decision-makers and planners	0/912	1.1.1.2. 34/331846
	NGOs	0/845	1.1.1.3. 39/828589
	Legislative institutions	0/871	1.1.1.4. 43/654499
	Cultural institutions	0/795	1.1.1.5. 51/040147
	Environmental protection agency	0/792	1.1.1.6. 32/923097
Technical actors	Environmental specialists	0/911	1.1.1.7. 13/939354
	Accountants	0/911	1.1.1.8. 24/417887
	Information users	0/813	1.1.1.9. 20/441176
	Technology	0/940	1.1.1.10. 11/937322
	Human skills	0/856	1.1.1.11. 20/785335
Organizational actors	Governmental and non-governmental directors	0/891	1.1.1.12. 13/254603
	Research institutions	0/934	1.1.1.13. 27/183696
	Regulations	0/920	1.1.1.14. 15/209630
	Administrative factors	0/920	1.1.1.15. 16/831657
	Environmental standards and regulations	0/766	1.1.1.16. 12/201248
Economic actors	Bank (Keshavarzi Bank)	0/895	1.1.1.17. 4/384368
	Credits and investors	0/766	1.1.1.18. 4/207894
	Business companies	0/938	1.1.1.19. 4/730569
	Market factors	0/736	1.1.1.20. 4/445117
	Environmental taxes	0/865	1.1.1.21. 4/559910
Technology actors	Software and hardware communications	0/881	1.1.1.22. 15/351584
	Information promoters	0/904	1.1.1.23. 26/740617
	Scientific societies	0/742	1.1.1.24. 21/008995
	Professional societies	0/768	1.1.1.25. 25/800962

According to Table 1, the factor loads of 25 items were above 0.7, which demonstrated the high quality of the items. On the other hand, given the fact that the factor load of none of the items was below 0.5, no item was eliminated in the analysis stage. In terms of the significance of items, the results presented in Table 1 indicated that the t coefficients related to all items were not in the range of -0.196 and +1.96, thereby confirming the significance of all items and lack of need for removal of items.

According to the results presented in Table 2, the factor loads of all 22 items of the questionnaire were above 0.7, indicating the high quality of the questions. On the other hand, since the factor load of none of the items was below 0.5, no item was removed from the analysis procedure. According to Table 2, the t coefficients of all items were not in the range of -1.96 to +1.96, which confirmed the significance of all items and lack of need for their removal.

Table 2. Factor load of items related to the components of ecosystem accounting

Variable	Items	Factor load	T coefficient
Need	The main objective of ecosystem accounting is to inform economic decisions	0/834	1.1.1.26. 16/775657
	International Classifications, concepts, and methods related to ecosystems have no applicability in solving local problems.	0/816	1.1.1.27. 14/722650
	Lack of determining a financial value for nature will lead to determining a zero value for this notion based on economic and financial decisions.	0/792	1.1.1.28. 13/280243
	Ecosystem accounting is applied to supply information in decisions related to the environment and natural resources.	0/699	1.1.1.29. 17/203015
	The usefulness of ecosystem accounts depends on their relationship with different decision-making conditions (economic, protective, resource management).	0/717	1.1.1.30. 14/948946
	Ecosystem accounting focuses on the recognition of technology innovation opportunities.	0/895	1.1.1.31. 15/058509
	Ecosystem accounting can help define the business and financial policies through the valuation of ecosystems.	0/873	1.1.1.32. 12/960405
Concepts	Market forces determine the most profitable applications of ecosystems.	0/774	1.1.1.33. 16/608699
	Ecosystem accounting can use the principles applied in financial accounting (e.g., stock flow, accounting courses, and coherent classifications).	0/794	1.1.1.34. 27/108000
	Financial and economic resources of sustainable development are so important that their relevant risks can be accepted.	0/882	1.1.1.35. 33/875267
	Loss of habitat and biodiversity has more effects on humans, compared to climate change.	0/962	1.1.1.36. 19/128993
	Biodiversity must be considered in the final services of the ecosystem.	0/939	1.1.1.37. 88/506654
Scope	Land cover is the best starting point for determining space units in ecosystem accounting.	0/767	1.1.1.38. 25/574679
	Ecosystem accounts should focus on assessing the capacity of ecosystems to deliver services in the future.	0/939	1.1.1.39. 53/944189
	Ecosystem accounting should measure ecosystem processes involved in ecosystem services.	0/820	1.1.1.40. 31/653343
	Ecosystem accounts should identify all roles of ecosystems in human health, not just in the economic and financial field.	0/737	1.1.1.41. 27/600768
	Ecosystem accounting should estimate future ecosystem services.	0/946	1.1.1.42. 19/747603
Feasibility	Ecosystem accounts should include data from local ecosystems to monitor changes in ecosystem services at the national level.	0/675	1.1.1.43. 22/217592
	Ecosystem accounting and derived indicators are always useful, even if they are not sufficiently precise.	0/763	1.1.1.44. 12/811229
	It is possible to calculate a single index related to the conditions of one ecosystem for a variety of ecosystems.	0/782	1.1.1.45. 15/089259
	Only ecosystem services that can be converted into money are displayed on national accounts.	0/801	1.1.1.46. 8/863862
	Different types of space units (e.g., landscapes and service production units) should be used in the compilation of ecosystem accounts.	0/843	1.1.1.47. 9/767136

4.1.2. Cronbach's Alpha, Composite Reliability, Collective Reliability

Cronbach's alpha is a criterion for assessing the internal consistency of the items with an acceptable level of 0.7. On the other hand, composite reliability is the criterion for evaluation of internal correlation of items with an acceptable level of above 0.7. Finally, collective reliability indicates the generalizability of items with an acceptable level of above 0.5 (Mohsenin and Esfidani, 2014, 164).

According to the results, reliability was above 0.7 and acceptable based on Cronbach's alpha coefficient and composite reliability. In addition, results of collective reliability showed that the amounts calculated for all variables were above 0.5, which confirmed the generalizability of items.

Table 3. Results of composite, collective, and Cronbach's alpha reliability

Components	Cronbach's alpha	Composite reliability	Collective reliability
Political-social actors (PS)	1.1.1.48. 0/933998	1.1.1.49. 0/947818	1.1.1.50. 0/751788
Technical actors (TE)	1.1.1.51. 0/844783	1.1.1.52. 0/889608	1.1.1.53. 0/617470
Organizational actors (OR)	1.1.1.54. 0/841046	1.1.1.55. 0/887414	1.1.1.56. 0/612373
Economic actors (EC)	1.1.1.57. 0/912475	1.1.1.58. 0/933971	1.1.1.59. 0/738898
Technological actors (TC)	1.1.1.60. 0/855657	1.1.1.61. 0/902747	1.1.1.62. 0/699296
1.1.1.63. Need (NE)	1.1.1.64. 0/878628	1.1.1.65. 0/905792	1.1.1.66. 0/579113
1.1.1.67. Concepts (CO)	1.1.1.68. 0/898996	1.1.1.69. 0/925923	1.1.1.70. 0/715234
1.1.1.71. Scope (SC)	1.1.1.72. 0/926510	1.1.1.73. 0/944664	1.1.1.74. 0/773670
1.1.1.75. Feasibility (FE)	1.1.1.76. 0/789920	1.1.1.77. 0/856314	1.1.1.78. 0/545098

4.1.3. Evaluation of AVE

In PLS modeling, one of the other criteria for evaluating the (external) measurement model is that the structure should have the most common variance with its markers compared to its similarity with other structures in a given model. For this assessment, researchers propose the use of AVE, which is the mean shared variance between the structure and its markers. In this criterion, which shows the validity of measurement tools, it is assumed that the desired latent variable has more shared variance with determined markers, compared to any other latent variable. Researchers have recommended an AVE of equal or above 0.5, which means that the desired structure explains 50% or a higher percentage of variances of its marker. The last confirmatory criterion of convergent validity is the comparison between the composite reliability and the mean of extracted variance. To confirm the convergent validity, CR>AVE must be established.

Given the fact that the proper value of AVE is 0.5, all variables in the table above had an average variance extracted of above 0.5. The accuracy of the convergent validity results is confirmed by using this index. In addition, CR>AVE in all latent variables, and the fourth condition of the convergent validity was established. According to the four tests performed, it could be concluded that the research model had suitable convergent validity.

Table 4. Convergent validity test results

Variable	Average variance extracted (AVE)	Composite reliability (CR)	CR>AVE
Political-social actors (PS)	1.1.1.79. 0/751788	1.1.1.80. 0/947818	OK
Technical actors (TE)	1.1.1.81. 0/617470	1.1.1.82. 0/889608	OK
Organizational actors (OR)	1.1.1.83. 0/612373	1.1.1.84. 0/887414	OK
Economic actors (EC)	1.1.1.85. 0/738898	1.1.1.86. 0/933971	OK
Technological actors (TC)	1.1.1.87. 0/699296	1.1.1.88. 0/902747	OK
1.1.1.89. Need (NE)	1.1.1.90. 0/579113	1.1.1.91. 0/905792	OK
1.1.1.92. Concepts (CO)	1.1.1.93. 0/715234	1.1.1.94. 0/925923	OK
1.1.1.95. Scope (SC)	1.1.1.96. 0/773670	1.1.1.97. 0/944664	OK
1.1.1.98. Feasibility (FE)	1.1.1.99. 0/545098	1.1.1.100. 0/856314	OK

4.1.4. Structural Model and Measurement Quality Tests

In this section, we evaluated the quality of the model in the form of quality of measurement model (questions) and quality of the structural model (variables and hypotheses). To evaluate the quality of the measurement model, the subscription index is used with CV-communality (CV COM). Positive amounts of this index are indicative of the proper quality of the measurement model. In addition, the CV-redundancy (CV RED) was applied to assess the quality of the structural model. In this regard, positive values demonstrated the suitable quality of the structural model. On the other hand, the goodness of fit (GoF) index is used as a criterion for evaluation of the overall performance of the model and simultaneously considers both the structural and measurement models. This indicator is calculated as the square product of mean coefficients of determination and subscription index. In this regard, three values of 0.01, 0.25, and 0.36 are poor, moderate, and strong values of this index, respectively (Mashverati, 2017).

According to Table 5, all values calculated for CV COM and CV RED were positive, which confirmed the measurement and structural models.

Table 5. Structural model and measurement quality tests

Variable	(CV RED)	(CV COM)
Political-social actors (PS)	1.1.1.101. 0/380578	1.1.1.102. 0/750710
Technical actors (TE)	1.1.1.103. 0/348300	1.1.1.104. 0/616051
Organizational actors (OR)	1.1.1.105. 0/423611	1.1.1.106. 0/610624
Economic actors (EC)	1.1.1.107. 0/061040	1.1.1.108. 0/734374
Technological actors (TC)	1.1.1.109. 0/458468	1.1.1.110. 0/699025
1.1.1.111. Need (NE)	1.1.1.112. 0/360230	1.1.1.113. 0/579124
1.1.1.114. Concepts (CO)	1.1.1.115. 0/377352	1.1.1.116. 0/715239
1.1.1.117. Scope (SC)	1.1.1.118. 0/562310	1.1.1.119. 0/773667
1.1.1.120. Feasibility (FE)	1.1.1.121. 0/458075	1.1.1.122. 0/545035

4.1.5. Evaluation of Structural Research Models

The model quality in the form of quality of measurement model (questions) and quality of the structural model. In this model, the values of CV COM and CV RED were positive and above 0.36, which confirmed the quality of the measurement and structural models.

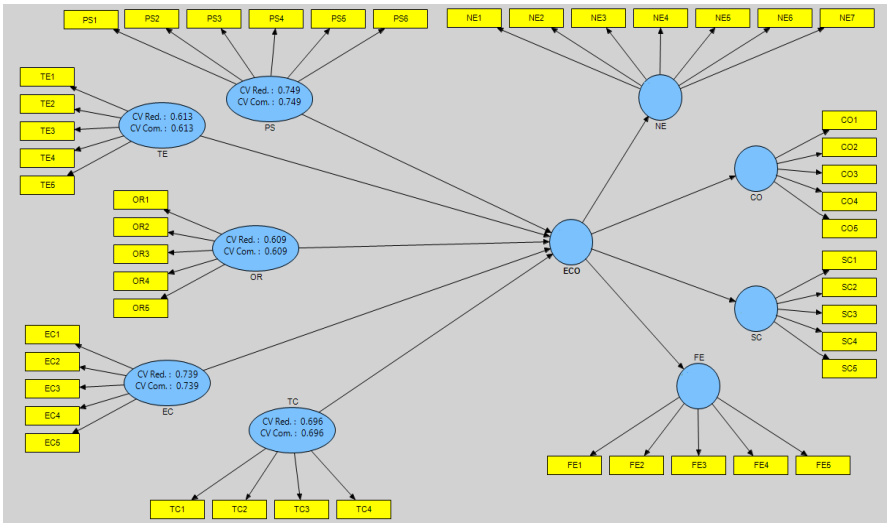

Diagram 1. Structural model quality and measurement

In this section, we evaluated the quality of model in the form of quality of measurement model (questions) and quality of structural model (variables and hypotheses). To evaluate the quality of the measurement model, the subscription index is used with CV-communality (CV COM). Positive amounts of this index are indicative of the proper quality of the measurement model. In addition, the CV-redundancy (CV RED) was applied to assess the quality of the structural model. In this regard, three values of 0.01, 0.25, and 0.36 are poor, moderate, and strong values of this index, respectively. In this model, the values of CV COM and CV RED were positive and above 0.36, which confirmed the quality of the measurement and structural models. Testing of the measurement model was in line with the confirmation of the relationships raised in the model. In this section, the research models were tested by two steps (path coefficient and significance coefficient). In this respect, model 2 is indicative of standard coefficients, whereas model 3 shows the significance coefficients.

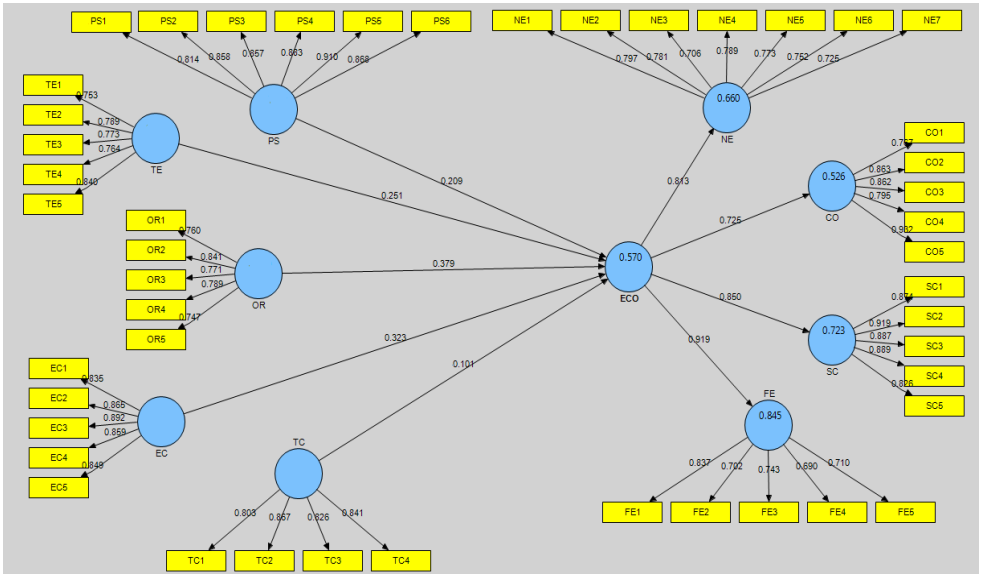

Diagram 2. Standard coefficients model

In this section, we assessed the significance of path coefficient at three levels. In the case of the level of significance of 90%, 95% and 99%, this value was compared with the minimum T statistics of 1.64, 1.96, and 2.58, respectively.

Given the fact that the significance coefficients of the technical actor component was above 1.96, it could be concluded that the variable had a significant and positive effect on ecosystem accounting at the confidence level of 95%. Moreover, the significance coefficients of components of political-social actors, organizational actors, and economic actors were above 2.58, thereby concluded that the variables exerted a positive and significant impact on ecosystem accounting at the confidence level of 99%. On the other hand, technology actors had no significant effect on the ecosystem accounting.

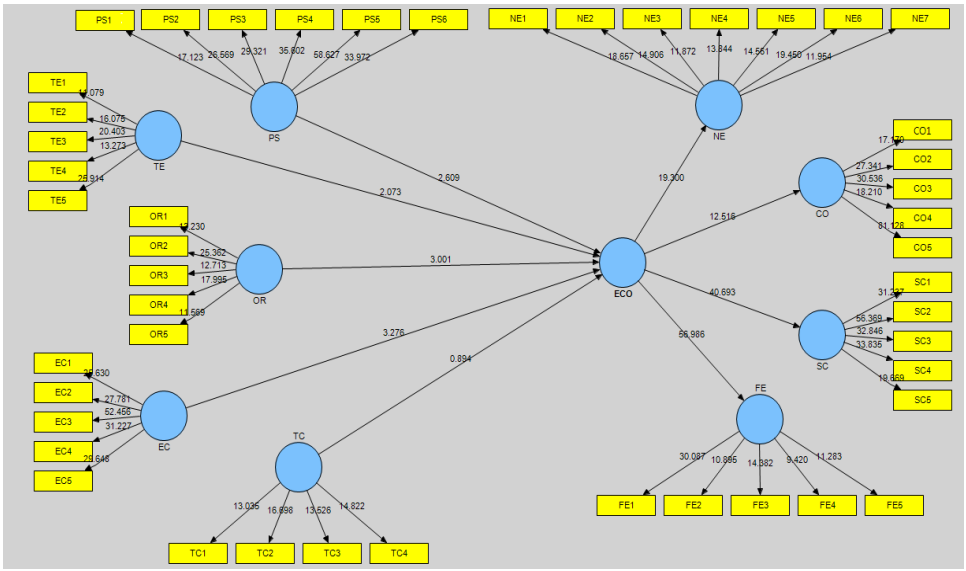

Diagram 3. (T) Significance model

Table 6. Model test results

1.1.1.123. The path proposed in the model	1.1.1.124. T coefficient	1.1.1.125. Path coefficient	1.1.1.126. Result
Political-social actors←ecosystem accounting	1.1.1.127. 2.609	1.1.1.128. 0.209	1.1.1.129. Positive and significant effect
Technical actors←ecosystem accounting	1.1.1.130. 2.073	1.1.1.131. 0.251	1.1.1.132. Positive and significant effect
Organizational actors←ecosystem accounting	1.1.1.133. 3.001	1.1.1.134. 0.379	1.1.1.135. Positive and significant effect
Economic actors←ecosystem accounting	1.1.1.136. 3.276	1.1.1.137. 0.323	1.1.1.138. Positive and significant effect
Technology actors←ecosystem accounting	1.1.1.139. 0.894	1.1.1.140. 0.101	1.1.1.141. Lack of significant effect

5. Discussion and Conclusions

According to the results of the present study and theoretical foundations expressed on ANT and ecosystem accounting, the actors affecting the in-network relations of actors in the ecosystem accounting system based on ANT were political-social, technical, organizational, economic and technological actors, each having a different subset of factors and components. In the social-political discussion, the criterion of cultural institutions has the highest impact coefficient among other sub-indicators and should be considered as the main factor in communications within the network of actors. According to the results of the current research, accounting professionals believe that decision-makers and cultural institutions should be considered as the most important factor (even more important than decision-makers or planners) affecting the relationships within the network of actors in the accounting system of the ecosystem accounting system of Iran. In fact, it could be expressed that improvement of cultural criteria and standards in the ecosystem accounting of Iran and elimination of its weaknesses could improve the quality of ecosystem accounting and increase the confidence of investors and creditors in this regard. Subsequently, the legislative institutions, as well as NGOs and planners can affect the increase of quality of ecosystem accounting and must be considered in this respect.

In this regard, our findings are consistent with the results obtained by Bani Talebi et al. (2015) in a research entitled explaining ANT in accounting from the perspective of knowledge and research, and by

Martin et al. (2018) in a study entitled the integration of cultural services of the ecosystem in satellite account of the ecosystem.

In the section of technical actors, accountants are the most effective factors, which are also involved in the financial reporting and analysis of **assets, capital and services** of the ecosystem. As we know, environmental resources are public goods and belong to all members of society and all generations. Therefore, controlling and limiting the detrimental effects of human economic activities on the environment is one of the tasks of public affairs management in society. Such management requires appropriate tools such as ecosystem accounting as well as experienced accountants for environmental disclosure. In this respect, our findings are consistent with the results obtained by Mahdavi et al. (2012) in a study entitled environmental accounting and wetland ecosystems, and a research by Sepasi and Esmaeili Kajaei (2015) entitled green accounting: providing a model for environmental disclosure.

According to the results, the technical actors had the most impact on accountants especially due to their involvement in financial reporting and analysis (accounting and auditing staff). It is notable that from a critical perspective, individuals working in the accounting profession have a proletarian viewpoint (professional) on the profession, which affects their performance to achieve the general goals of the system. On the other hand, accounting professionals' ultimate goal and purpose are to gain more profits and benefits for business owners, especially managers, in order to receive more rewards and provide unrealistic performance to the existing status of the organization and a kind of lack of transparency. In this respect, no attention has been paid to increase of quality of financial reporting and sincere presentation as the main priorities. Due to these factors, individuals working in this profession have no choice but to overlook some ethical behaviors to maintain their position and status and earn more revenues.

It was also realized that despite the role of in-service education in an increase of skills and expertise of individuals, it lacks adequate efficiency. As such, it is extremely important to address this issue and pay attention to this indicator in all levels of the ecosystem accounting system, which can promote the quality of the reporting system.

After that, technology and information users must be focused and promoted as important factors for improving the quality of the ecosystem accounting system, and the shortcomings and deficiencies in this field must be addressed. Furthermore, it seems that superior technology has no special place in the ecosystem accounting system of Iran. In order to increase the efficiency of this system, it is necessary to pay special attention to this indicator or actor and to eliminate the gaps in this field with precision. It should be noted that in this index, factors such as environmental specialists have been introduced as the least important technical factor affecting communications within the network of actors in the system of ecosystem accounting of Iran.

In the section of organizational actors, research institutions are the most important factors. In today's world, where science and technology are considered as major and key factors in the process of economic, social and cultural development of societies with their widespread growth and development, the importance and role of research institutions is identified as one of the main actors. Since research is the most important method to find and eliminate problems in the field of sustainable development, a budget proportional to the work of research institutions, knowledge-based companies and startups working in the area of ecosystem, environment and recognition of services, assets and the capital of the ecosystem to support national decision-making must be considered, and all achievements of research institutions must be properly exploited. Consistent with the results obtained by Bordt (2018), these findings showed that more efforts must be dedicated by research and training institutions to forming of the necessary concepts, measures and processes to support a comprehensive and integrated framework to combine the values of the ecosystem in national planning. After research organizations, administrative factors, laws, government and non-government managers and environmental standards and regulations were recognized as the most important organizational factors affecting the relations in the actor network in the system of ecosystem accounting.

Another factor affecting the communications within the network of actors in the ecosystem accounting is organizational actors, the most important sub-indicator of which is non-governmental directors. The following priorities are regulations and research institutions. On the other hand, governmental

managers were recognized as the least important factors. Therefore, increasing the use of efficient and non-governmental directors will be important to achieve financial reporting goals with relevancy and reliability indicators. In terms of the least important factor (governmental directors), it seems that the ecosystem accounting of Iran and its components still do not have the necessary executive importance from the viewpoint of the government and governmental executives and various actors still resist to some issues in the system. In fact, the establishment of systems such as Nab and Chabok introduced as modern systems for quick response to changes has no special place. Therefore, more attention must be paid toward this field and the existing barriers in the field must be recognized and eliminated. By doing so, we will witness the provision of high-quality information by the ecosystem accounting system.

Another factor affecting the in-network communications of actors in the ecosystem accounting system of Iran is economic actors, the most important sub-indicator of which is business companies. In this respect, it is proposed that the participation rate and freedom of action and use of the views of business executives be increased in decision making related to the ecosystem accounting system to improve this factor. In addition, special mechanisms must be employed to increase the level of attention of financial managers of business companies to settlement problems of the ecosystem accounting system. By doing so, we can expect an increase in the quality of the ecosystem accounting system and a decrease in information asymmetry. After this sub-indicator, environmental taxes, creditors and investors are other factors that can affect the in-network communication of actors in the ecosystem accounting system of Iran.

In conclusion, it could be expressed that all of these factors could improve the quality of the ecosystem accounting system by creating synergy and coherence among its components, introducing the profession of accounting as professional knowledge in the economic, environmental and business space.

In this regard, our findings are congruent with the results obtained by Adens and Hein (2013) in a study entitled a consistent approach to ecosystem accounting.

The fifth factor affecting the in-network communications of actors in the ecosystem accounting system of Iran was technology actors, which is the necessity of any system, including the ecosystem accounting system, to achieve its ultimate goal in the best way possible and prohibit any error or deviation. The more the error and deviation are below the determined principles, the more the process of analysis and decision-making can be improved. The most important criterion for this indicator is professional societies, whereas the least important factor is communication hardware and software.

Information technology of organizations has become extremely importance since the technology plays the role of corporate capital in today's business, and the protection of information and information systems such as accounting with the use of modern technology is one of the important pillars of its survival, and the globalization of the economy has created worldwide competition. Based on these conditions, the need to support the financial information and reduce the associated risk is significantly more important and prominent than before. In addition, it seems that the success of information security greatly depends on the type of technology of organizations. On the other hand, the constructive behaviors of users and directors can increase this effectiveness.

In addition, the results showed that focusing on the main actors affecting the ecosystem accounting depending on their qualitative and quantitative nature and level of importance can lead to the improvement of the quality of the ecosystem accounting system and move of organizations toward the implementation of environmental accounting, which ultimately results in measuring the relationship between ecosystems and human welfare for national planning and move toward a sustainable development.

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