

PROPOSING AN AGGREGATED MEASUREMENT OF INNOVATION: THE COMPOSITE INNOVATION INDEX (CII)

Robert ȘTEFAN^{a*}

^a „Dunărea de Jos” University of Galați, Romania

ABSTRACT

In order to make innovation as tangible as possible, it is necessary to structure creativity. Therefore, innovation processes should be constantly monitored and quantified, like any other aspect of an organization's performance. A 2010 survey reveals that only 22% of top managers have implemented innovation-performance measurement indicators in their organizations. This indicates that most of the global innovation phenomenon is still waiting to be measured, evaluated and streamlined, by virtue of fundamental benefits such as: efficient allocation of resources, focus of innovative efforts and maximizing value in the company. The Composite Innovation Index is a tool proposed for the market or industry-wide measurement of innovation and is based on 6 main determinants of innovation, named "dimensions" of innovation. Data for the computation of the index is surveyed by the questionnaire or interview methods. After having designed a questionnaire addressed to management employees of the banking industry in Romania, the Composite Innovation Index obtained thereby reveals a somewhat below-average level of proactivity of the banks in Romania in the phenomenon of innovation.

KEYWORDS: *aggregated index, composite innovation index, innovation, innovation metrics, management, Romanian banking industry*

DOI: 10.24818/IMC/2021/02.20

1. INTRODUCTION

In the case of organizations that are not founded on values that prioritize progress by future-orientated vision, innovation seems to be a mystical, hardly tangible phenomenon. This, unfortunately, underestimates the value of creativity with a defined purpose and of a structured effort to create new services, products, business models and experiences. The reality is that, in order to make innovation as tangible as possible, it is necessary to structure creativity. Nicknamed "the father of modern management-thinking", management consultant, professor and author Peter Drucker states: "Most innovations, especially successful ones, result from a conscious, purposeful search for innovation opportunities" (Drucker, 2002). So, if innovation is a conscious and purposeful endeavor, it means that it should be constantly monitored and quantified, like any other aspect of an organization's performance. A 2010 survey by management consulting firm McKinsey reveals that only 22% of top managers globally have implemented innovation-performance measurement indicators in their organizations. This indicates that most of the global innovation phenomenon is still waiting to be measured, evaluated and streamlined, by virtue of fundamental benefits such as: efficient allocation of resources, focus of innovative efforts and maximizing value in the company.

* Corresponding author. E-mail address: electron300020@hotmail.com

2. CONCEPT

Because the way the innovation process is conducted is not entirely universal across industries, with standard stages and benchmarks in all industries, it is difficult to define all the specific factors that could characterize innovation in each industry. However, there are several categories of aspects that universally define the innovative approach in an organization, which can be surveyed using a relevant sample and aggregated to measure innovation at the level of an industry, either limited by a geographical area or globally. These aspects that universally define the innovative nature and endeavor of an organization I will further call "dimensions of innovation". I further identify 3 categories of dimensions of innovation, with the help of which I will propose, in the next chapter, a way to measure innovation, by survey, at the level of a market or an industry:

- (1) **Dimensions that are intrinsic to innovative mindfulness** – these dimensions refer to the fundamental values of an organization, respectively if the principles on which the organization was founded are oriented towards progress through innovation. When an organization has a mission to innovate since the beginning, it is clear that it is much more likely to be involved in innovation than organizations whose values or mission do not clearly show an orientation towards innovation;
- (2) **Dimensions indicating effort (input) towards innovation** – these refer to the resources that the organization allocates to innovation, namely time, capital, effort to focus objectives towards innovation or any other kind of effort or opportunity cost in favor innovative endeavor;
- (3) **Performance (output) dimensions, or key performance indicators (KPI's)** - these dimensions have to do with the appraisal of innovation in terms of the results of efforts made in this regard. Examples of this category are: the annual number of new products launched on the market in relation to the total number of products, the revenues obtained from the launch of new products or services, the market position in terms of innovation leadership (if the organization is an innovation leader or an innovation follower) etc.

Now let us define what an index is. In statistical-mathematical terminology in the field of science, the term "index" generally refers to an indicator, a statistical instrument designed to measure and represent the state of a phenomenon, a situation, the characteristics of a substance, a technical system or, generally, of any measurable fact or aspect. From a synonymous point of view, it could be synthesized by the terms: clue, indicator, pointer. Indices are designed to easily represent a large volume of information and to generate a standard measure thereof. A simple index uses a single mathematical formula or expression to measure the aspect analyzed, while a composite index sums up or averages a series of mathematical formulas or expressions to generate the synthetic measure of a multidimensional aspect. The source of inspiration for the idea of designing an index to approximate the intensity of the innovation phenomenon in a certain market is the Aggregated Index of Competitive Pressure (AICP), developed by the Romanian Competition Council in 2013. Similarly to the AICP composite variety of index, that aggregates a number of 20 indicators in an attempt to best approximate the level of competitive pressure in a market, the Composite Innovation Index will measure, through a questionnaire, a number of 6 principal dimensions that define the intensity of innovation in the market of a certain good or service. The phenomenon of competitive pressure in a market is negatively affected by anticompetitive behaviors invisible on the surface, thus requiring as many factors as possible to accurately approximate and compare discrepancies between markets in order to deduce the existence of anticompetitive phenomena. Unlike the case of competition appraisal, innovation is a slightly less complex phenomenon in terms of determinants and, although part of it is visible on the surface through news released by manufacturers or service providers, there is also the invisible side to the surface of the phenomenon, namely the one related to the internal aspects of organizational culture such as the attitude towards or relationship with innovation and the internal

activities related to the preparation and implementation of innovation processes. Thus, the 6 dimensions taken into account for determining the Composite Innovation Index are:

- (1) **Openness to innovation** (the attitude of organizational culture and its values towards the phenomenon of innovation);
- (2) **The proactive research and exhaustive knowledge of innovation trends in the field** (proactive nature of relating to innovation);
- (3) **Maintaining the pace of innovation according to existing trends** (if the organization at least keeps up with the pace of innovation, without necessarily trying to be an innovation leader);
- (4) **Percentage of annual asset growth invested in innovative R&D and/or in the implementation of innovations or innovative processes;**
- (5) **The comprehensive approach to innovation** (if the organization invests in all innovative directions relevant to its core business);
- (6) **Leadership in innovation:** creation of new innovations in the field and / or proactive implementation of prototype innovations.

3. CALCULATION OF THE INDEX AND METHODOLOGICAL ASPECTS

As mentioned above, according to the structure of a composite index, the general (aggregation) formula proposed for the calculation of the Composite Innovation Index is:

$$CII = SD1*W1 + SD2*W2 + SD3*W3 + SD4*W4 + SD5*W5 + SD6*W6 \quad (1)$$

Where:

SD1, SD2 SD6 = scores of component dimensions 1 to 6

W1, W2 W6 = importance weights attributed to each component dimension,

according to importance categories based on the relevance with regard to the value of the index.

The proposal is to obtain the scores of the component dimensions of the index by surveying a relevant sample for the industry or market analyzed either by the questionnaire method or by the interview method. The answers to the questions in the questionnaire or interview will be structured according to a Likert scale in 5 to 7 points to which relevance scores will be assigned in the range 0 - 100, graded according to the specifics of each question and the answer options. It should be mentioned, therefore, that each questionnaire or interview intended to collect data for the calculation of the index at the level of a certain market or industry will be designed specifically for that market or industry, containing specific questions of the market or industry surveyed, but referring to the most recent aspects and information from the respective industry or market regarding the 6 dimensions that appraise the level of innovation. The score of a dimension will be calculated by the arithmetic mean of the scores of the questions that survey the respective dimension. Thus:

$$\text{Score of Dimension (SD)} = (\text{Score_of_Question_1} + \dots + \text{Score_of_Question_N}) / N \quad (2)$$

Where:

N = the number of questions that survey the respective dimension

As far as the importance weights assigned to each component dimension, they are established according to importance categories based on the practical relevance of the dimension in terms of the materialization of the innovation process. For example, the dimension "Openness to innovation" is part of the least important category in the calculation of the index because it measures a feature of the organization that has no material effects in making innovation happen, but is an indicator of the organization's propensity to innovate and an important precursor to the factors that materialize

innovation. At the other end is the dimension of "Leadership in innovation" because it is the culminating point of a company's innovative endeavor, thus pertaining to the highest category of importance. Being an innovation leader means always being at the forefront of innovation, this dimension therefore being the ultimate proof of absolute innovativeness. The dimension "Percentage of annual asset growth invested in innovative R&D and/or in the implementation of innovations or innovative processes " tells us what is the actual effort of resources directed by the company towards innovation. In the past, there has been considered the use of percentage of equity spent on R&D as the only measurement of innovative effort, but this approach falls short because the phenomenon of innovation is multidimensional, so a more complex approach is needed. I consider that a better measurement of financial effort towards innovation is the percentage of annual asset growth spent on innovative R&D or implementation of innovations because a company can also have a leveraged approach in financing projects, not only by direct shareholder's equity. Thus, total asset growth includes debt-sourced financing efforts. The dimension described herein was assigned the category of medium importance, because, regardless of a company's financial efforts towards innovation, in the end, what counts is the material results of innovative projects.

4. THE COMPONENT DIMENSIONS OF THE INDEX

As described above, in order to establish a weighting logic in the calculation of the composite index for the component dimensions, I have included them in the following categories of importance:

Table 1. Dimension categories according to importance within the index

Importance category:	Description:	Importance weight:
A	Dimensions with the highest practical relevance in relation to indicating the level of innovation	0,30
B	Dimensions with moderate practical relevance in relation to indicating the level of innovation	0,20
C	Dimensions that represent a basic, foundational or merely a prerequisite level of engagement with the phenomenon of innovation	0,10

The table below highlights the component dimensions considered in the calculation of the Composite Innovation Index with the categories and respectively the weights of importance assigned to them:

Table 2. Importance categories and weights of each component dimension of the CII

CII = the Composite Innovation Index		
Component dimensions:	Importance category:	Importance weight:
1. Openness towards innovation	C	0,10
2. The proactive research and knowledge of innovative trends in the field of activity	C	0,10
3. Keeping up with innovation according to established trends	C	0,10

CII = the Composite Innovation Index		
Component dimensions:	Importance category:	Importance weight:
4. The percentage of the annual variation of total asset value, invested in innovative R&D and/or implementation of innovations	B	0,20
5. The comprehensive approach of innovation	B	0,20
6. Innovation leadership: creating new innovations in the field of activity and/or proactively implementing prototypes	A	0,30

Next, I will describe each dimension separately. The dimensions that make up the index have been numbered in ascending order, according to the level of innovation that they indicate. Thus, the first two dimensions indicate the minimum level of innovation that an organization could assume, while the last dimension, leadership in innovation, indicates the highest level of innovation that an organization could be operating at.

Dimension 1: Openness to innovation

According to the characteristics of the dimensions that define innovation, described in the previous section, the dimension "openness to innovation" is the only one in the category of those intrinsic to an organization's orientation or propensity towards innovation. On the one hand, this dimension is related to the organizational culture, to the company's value system, to the way it relates to the innovation phenomenon. On the other hand, openness to innovation can be inherently conditioned by the nature of the industry: for example, it is a known fact that high-tech industries are virtually inseparable from the phenomenon of innovation, while certain industries with monopolistic structures (state or natural) or oligopolistic, with profitable business models consolidated by secular tradition and / or politically concentrated and branched economic power, tend to persist in an anti-innovative inertia as long as the conjuncture allows them and can avoid assuming high costs of implementing transformative innovations. Although the dimension of "openness to innovation" is not an indicator of the implicit existence of innovation within the organization, assessing the organization's attitude towards innovation is a good indication of the possible subsequent action taken by the organization in the direction of innovation. In the case of many companies, the vector of innovation orientation tends to be competitive pressure rather than the value system and organizational culture, so that, regardless of openness to the phenomenon, taking action towards innovation becomes a necessity. Thus, in the calculation of the index, this first dimension considered in the importance category C was assigned an importance weight of 0.10. Openness to innovation can be surveyed using questions about the attitude towards the phenomenon, the latest technologies in the field and towards the idea of disruptive innovation.

Dimension 2: The proactive research and exhaustive knowledge of innovation trends in the field

The next quantifiable dimension that follows in logical succession to openness to innovation is the degree of knowledge of innovations in the field, especially emerging technologies. Although it is a dimension similar to the previous one in the sense that it does not, in itself, indicate material effort towards innovation, it indicates that the organization makes an attemptive effort towards innovation. Keeping up to date with all the information related to the innovation phenomenon in the respective industry is the minimum necessary effort, without implicit material effects, in the direction of

innovation. Thus, it is an indispensable step forward towards implementing innovative processes. The importance weight assigned to this dimension of category C is therefore 0.10. Surveying the score of this dimension is done using questions that highlight the knowledge of the history of at least two decades of innovative stages in the field, as well as the familiarization with the latest emerging technologies and industry disruption perspectives.

Dimension 3: Maintaining the pace of innovation according to existing trends

This is of the "output dimension" variety, indicating if or to what extent the surveyed industry keeps up with the existing innovation standards in that field. Thus, a step above from the previous dimension, this one measures the concrete actions taken by companies in order to ensure minimum competitiveness in relation to competitors who launched new innovations or competitors who implement or have implemented innovations that have become standard in the global market. The questions that measure the size of maintaining the pace of innovation according to the existing trends at the level of industry / global market refer to the implementation of the latest established technologies, to the technological transfer from abroad from the parent companies, to the implementation of already-established innovative business practices or those that are on their way to becoming market-standard and/or clearly represent a competitive advantage over those who do not take them into account or do not have the means to implement them. An organization that only maintains the pace of innovation according to the industry will never be an innovation leader but only a follower who is reactive, not proactive, in relation to the phenomenon of innovation. However, I believe that the status of "follower" of innovative trends started by others is proof of practical involvement in innovation, even as merely the result of innovation-based competitive pressure. Thus, I deemed it indispensable to take into account this dimension as a component of the index, but assigning it the importance category C, with the corresponding weight of 0.10 in the aggregation of the index.

Dimension 4: Percentage of annual asset growth invested in innovative R&D and/or in the implementation of innovations or innovative processes

This is of the "input dimensions" variety, being most measurable when concrete financial data are available from the surveyed companies. As I already mentioned above, I consider that a better measurement of financial effort towards innovation (as opposed to percentage of equity capital) is the percentage of annual asset growth spent on innovative R&D or implementation of innovations because a company can also have a leveraged approach in financing projects, not only by direct shareholder's equity. Also, the percentage should be of the annual growth (not balance of assets or equity), since the annual expenditures on innovation represent a dynamic value (a cash flow), in order to be as relevant as possible as measure of the relative investment effort, innovation expenditures should be expressed by referring also to a variation, thus the change in assets rather than balance of assets. The question or questions that survey this dimension will therefore refer to the ratio between the annual budget allocated to activities for the purpose of innovation and the annual increase in the value of the company's total assets. The dimension "Percentage of annual asset growth invested in innovative R&D and/or in the implementation of innovations or innovative processes" is part of importance category B, because it measures only the investment effort, without indicating the effectiveness in terms of results. Therefore, the weight attributed to this dimension in the index aggregation is 0.20.

Dimension 5: The comprehensive approach to innovation (360 degrees)

The 5th component dimension of the Composite Innovation Index is also in the category of those that measure an organization's effort in the direction of innovation. This component of the index is meant to assess whether the innovation process is comprehensively approached at the level of the entire organization, namely whether it takes into account the innovation of all aspects of the organization,

beyond product or service innovation: business model innovation, profit model innovation, process innovation in all areas of activity, organizational culture innovation, distribution channel innovation, brand innovation, customer loyalty strategy innovation, etc. It is essential to mention that when it comes to a technology that could transform an industry, a so-called "disruptive" innovation, this transformation is not possible without the existence of a dedicated business model or the creation of a new business model that makes the connection between new technology and an emerging need or desire (Kavadias et al., 2016). The comprehensive approach to the innovation can be surveyed through questions related to the budget structure allocated to various categories of innovation within the organization, as well as questions related to the types of innovation that the organization considers or implements. Although being an innovation leader does not implicitly involve the innovation of the entire organization, and disruptive technological innovations that require adaptation of the business model are generally rare, the share of importance given to the component dimension called "comprehensive approach to innovation" is significant because it is a basic indication of the proactivity of the organization in relation to the innovation phenomenon. It should also be mentioned that, even if the company does not consider the objective of technologically disrupting a market, the comprehensive approach to innovation often creates internal synergies that lead more quickly to achieving and securing a position of innovation leader. Thus, the weight of importance of this component dimension in the calculation of the index aggregation is 0.20.

Dimension 6: Leadership in innovation: creation of new innovations in the field and/or proactive implementation of prototype innovation

Finally, the 6th dimension considered to be fundamental to comprise the Composite Innovation Index is "leadership in innovation". From the point of view of a company, leadership in innovation is the most desirable competitive position, but it is also difficult to achieve and most difficult to maintain in terms of the phenomenon called "leveling" of industrial sectors with the widespread adoption of innovations premiered by a competitor. As I explained in the previous paragraphs, the one who launches a new technology for the first time is called "innovation leader", and the one who follows, implementing the new technology later, is called "follower". As followers catch up, keeping up the pace with the market, the exclusive competitive advantage of an innovation leader expires in a matter of years, during which time it can achieve a relative profitability premium ("Schumpeterian rent" – Aghion et al., 2014) over the rest of market participants. However, innovation leaders have to strive to maintain this position, to "escape from competition" by constantly innovating in order to stay on the front lines of innovation. The questions that survey this dimension will evaluate if the organization has created or is creating new innovations in the field or if it is working on finalizing or implementing some well-known innovative concepts that are in an emerging or prototype stage. In view of the fact that it indicates the ultimate level a company can reach through its innovative approaches, the dimension of innovation leadership is listed (in this index proposal) as the most important indicator of innovation involvement, classified in importance category A, with a weight of 0.30 in the aggregation of the index.

5. APPLICATION: SURVEY BY QUESTIONNAIRE OF THE BANKING INDUSTRY IN ROMANIA

In the case of this paper, the Composite Innovation Index was calculated based on a questionnaire of 20 questions assessing the component dimensions described above. The questions were specifically designed for the banking services industry, in the light of the latest innovative phenomena in the field. Out of the 20 questions, 18 questions use Likert scales between 5 and 7 points, according to the standard approaches, there is also a question with 4 answers, as well as one with 8 answers. Regarding the scores given to the answers, they vary between the values 0 (least innovative or least innovation-oriented) and 100 (most innovative or most innovation-oriented), each answer being assigned

appropriate values according to the specifics of each questions, as I will explain below. In order to obtain a relevant sample, the questionnaire was sent mainly to managers at the managerial level within the banks. Given the reluctance of most managers to answer such a questionnaire because the questions could be perceived as trying to extract strategic information (although the anonymity of the responding banks was ensured and the industry-wide aggregate purpose of the results was explained, as well as the public usefulness of the study), in the end, the questionnaire was completed by a number of 16 managerial employees from 5 banks. Among the responding employees, more than 60% represented managerial positions at branch and national level. The cumulated market share of the 5 banks exceeds 50% at national level, namely Top-10 banks in in Romania according to total asset value. Therefore, the sample can be considered representative in terms of a good approximation of the innovation phenomenon at the level of the banking services industry in Romania. For the calculation of the index, I will further explain the scoring methodology for the questions and statements that make up the questionnaire. The tables below also indicate the percentages obtained from the survey, for each answer:

Table 3. Question 1 – Score allocation and survey results

	Points afferent to answers and Percentage of answers from survey:					
↓ Question ↓	Mobile app banking	Internet banking	Electronic Transfer of Funds (ETF)	Open Bank API	Radio Frequency Identification Cards (RFID)	Don't know or Not sure
1. Which of the following banking innovations came out FIRST, chronologically?	0	30	100	0	0	0
% survey:	6.3%	6.3%	56.3%	0.0%	6.3%	25.0%

In the case of question 1, the scores were attributed as follows: there is only one absolutely correct answer, namely, "Electronic Transfer of Funds", being the oldest banking innovation listed, so that this answer has the maximum score. However, the answer "Internet banking" could be the next chronologically valid one, indicating a partial knowledge of the history of banking technological innovations of the last decades, so that this answer was given a marginal score of 30. The selection of any other answer indicates an insufficient knowledge of the aspect surveyed by the question, so that the rest of the answers were scored with 0.

Table 4. Question 2 – Score allocation and survey results

		Points afferent to answers and Percentage of answers from survey:							
↓Question↓		Back-office process automation by AI and Cloud	Partnerships with Fintechs	Online shops or "kiosks" of banking apps	Improved ATM access through biometrics	Chatbots based on AI, for digital banking	ATM - mobile phone interaction	Composable Banking and Decentralized Finance (DeFi)	Don't know or Not sure
2	Which of the following is NOT an emerging technological innovation within the banking industry?	0	100	0	0	0	0	0	0
	% survey:	0.0%	37.5%	12.5%	12.5%	0.0%	6.3%	6.3%	25.0%

In the case of question 2, there is one exclusively correct answer: "Partnerships with fintechs", being scored with 100. The latter is an innovation already implemented by a multitude of banking institutions, not an emerging one, respectively in the development stage. Therefore, all other answers were assigned a score of 0.

Table 5. Question 3 – Score allocation and survey results

		Points afferent to answers and Percentage of answers from survey:			
↓ Question ↓		Innovation is always welcome, I adhere to "Always innovate!"	Innovation is most of the time welcome, creating additional value-added, in general.	Innovation is only justified in terms of short or medium-term profitability or competitive pressure.	Innovation in banking is not really justified, as it disturbs the already optimal current business model.
3.	What do you think of innovation in the banking industry?	100	80	50	0
	% survey:	56.3%	31.3%	12.5%	0.0%

To question 3, the most relevant answer regarding the orientation towards innovation is obviously the one that expresses the attitude "Always Innovate!", thus having been assigned the maximum score of 100. The belief that innovation generally creates added value is close enough to the proactive attitude towards innovation, so that it was given a score of 80. The conditioning of innovation by short or medium term economic profitability indicates a mediocre level of openness to innovation, being assigned a score of 50. Finally, the attitude that is generally contrary to the idea of innovation was scored with 0.

Table 6. Statements 4 to 19 – Score allocation and survey results

↓ Statement ↓	Points afferent to answers and Percentage of answers from survey:				
	Totally Agree	Agree	Nor Agree or Disagree	Disagree	Totally Disagree
4. In Romania, the banking organization for whom I work keeps up with the pace of innovation by technological transfer from abroad % survey:	100 12.5%	80 43.8%	50 25.0%	15 12.5%	0 6.3%
5. In Romania, the banking organization for whom I work creates its own innovative solutions, besides the technological transfer from abroad % survey:	100 6.3%	80 6.3%	50 18.8%	15 37.5%	0 31.3%
6. In Romania, the banking organization for whom I work does not really keep up with innovation % survey:	0 6,3%	15 18.8%	50 37.5%	80 31.3%	100 6.3%
7. Blockchain is a technology useful for banking % survey:	100 18,8%	80 37.5%	50 31.3%	15 6.3%	0 6.3%
8. Blockchain-based transfer protocols (ex: Ripple) create operational efficiencies % survey:	100 6.3%	80 31.3%	50 37.5%	15 12.5%	0 12.5%
9. Blockchain is useful only for back-office activities % survey:	0 6.3%	15 12.5%	50 43.8%	80 18.8%	100 18.8%
10. We are already implementing blockchain for back-office activities % survey:	100 0.0%	80 6.3%	50 62.5%	15 18.8%	0 12.5%
11. We are already implementing blockchain for operations % survey:	100 0.0%	80 6.3%	50 43.8%	15 25.0%	0 25.0%
12. Partnering with fintechs is a competitive advantage in relation to competitors who do not % survey:	100 37.5%	80 43.8%	50 6.3%	15 6.3%	0 6.3%

↓ Statement ↓	Points afferent to answers and Percentage of answers from survey:				
	Totally Agree	Agree	Nor Agree or Disagree	Disagree	Totally Disagree
13. We do not collaborate with fintechs because they are entities that are not sufficiently regulated in order to work in conjunction with the banking system % survey:	0 12.5%	15 6.3%	50 18.8%	80 37.5%	100 25.0%
14. We are analyzing the possibility of implementing blockchain solutions that are auxiliary to our operating activities % survey:	100 12.5%	80 31.3%	50 43.8%	15 6.3%	0 6.3%
15. We have already taken action to implement blockchain solutions auxiliary to our operating activities % survey:	100 0.0%	80 6.3%	50 50.0%	15 25.0%	0 18.8%
16. Every year, the banking organization for whom I work proactively allocates resources to ALL areas of R&D related to the development of operations % survey:	100 6.3%	80 18.8%	50 56.3%	15 12.5%	0 6.3%
17. We are familiarized with the concepts of Decentralized Finance (DeFi) and Smart Contract % survey:	100 12.5%	80 25.0%	50 43.8%	15 12.5%	0 6.3%
18. The future of financial and banking services is heading towards DeFi, because smart contracts will change the banking business model % survey:	100 0.0%	80 15.4%	50 76.9%	15 0.0%	0 7.7%
19. We are analyzing the possibility of implementing some business models based on DeFi % survey:	100 0.0%	80 15.4%	50 69.2%	15 7.7%	0 7.7%

The tables above summarize the scoring of the part of the questionnaire composed of statements with answers indicating the level of agreement. Thus, in the case of most statements, the maximum score

is given by total agreement and the minimum score by total disagreement. The exceptions are statements 6, 9 and 13, in which case the total disagreement is the most representative from an innovation standpoint and total agreement is at the opposite side. Regarding the way the answer scores progress, they are not linear, but were meant to polarize the scores related to the quasi-extremes ("Agree" and "Disagree"). Thus, the difference in points between extreme and quasi-extreme is smaller than that between quasi-extreme and center in order to better separate the pro-innovative or anti-innovative stance/situation of the respondent.

Table 7. Question 20 – Score allocation and survey results

Table 7: Question 20 – Score allocation and survey results								
		Points afferent to answers and Percentage of answers from survey:						
↓ Question ↓		0 - 15%	16 - 25%	26 - 35%	36 - 45%	46 - 50%	Over 50%	Don't know
20.	What percentage of the annual growth of total asset value does your banking organization allocate to innovating and/or innovative R&D of operations?	0	15	30	55	80	100	10
	% survey:	0.0%	0.0%	12.5%	37.5%	12.5%	0.0%	37.5%

The Likert scale of question 20 is in 7 points, respectively 7 answers. As the percentage of investment in innovation can vary greatly, we considered that a more fragmented breakdown of responses is needed in this case. Investing half or more of the company's annual asset growth in innovation denotes a maximum dedication, being scored with 80 and 100 respectively, while a share of up to 35% of investments ensures a maximum score of 30. Here as well can be noted a polarization of scores towards the extremes. In the case of the answer "I don't know", a marginal score of 10 is given on the presumption that this answer tends to suggest either a lack of investment in innovation or a low level of investment in innovation, on the average of respondents.

5.1. Calculating the CII for the banking industry in Romania

The table below shows the scores registered for each question/statement:

Table 8. Scores incurred by survey for each question/statement

Q.1.	58	Q.6.	53	Q.11.	31	Q.16.	51
Q.2.	38	Q.7.	65	Q.12.	77	Q.17.	56
Q.3.	88	Q.8.	52	Q.13.	65	Q.18.	51
Q.4.	62	Q.9.	58	Q.14.	60	Q.19.	48
Q.5.	26	Q.10.	39	Q.15.	34	Q.20.	38

The scores for each question were calculated by summing up the products, for each answer, between the percentage of the total of the respective answer and its attributed score. For example, in the case of question 1 (see data in table above), the resulting score of the question is:

$$6,3\%*0 + 6,3\%*30 + 56,3\%*100 + 0\%*0 + 6,3\%*0 + 25\%*0 = 58 \quad (3)$$

Next, the table below shows the scores obtained from the survey, for each component and the final result, the value of the Composite Innovation Index:

Table 9. The Composite Innovation Index for the Romanian banking sector

CII = the Composite Innovation Index			
Component dimensions:	Weight of importance:	Dimension score:	
1. Openness towards innovation	0,10	63	corresponding questions: 3, 7, 8, 12, 14, 18, 19
2. The proactive research and knowledge of innovative trends in the field of activity	0,10	54	corresponding questions: 1, 2, 7, 8, 9, 17
3. Keeping up with innovation according to established trends	0,10	60	corresponding questions: 4, 6, 13
4. The percentage of the annual variation of total asset value, invested in innovative R&D and/or implementation of innovations	0,20	38	corresponding questions: 20
5. The comprehensive approach of innovation	0,20	51	corresponding questions: 16
6. Innovation leadership: creating new innovations in the field of activity and/or proactively implementing prototypes	0,30	36	corresponding questions: 5, 10, 11, 15, 19
CII of Romanian banking industry =		46	

The score of each component dimension of the index is the arithmetic mean of the questions that survey that dimension. Finally, the aggregation calculation resulting in the value of the Composite Innovation Index of banking services in Romania is the weighted average (with the importance weights) of the scores obtained for each component dimension:

$$CII = 63 \cdot 0,10 + 54 \cdot 0,10 + 60 \cdot 0,10 + 38 \cdot 0,20 + 51 \cdot 0,20 + 36 \cdot 0,30 = 46 \quad (4)$$

6. RESULTS AND CONCLUSION

So, the Composite Innovation Index of banking services in Romania, resulting from the survey, has the value of 46 out of the maximum possible of 100, respectively a slightly below-average level of involvement/proactivity in the innovation phenomenon, in the specific field of activity. Taking into account the fact that the innovation leadership standards set by the questionnaire were rather of the order of avant-garde, respectively of assuming disruptive innovations in the field, the low value of the index does not necessarily highly specific to the Romanian banking sector. Even globally, the banking system does not yet relate very proactively to the blockchain phenomenon, so if we used the same questionnaire to survey the banking industry of any other country, especially developed countries such as those of Western Europe or North America, it could be assumed that a maximum CII value of around 60 would be registered. Even in countries with innovation-leading banks that could already be involved in research, design and implementation of blockchain-based business

models, at industry level, it is safe to assume that the index would not go far beyond an average reading, taking into account that the level of interest in blockchain-based innovation is still low, given its profoundly disruptive nature in relation to traditional banking business models.

Analyzing the dimension scores, we can see that the highest values were registered for "Openness to innovation" and "Keeping up with innovation trends". We can therefore deduce that Romanian banks are, on one hand, open to the idea of innovation, but on the other, they are not proactive in becoming innovation leaders, rather being followers of innovations transferred from their parent groups from abroad. The dimension of "Proactive research and knowledge of innovation trends" also scored above average. Thus, it is notable that the highest scores were registered for the dimensions of importance category C (with the lowest weight in the aggregation), while "Leadership in innovation" and "Percentage of annual asset growth invested in innovative" recorded the lowest scores. Therefore, Romanian banks do not seem to invest enough in innovation. Although there are 34 banking institutions in Romania, out of these, according to the 2019 Annual Report of the National Bank of Romania, 7 of them, branches of foreign banking groups, controlled almost three quarters (73.6%) of all net banking assets in the country. Also according to NBR data, in 2020, in spite of the market-share hierarchy of banks in Romania having changed in favor of local banks, a number of 5 branches of international groups still controlled about half of the national market. Thus, if we take into account this oligopolistic structure of the Romanian banking system, based on branches of groups with foreign capital, we can deduce the context of the lack of sufficient vectors of competition based on innovation at the local level.

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