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Chaos Theory And Accounting Process

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Abstract

The financial reporting process has a chaotic structure due to the complexity it contains. The root cause of this chaotic structure in the accounting process system stems from the dynamics of data flows. While recording financial events, the accounting system uses different account codes, and in doing so, processes the data flow at different points in time into the relevant account codes within a certain systematic framework. The existence of the connections required by accounting theory between these account codes brings the process of recording each financial event to a chaotic structure, where an insignificant variable in the initial conditions of the process leads to unpredictable results in the final analysis, for the practitioners of the accounting profession. In this study, an approach to the accounting process is developed from the framework of chaos theory and an attempt is made to create a theoretical basis for the complexity of the accounting process for possible future academic research.

Keywords : Chaos Theory , Fractal Image, Accounting System, Financial Reporting

1. INTRODUCTION

The neo-classical finance approach, which models the economic behavior of businesses and individuals as micro units, is criticized for its basic assumptions. These deficiencies and shortcomings in explaining the structure of the decision mechanisms of businesses and individuals make it difficult for decision makers to adapt to the dynamic structure of the economic and social conditions in which they operate. Zakeri, Yazdani and Zare (2016) propose the use of chaos theory as a new method that can reduce the risks posed by unpredictable changes in markets or help managers manage these dynamic risks in order to allow managers to understand dynamic financial behavior. Juarez (2016) aims to create interest in viewing financial statements as a complex information system. Based on the fact that although chaos theory is widely used in the field of finance, it is rarely discussed in the context of financial statements, in his study, the analytical possibilities of chaos theory in the analysis of financial statements are examined. claims that it can be used to provide

Considering the dynamics of organizational structures as a projection of business activities, the structure of management accounting applications that compile information from all departments within the organizational structures of businesses and produce information for all

departments stands out. As a result, this requires the accounting function to interact with all other business functions. Based on the fact that management accounting has become an eclectic discipline, Tse and Robb (1994) resort to a wide variety of methodologies such as statistical analysis and evaluation of probabilities to help solve problems. His research on the application of dynamic systems theory as a tool to explain cost behavior in the context of standard costing is particularly noteworthy in this context. Chaos theory states that unpredictability increases in the long term. If such a situation is valid, an organization that can shift the decision-making process away from the long term and towards the current period, since the state of a process and environmental factors are stable in the short term, can control the negative effects of Chaos theory (Brimson, 2011; 94-95). In their study where they applied chaos theory to bankruptcy prediction, Lindsay and Campbell (1996) found that, based on the fact that healthy businesses exhibit more chaos than unhealthy ones, the returns of firms approaching bankruptcy exhibit less chaos when compared to firms in the earlier period. Abbaszadeh, Nooghabi, and Rounaghi (2020) point out the increasing interest in the application of econophysics methods to problems in the fields of finance and economics in recent years, and emphasize the importance of chaos and its applications for current financial and economic events. They test the existence of chaotic behavior by applying the Lyapunov method on companies traded on the Tehran stock exchange. They prove the existence of multiple fractal phases in the evolution of stock prices. In order to determine the relationships between the indicators of the financial statements, the Lorenz equation was applied to the cash flow, profit and loss and assets of 70 enterprises operating in the crude oil mining and natural gas sector, and as a result, the variance explained in the linear regression between the new complex indicators was 73 percent. However, it has also been stated that these transformations make the interpretation of financial indicators difficult (Juarez, 2011).

This study discusses the applicability of chaos theory in the context of financial reporting. For this purpose, the unique value of the article is to showcase the chaos in financial reporting processes. By analyzing the complexity of companies' financial reporting processes, a unique theoretical basis will be built for future multidisciplinary studies that will examine accounting practices within the framework of chaos theory.

2. LITERATURE REVIEW

The Chaos Theory developed by Lorenz and the work of Mandelbrot have become the subject of interdisciplinary research in various fields. While Chaos Theory's most comprehensive applications are in physics and biology, studies have also been conducted and continue in other diverse fields such as medicine, psychology, economics, finance, and social sciences. In a study conducted by Yılmaz (2017), Doppler flow signals obtained using the Doppler technique were evaluated using chaotic analysis methods to examine the chaotic behavior of blood flow in diseased vessels. Statistical tests applied to the results obtained from chaotic analyses revealed significant differences between healthy and diseased conditions. According to this study, the chaotic structure of blood flow in diseased conditions was determined using the largest Lyapunov exponent and the Grassberger-Procaccia algorithm, demonstrating that chaos theory analysis methods provide effective and useful results in detecting vascular diseases. In Juárez's (2016) study, analytical possibilities of Chaos Theory in financial statements were explained

through chaos theory method analyses. The adaptability of Chaos Theory to accounting equations was presented using equations. Various models of Chaos Theory were used to analyze financial statements and ratios, explaining the possibilities of Chaos Theory in this context. Etheridge, Harlen, and Ram (1993) suggested in their study that Chaos Theory could provide various statistical and modeling techniques for accounting researchers. Sivakumar (2004) provided a comprehensive explanation of the successes and current state of Chaos Theory in geophysics, emphasizing the importance of chaos research in geophysics in terms of its current status and future improvement potential. Murphy (1996) explained the basic tenets of chaos theory and discussed its application in modeling public relations situations, crisis management, stakeholder development, crises, and rumors. Klioutchnikov, Sigova, and Beizerov (2017) attempted to explain some situations related to the possibility of using chaos theory in finance, describing the prediction and probabilities of fractal structures in macro and micro-level processes with specific methods and tools. Ayers (1997) discussed the challenges of applying Chaos Theory and, based on results regarding the utility of chaos in psychology, evaluated the application of chaos theory in psychology. In Terzi's (2023) study, the validity of chaos theory in ceramic art and contemporary art was examined. The study investigated how chaos theory, in connection with the formation of artistic works, influences the outcome based on factors and parameters.

3. CONCEPTUAL FRAMEWORK

3.1. Chaos Theory And It's Mechanics

While it is considered impossible for "chaos and order" to be in the same place, scientifically, Chaos Theory is a hidden order underlying seemingly disordered complexity. It can be called complex systems where order is created by disorder or where order creates disorder. These complex systems are systems that renew themselves and change over time. The fact that the variables in the system change over time and are dynamic is the field of study of chaos theory.

Although classical physicists and scientists in the field of mathematics have worked on disorder and dynamic systems, the first serious steps of chaos theory were taken with the work of the French mathematician Jules Henri Poincaré (Kendirli, 2006:172 cited in Latif, 2002:126). In his book "Science and Method", Poincaré said the following:

> *A very small cause, overlooked by us, can lead to a huge effect that we cannot ignore, and then we say that this effect is due to chance. If we knew exactly the laws of nature and the state of the universe at the starting point, we could predict the occurrence of the same situation in the same universe at the next moment, but even if we have reached a point where the laws of nature have no more secrets to hide from us, we can only know the situation approximately. If it allows us to predict the next situation within the same limits of approximation, that is enough for us; then we can say that the phenomenon is predictable and governed by laws. But this is not always the case; small differences in the initial conditions can lead to very large differences in the final phenomenon. A small error in the first will lead to an enormous error in the second. Prediction becomes impossible....(Gleick,2018:28 cited in Poincaré:1854)*

In terms of chaos theory, dynamical systems are divided into linear and nonlinear systems. The most prominent feature of chaotic systems is the study of nonlinear systems.

"Dynamical Systems and Chaos Theory is a theory that states that small adjustments to complex systems, which are generally non-linear, can lead to major changes in the future" (Kendirli, 2006:172). Although linear systems always produce an output proportional to the input, the system exhibits unpredictable behavior due to the complex structure of chaotic systems. In chaotic systems, there is not always a proportion between input and output, they do not react to the same input in the same way. Therefore, nonlinear equations are used to calculate the behavior of such dynamic systems (Canan, 2018:188).

Although Poincaré took the first steps in the name of chaos theory with his precision in dynamic systems and initial conditions, the building blocks of chaos theory were formed with the work of mathematician Edward Lorenz, who worked on meteorology. As Gleick (2018) mentions in his book "Chaos", in 1961 Lorenz reduced weather forecasts to the simplest form with numbers and codes. On the function model he created on the primitive computers of that day, he was observing the results of weather forecasting by making the repetitions of the functions input to the computer. Lorenz, who wanted to analyze a long series of records, instead of examining the entire record from beginning to end, he took a shortcut and tried to interrupt the process and enter one of the intermediate values given by the machine into the computer as the initial values. While the data he entered was expected to be a repetition of the old sequence, Lorenz encountered an unexpected result. Although the initial values were almost identical, the result was very different. Instead of entering only six digits after the comma (.506127) in the intermediate value, Lorenz had entered three digits (.506) as rounding. The weather was diverging so rapidly from the breakdown in the previous figure that within a few months all resemblance had disappeared. In order to examine more closely the divergence of the two weather charts shown in figure 1 below, Lorenz superimposed the two outputs and observed that the similarity disappeared completely. Lorenz's fortuitous result proved that small errors in Poincaré's system of equations could lead to big results.

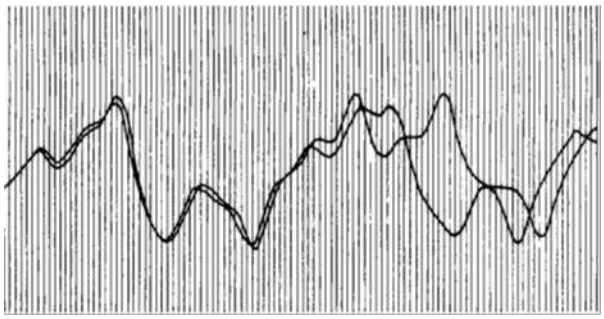

Figure 1. Lorenz's Weather Forecast
Source: Gleick,2018

Lorenz's seemingly insignificant mistake showed that small changes in initial conditions could cause large differences after a short period of time, i.e. "the flapping of a butterfly's wings"

could cause a storm. As a result of his studies, Lorenz demonstrated for the first time in his 1963 paper that the weather forecasting models used at the time were faulty and that the initial conditions could not be known (Lorenz, 1963).With the three-variable "Lorenz system model" created by Lorenz, the first strange attractor image resembling butterfly wings in three-dimensional space, shown in Figure 2 below, emerged. The figure reveals a delicate structure hidden in an irregular flow of data. The resulting image reveals a kind of infinite complexity, the system always staying within certain limits and never repeating itself. It has a strange, idiosyncratic three-dimensional structure, like a butterfly with two wings. With no repeating points or patterns, the shape suggested pure disorder. It also pointed to a new kind of order (Gleick, 2018:44-45).

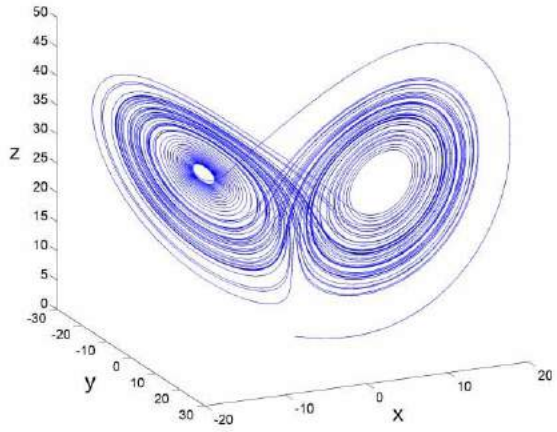

Figure 2. Lorenz Hammer
Source: https://www.kozmikanafor.com/kaos-ve-kaos-teorisi

The concept of the "Butterfly Effect", which has been the subject of many movies and books and has become a phenomenon, was first used when Lorenz, as stated in his book "The Essence of Chaos" (1993), wrote "Does the flap of a butterfly's wings in Brazil set off a tornado in Texas?" as the title of the presentation he attended in Washington in 1972.

Lorenz's "Lorenz attractor" has been the subject of interdisciplinary studies and many attractors similar to Lorenz's attractor have emerged (see Julia and Mandelbrot sets). Gravers are formed by iteration. These iterations give rise to fractals. Iterations of attractors have opened new fields in mathematics and the subject of fractals has emerged. While we could not fully express nature with Euclidean geometry, the formation of fractal geometry played a major role in our mathematical definition of nature. When a snowflake is magnified, it is possible to see fractalization and no two snowflakes are the same. To explain this situation with the butterfly effect; there is such a micro-level change in the initial conditions that the iterations of the fractals forming the snowflake make each one different (Balcıoğlu, 2017: 34-35).

Fractal Geometry has not only helped us to recognize nature, but has also shown significant effects on different fields such as physics, physiology and finance. "Fractal Geometry", which we can call an image, shape and dimension of Chaos Theory, was first introduced by Polish-born mathematician Beneoit B. Mandelbrot in 1975, leading to the birth of a new geometry

system. The word "fractal" first appeared in the literature in 1977 with Mandelbrot's book 'The Fractal Geometry of Nature'. Mandelbrot argued that describing nature with Euclidean geometry would not yield accurate results. Because, as Mandelbrot put it, "Clouds are not spheres, mountains are not cones, coasts are not circles, bark is not smooth and lightning does not move in a straight line. More generally, he claimed that many models of nature are very irregular" (Mandelbrot, 1977:1).

As Kılıç (2010) states, Fractal Geometry examines the shapes formed by simple geometric rules repeating themselves in the universe. The parts or components that make up an object similar to itself follow the whole of the object. Details and patterns that appear to be irregular are repeated at smaller and smaller scales with the help of iterations (mathematical repetition) and can be continued indefinitely in abstract objects. Or, vice versa, when magnified at a certain scale, the patterns and components of the object in abstract dimensions will resemble the whole object while approaching infinity. The structure of some plants that can be seen in nature, such as ferns, cauliflower and broccoli, is fractal.

One of the important features of fractal geometry is that it can be used in many fields. For example, it can be used in length measurements of the British coast, in fluctuations in cotton prices, in mathematical description of nature, in geometric expression of the formation of clouds and rocks, in the formation of the earth's crust or forests, in human physiology, in the study of a wide variety of systems ranging from blood flow in veins to air currents (Uçar, 2010:41).

In addition to trying to explain irregular structures and nature with fractal geometry, the mathematical scientist Mandelbrot was also interested in economics and studied large and small distributions in the economy. As Gleick (2018) mentions in his book "Chaos", Mandelbrot had accessed an average of sixty years of cotton price data and analyzed it on IBM computers and reached the astonishing results he expected from his studies. The numbers, which deviated from the normal distribution, were symmetrical from the scaling point of view. Specifically, every price change was random and unpredictable, but it was also independent of the scale at which it occurred. Mandelbrot found a perfect correspondence between the daily price change curves and the monthly price change curves, finding an unexpected kind of order in the most irregular mass of data (Gleick, 2018:107). As a result of the similarity he saw, Mandelbrot made a connection between economics, finance and fractal geometry and laid the foundations of his work. In financial markets, he brought new methods to many studies such as the prediction of share price returns, the change of exchange rates, and the prediction of economic crises.

The Chaos Theory, of which Lorenz was the building block, and Mandelbrot's work have caused a butterfly effect in the world of science. Today, Chaos Theory, the new paradigm of science, attracts great interest from scientists all over the world as an interdisciplinary research field. In addition to physics and weather forecasting, studies continue in many fields. In terms of complex, dynamic and nonlinear systems, it enables important studies in social sciences.

4.METHODOLOGY

In this study, the complexity within accounting application processes is analyzed to establish the theoretical framework of the chaotic structure in accounting systems within the framework of chaos theory. To discuss the hidden order in the accounting process, this qualitative study

will be analyzed through descriptive and interpretative methods under two main titles: "Sensitive Dependence on Initial Conditions in Accounting System" and "Fractal Image in the Accounting System." The goal is to create a theoretical framework for the chaotic structure in accounting systems through an examination of these two aspects using descriptive and interpretative methods.

4.1. Accounting System And Sensitive Adherence To Initıal Conditions

Accounting starts with the collection and classification of data and documents related to economic information about financial events. The classified documents are recorded in legal books and form financial statements. The analyzed financial statements are interpreted by managers and information users, and accounting, which provides effective information for decision-making, is a science, profession and art. When we look at the general definitions of accounting, it is stated that accounting is a "classification system". Classification of documents, process and recording, summarizing and reporting operations constitute the accounting system and the skeleton of classification. The classification process, which is more than a mechanical process, depends on the classification methods at each stage of the process to transmit the reports that occur in the accounting formation process to the information users (Akdoğan and Aydın, 1987: 20-37). The recording process that occurs with financial events, which is an important element of accounting, instantaneous, daily and the duration of these transactions constitute financial values. In the formation of the relevant tables, the classification and recording of financial documents can be considered as the repetition of instant, daily, weekly, monthly transactions. In the accounting process shown in Figure 3, the enterprises that bring financial events into being firstly create the order in the complexity by sorting and recording the documents corresponding to complex financial values.

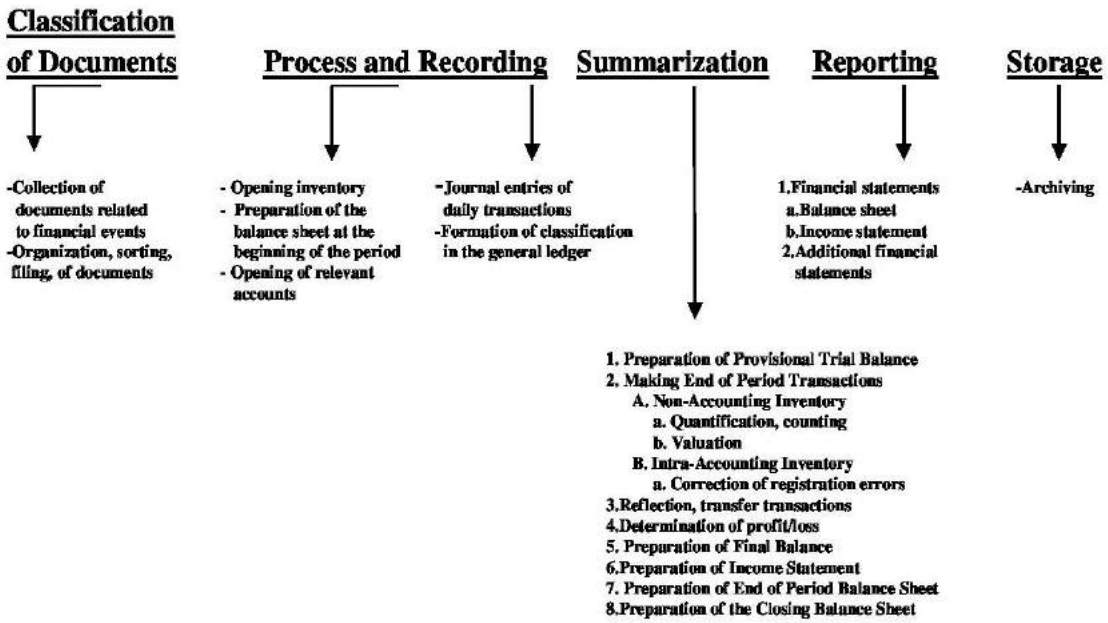

Figure 3 . Accounting Process System
Source: The figure was drawn by the authors.

The accounting process system shown in Figure 3 above attempts to bring order to the complexity of financial events. In order to talk about the hidden order in the accounting process, the attractors of the dynamic process, the equilibrium points and the transition times to chaos must first be determined. It is necessary to observe the transitions of the system from a regular structure to an irregular structure and then back to a regular structure with equilibrium points.

As Uçar (2010) states in his thesis, 'attractors', another important concept of Chaos Theory, are the managers of dynamic systems. To give an example of equilibrium point and attractors, we can talk about a pendulum in oscillation. In the frictionless environment shown in Figure 4, the pendulum is periodically moving to the right and left while oscillating, while being pulled to the center, the equilibrium point, over periods. The motion of the pendulum has two parameters. These are position and velocity. When these two parameters are expressed in the analytical coordinate plane, a self-repeating circle is formed in the frictionless medium as shown in Figure 5.

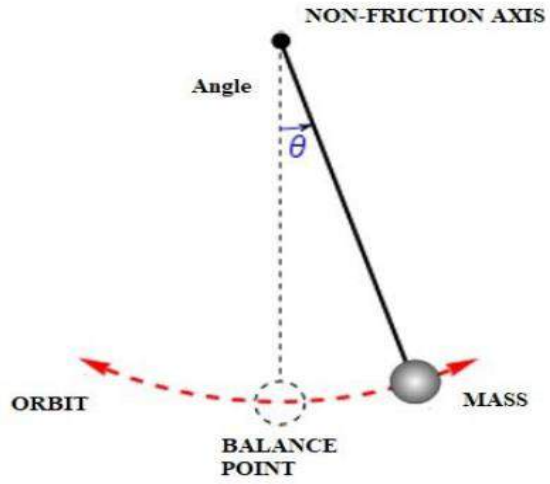

Figure 4: Simple Pendulum
Source: Uçar,2010

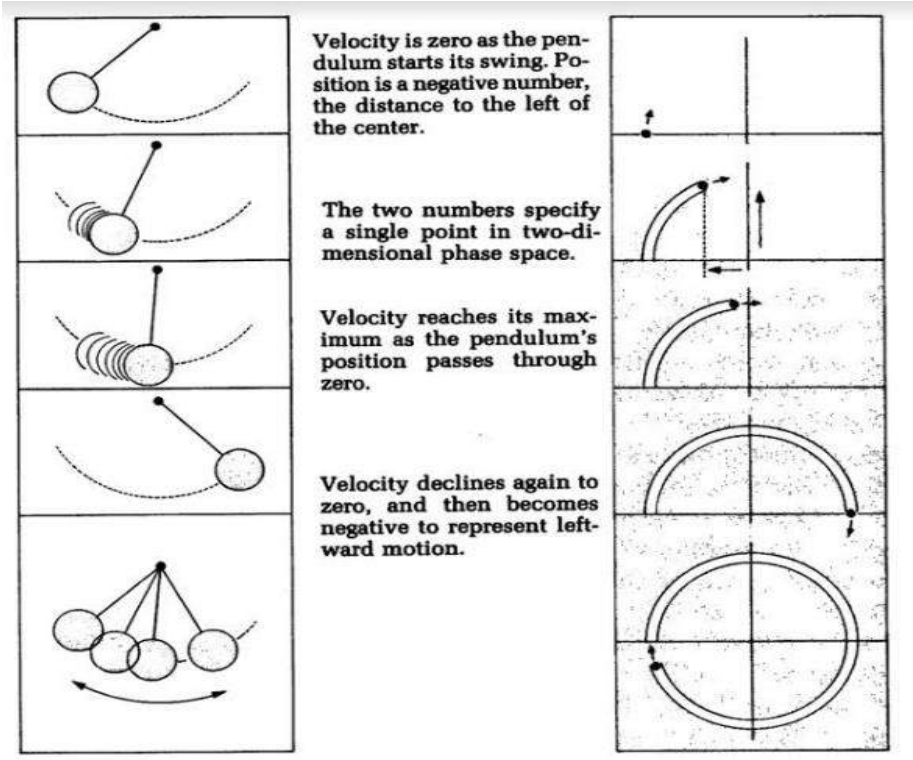

Figure 5. Position-Speed Graph of a Pendulum
Source: Gleick,2018

When we examine a pendulum in a frictional environment shown in Figure 6 below, all circular motions in the analytical coordinate plane are pulled towards the central point where there is no motion and eventually the pendulum stops. A pendulum, which is constantly losing energy due to friction, starts to slow down its speed by making spiral movements to the equilibrium point, representing the steady state, and is pulled from the steady state to the equilibrium point. This point is called the "equilibrium point". The equilibrium point is described as the pulling point of this system. Even if the initial conditions of the pendulum change, the pendulum will be pulled to the equilibrium position and this point is the attractor of the system. It is certain and predictable that the pendulum will stop at the equilibrium point due to friction, no matter how much the initial conditions regarding the pendulum's oscillation speed are changed. The pendulum in both oscillations exhibits completely predictable behavior. In other words, these two dynamic systems exhibit predictable behavior and are linear systems, not chaotic. While a small change in the initial conditions of non-chaotic systems grows linearly over time and leads to another change and is predictable, a small change in chaotic systems grows exponentially and can have an unpredictably large effect on the system. In nonlinear chaotic systems, more than one equilibrium state occurs. It may be difficult to determine which equilibrium state the initial conditions will create (Uçar, 2010:44-52).

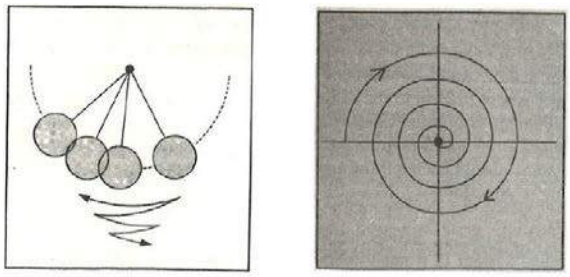

Figure 6. Pendulum in a Frictional Environment
Source: Gleick,2018

As explained above, we can say that checks in chaotic systems are multiple equilibrium points that occur in order for the movement of the system to remain on a long-term trajectory. In this context, in order to see the equilibrium points and the resulting attractors in the accounting process system, we need to decompose it into certain periods. In Figure 7 below, the accounting process system is decomposed into monthly, quarterly and one-year periods in order to find traces of chaos theory.

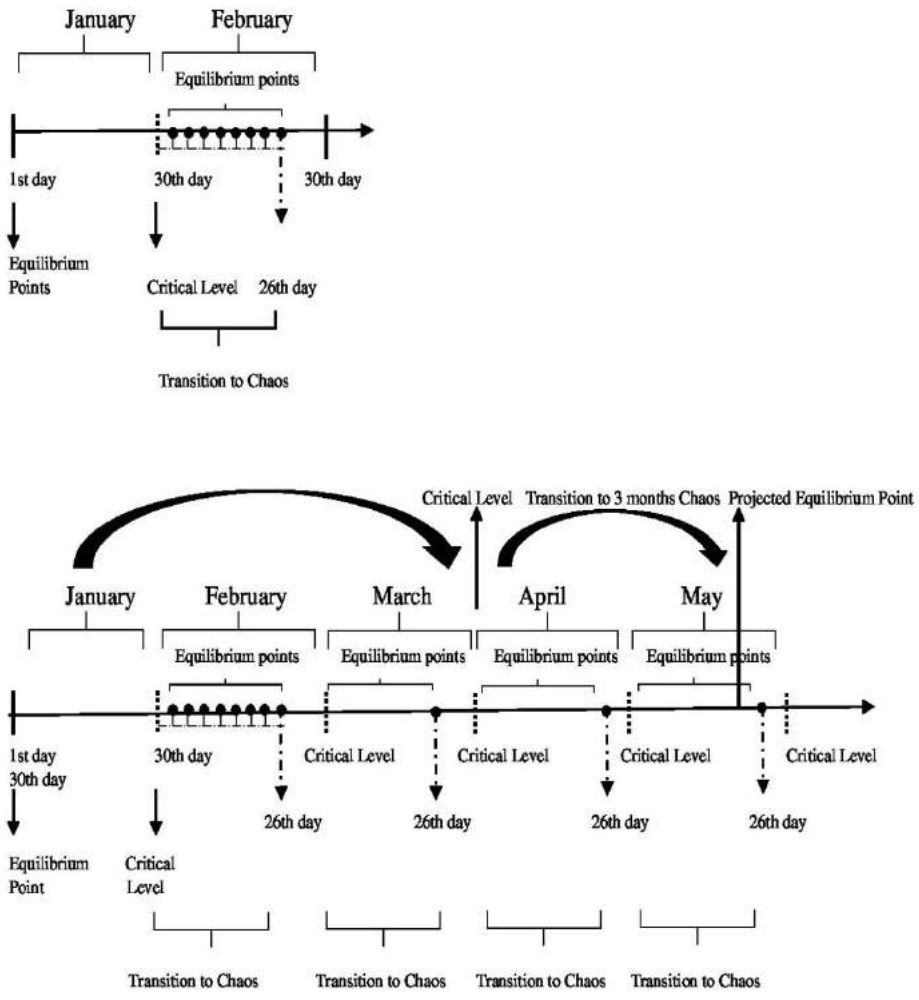

Figure 7. Chaotic Structure in the Accounting System
Source: The figure was drawn by the authors.

The balance point, the starting point, of an operating business is the 1st day of January. As financial events continue to occur, official documents are created and payment instruments begin to operate. The financial values created by financial events are recorded through the uniform chart of accounts and irregular data flows are constantly tried to be regularized. As financial events do not occur and time continues to pass, the system will constantly try to pull itself back to the equilibrium at the determined starting point, and the data generated will only remain in equilibrium like a linear system. But a business that continues its life is a non-linear dynamic system. As financial events occur in a business that continues its financial activity, the system will begin to move away from the equilibrium point, and by following the accounting process shown in Figure 3 above, the data will be tried to be brought from an irregular state to a continuous regular state.

The system first organizes the classification of the documents generated by financial events and ensures that the records are made in the daily journal within the framework of the uniform chart of accounts with the recording element, which is the important element of accounting. As it starts to move away from the equilibrium point, the system continues its operations as a continuation of the documents it records and files, and tries to organize the complex data flows that are constantly coming in.

With the collection of financial data arising from one month's worth of financial situations and their duration, the system will start to shift from a regular to a disorderly structure. This is called the "critical level" point following the 1st month shown in Figure 7 above. In the accounting processes of the enterprises, it is necessary to calculate the taxes related to the procedures and principles determined by the Turkish Tax system and to submit declarations electronically against the earnings obtained every month and in certain periods due to tax responsibility. The "critical levels" and "balance points" in the figure above have been established in this context. The financial data of the previous month are declared on certain dates of the following month. Classification of data arising from financial events in a month period, recording of documents, recording of all kinds of financial events that may occur within the enterprise continue instantaneously and daily. While these transactions continue, controls will be started to be made for tax calculations to be determined in the following month and for the determination of missing and erroneous events in the complex data flow in the previous month. On the one hand, while the controls of the previous month are carried out, on the other hand, instant transactions continue. The critical level point during this period may vary.

The complex process of reconciliations and checks of the previous month's data, and the process of correcting identified errors, transforms the system from an orderly to an irregular structure. In other words, the system starts to become chaotic. The processes after the end of each month shown in Figure 7 above are called "Transition to Chaos". The process of preparing the declarations behaves like a balance point that constantly pulls the system into itself. The system will try to pull itself back to the equilibrium point with the completion of the previous month's controls, reconciliations, entry of payment instruments, personnel salary calculations and notifications, payments, etc. and the declarations and notifications given according to the procedures of the Turkish Tax system. The period between the beginning of each new month, the checks of the financial data of the previous month and the preparation of the declarations

causes the system to suddenly become chaotic and the system is in chaos in this process. And as mentioned above, like a swinging pendulum, the system will constantly try to keep itself in balance. We can call the control of financial data as the system's tractor. The controls of past financial data and on the one hand, the classification and recording of data flows in ongoing financial events, etc. make the system more complex. In this context, critical levels and balance points in the system are difficult to predict.

Critical levels occur in the monthly ongoing accounting process. As the accounting system tries to streamline the complex data flows arising from financial events, the system reaches the critical level point and passes into chaos. The chaotic system starts to be drawn to the equilibrium point with the process of accounting and the structure will start to become regular again. In the tax calculations based on the profit calculated in quarterly financial periods, the quarterly periods become clear in the second month. The equilibrium points and transition points to chaos in the accounting process in the linear plane shown in Figure 7 above appear to have increased. While the monthly transactions and the process of continuously trying to transition to a regular structure continue, the checks and calculations of the data generated in January, February and March begin. Until the formation of the monthly, quarterly and one-year financial calendar, the accounting process tries to control the system and report accurately. More than one critical level occurs in the system and while the system is trying to be organized, it goes back to a disorganized structure. When the transactions are completed in the financial calendar process of one year, the accounting system temporarily organizes the system in the chaos caused by financial events. When we examine a calendar year, which is a cross-section of the lives of businesses, we can foresee the hidden order in the complexity of the accounting process.

While the accounting process tries to streamline the complexity of data flows, small mistakes can have big consequences. The variables in the monetary movements of the enterprises correspond to the use of different account codes and it is possible to make erroneous records due to the heterogeneity and excess of daily transactions. As a result of the recorded data, it is possible that the declarations sent electronically are sent incorrectly. The biggest risk of the profession is to face fines for very small mistakes, and from the perspective of chaos theory, a very small variable in the initial conditions can lead to major consequences. We can say that the interconnectedness of the accounts created by the accounting records actually creates the initial conditions in every process, as each transaction cannot be deduced from the previous situation, so we can say that it shows sensitive dependence on the initial conditions.

4.2. Fractal Image In The Accounting System

Chaos Theory tries to see order in complex and irregular structures. The components that make up these complex and irregular structures are dissimilar and different, but are formed by iteration. These structures that seem to repeat each other create a picture, and this image is called the picture of chaos, fractals. As we have mentioned in other chapters, fractal geometry is the study of self-repeating behavior and shapes. Small components that appear to be irregular go on forever with the iteration method, while a small part in detail shows the whole of the object. Or, conversely, when looking at the whole object, which is composed of seemingly

repetitive components, the pattern of the small component in the detail is formed. Fractals, which are images of complex structures formed by irregularity, show sensitive dependence on initial conditions.

The accounting process system, which is sensitively dependent on initial conditions and constantly tries to bring the system into balance, tries to create the hidden order in the complex structure by repeating financial events. While the irregularity and complex structure in the financial events created by the enterprises are tried to be balanced by the accounting process system, a picture, a fractal image emerges, as shown in Figure 8 below.

As financial events occur, data and documents are first sorted and recorded in the journal. This situation, which forms part of the accounting process system, is instantaneous, daily, monthly, quarterly and annually recurring. Although the continuity of instantaneous transactions creates a process such as repeated, each financial event consists of a heterogeneous structure and different situations. Although the instantaneous transactions in the accounting process system seem to repeat each other as an image, the transactions in the financial events experienced are different from each other. Situations such as the creation of financial events by enterprises, follow-up of collection processes, profit or loss, are linked to market conditions and the performance of enterprises, but are constantly changing within themselves. These variations within the accounting system itself are the structure that creates chaos in accounting. This complex system, which is formed by the structure that varies due to financial events and the constant balancing of the accounting process system, is a chaotic structure. This chaotic structure is an unpredictable non-linear system. Non-linear dynamic systems do not repeat each other and try to create more than one equilibrium point. As the system constantly tries to pull itself to a point, it may exhibit behaviors similar to the previous equilibrium point. Although chaotic structures do not repeat themselves, they form a cycle as the system tries to pull itself to an equilibrium point. The beginning of each cycle is also the beginning of chaos. As the process continues, multiple equilibrium points are formed. There are as many cycles as there are equilibrium points. Although the system creates an irregular structure within itself, each cycle that occurs with the formation of equilibrium points creates attractors. The re-formation of the cycles formed in the irregular structure shows the fractal image in the chaos process.

The accounting process system consists of instantaneous events, daily transactions, monthly reports with the repetition of daily transactions, reporting of quarterly transactions with the balancing of monthly transactions, and financial events consisting of quarterly periods constitute the annual financial data of an enterprise. Financial events, which consist of different components in themselves, look similar to each other when we look at the annual accounting process system. We can say that the continuity of instantaneous transactions creates a yearly reporting period and the transactions of the enterprises every year show a pattern from the lives of the enterprises.

Figure 8 below illustrates the chaotic structure of the accounting process system in the linear plane. When the images of different cross-sections of monthly transactions are examined, they show similarities such as repetition of each other in the linear plane. When the cross-sections of the accounting process system in the quarterly period formed by monthly transactions are taken

from different periods or for different years, it is seen that a similar image emerges again. When we take different monthly, quarterly or annual cross-sections of businesses that continue their lives for more than one year, the image of a system that repeats each other with the formation of different events in the accounting process system shows us the image of the fractal structure. While the instant transactions, which are the small component of the accounting process system, give the image of the transactions made in a month, a fractal image is formed when the pattern of quarterly transactions is similar to the image of one-year transactions.

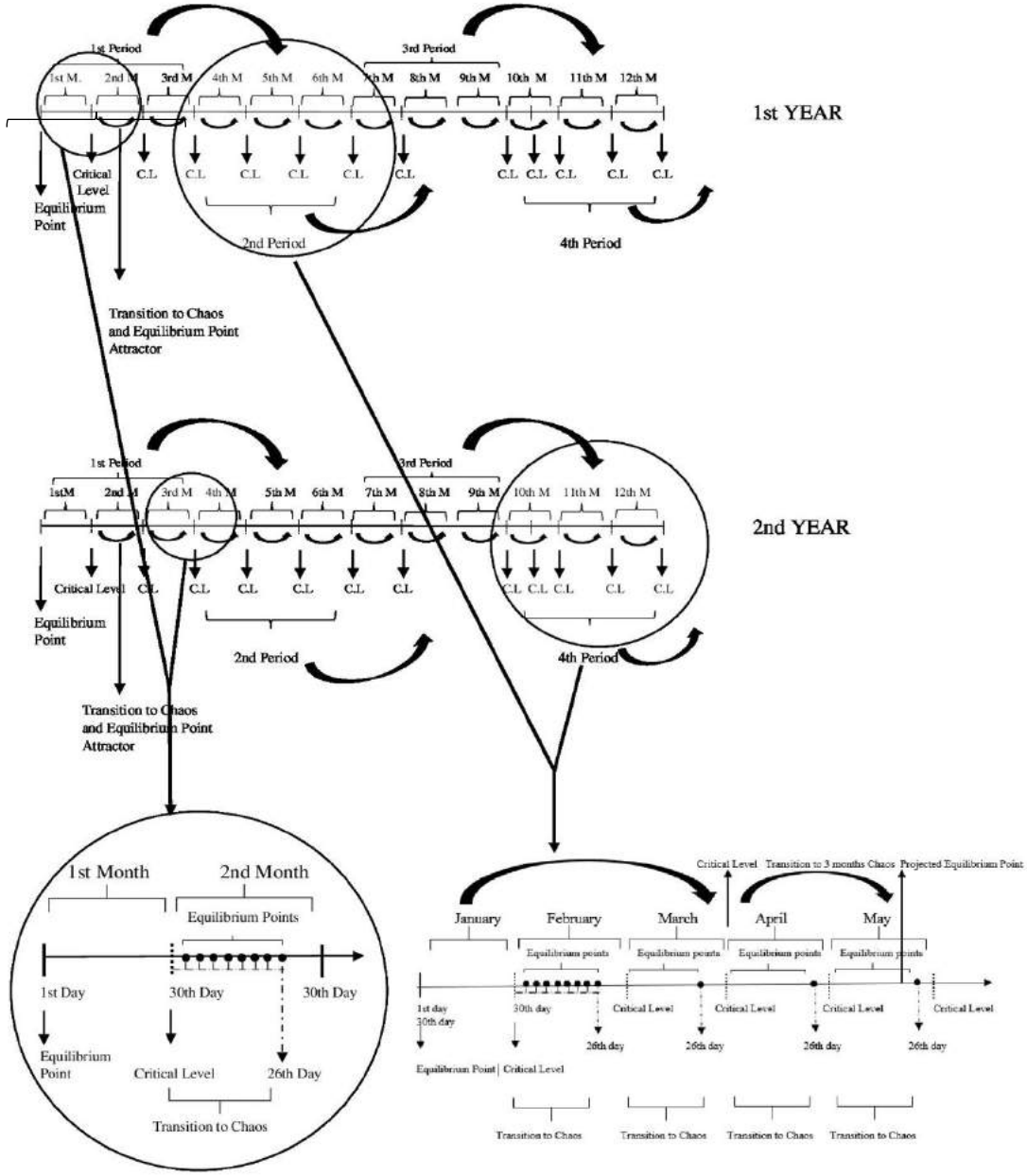

Figure 8. Chaotic Structure and Fractal Image in Accounting System
Source: The figure was drawn by the authors.

Businesses need accounting process systems to continue their economic activities. Even when cross-sections of the accounting process systems on an instantaneous, daily, monthly, quarterly and annual basis are taken randomly, fractal images emerge as in Figure 8 above.

5.CONCLUSION

The order, whether formed by disorder or creating disorder itself in complex systems, is a dynamic, self-renewing system that evolves over time. The mechanics of chaos theory are constituted by the dynamic nature of variables changing over time within the system. In this study, the accounting process system, which is a dynamic process of financial reporting and has a complex, heterogeneous structure within itself, is theoretically examined due to exhibiting similar characteristics to chaotic structures in chaos theory.

Due to the complex structure of chaotic systems, outputs in nonlinear systems are not proportional to inputs, and the system exhibits unpredictable behaviors. The accounting process system, while attempting to organize the complexity in data flows, can lead to significant consequences due to small errors made by those recording the data. Variables in the financial transactions of businesses correspond to the use of different account codes. From this perspective, the heterogeneous nature of daily financial transactions and the high volume of transactions make the occurrence of erroneous records likely. As a result of recorded data, there may be situations where electronic declarations are sent with errors. Encountering financial penalties due to very small errors constitutes the greatest risk factor in the practice of the accounting profession. From the perspective of chaos theory, a very small variable of negligible nature in initial conditions can lead to large and unpredictable results. Since the accounts created by accounting records are interconnected, each transaction cannot be subtracted from the previous state, and it is observed as a phenomenon that, in each process, establishes the initial conditions and therefore exhibits sensitive dependence on initial conditions. The accounting process system, with its sensitivity to initial conditions and continuous efforts to balance the system, attempts to create hidden order in the complex structure through the repetition of financial events. While trying to balance the irregularities and complex structure in financial events that arise during the activities of businesses, an intricate fractal pattern emerges, as shown in Figure 8.

Dynamic Systems and Chaos Theory is a theory that generally states that small changes made in nonlinear complex systems can lead to significant changes in the future (Kendirli, 2006:172). While linear systems always result in an output proportional to the input, chaotic systems, due to their complex structure, can exhibit unpredictable behavior. Therefore, the emerging pattern indicates a kind of infinite complexity, with the system always staying within certain limits and never repeating itself. From this perspective, the accounting process is followed, and data is continuously attempted to be organized from an irregular state to a regular state. When the operations in the financial calendar year, taken as a basis, are completed, the accounting system temporarily organizes the system created by financial events in chaos. When a segment of the life of businesses is examined in a financial calendar year, the hidden order in the complexity of the accounting process is predictably qualitative. Although the instant transactions in the accounting process system may appear as repetitions, the financial events differ from each other. Events such as the creation of financial events by businesses, the tracking of collection

processes, and the occurrence of profit or loss are connected to market conditions and the performance of businesses, and they exhibit continuous variability within themselves. The variability within the accounting system is the structure that creates chaos in accounting. In conclusion, in this study, when a financial calendar year is considered in the context of financial reporting, observable chaotic dynamics are demonstrated in accounting practices. By using primary data on chaos theory and the accounting process, a theoretical basis is provided for future academic research on where to look for chaotic elements in the accounting process.

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Assessing The Evolution of Fintech Adoption In Traditional Banking: A Bibliometric Analysis Using R

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Abstract

The purpose to find scientific research publications of Fintech (financial technology) applications in banking institutions in the areas of artificial intelligence, machine learning, blockchain, and big data. The methodology includes bibliometric analysis in the scientific literature of Fintech application in banking institutions. The data of this study comprises relevant articles obtained from the Scopus database from 2016- 2022 using the RStudio programming. Results show the remarkable rise of scientific publications in Fintech after 2019, mainly in the fields of crowdfunding, digital finance, payment system. The two main centers of Fintech application research are China and the US. The influential studies are on Fintech and banks, authors and the distributions of scientific research are from China and the US. Citations and author's impact are very high in China and the US. **Originality –** The study contributes to the literature of bibliometric analysis of Fintech applications using the R-Studio program from 2016 to 2022 in banks related to artificial intelligence, machine learning, blockchain, and big data.

Keywords: 'Fintech, Bank, Artificial Intelligence, Blockchain, Big Data.

1. INTRODUCTION

Fintech is widely used in many banks as cost-effective, improving bank efficiency, increasing profitability, enhancing capacity, taking competitive advantage, etc. (Dabbeeru & Rao, 2021). The Fintech term and its origin traced back to the 1990s, its evolution initiated in 2008, contributed through various development stages, and emerged as a 21st century technology service for start-ups, new entrants, artificial intelligence, machine learning, big data, blockchain, etc., but it has attracted the banking industry since 2014 (Varma et al., 2022). Varga (2017) claims

that bank and start-up investment has fueled the growth of fintech development, with funding growing dramatically during the pandemic due to increased demand for mobile banking and competition. When utilizing advanced technology, banks must prioritize their competitiveness in increasing efficiency and cost-effectiveness (Siek & Sutanto, 2019). Growth and competitiveness are generated by fintech development since it increases bank efficiency (Singh & Jain, 2021). Fintech growth in banks is a crucial component of the developing financial markets, and the primary drivers of fintech applications include big data, blockchain, artificial intelligence, and machine learning (Siek & Sutanto, 2019).

The literature on scientific research covers a wide range of issues and is divided into many areas. But the particular focus of this study is on how fintech adoption has changed within conventional banks. Scientific research material is mostly sourced from scholarly journals that are accessible through online databases like WoS, Scopus, etc. To ensure full understanding of the subject, particularly fintech adoption in banks, as utilized in this study, it is essential to integrate these resources.

Depending on the topic and the particular area of research, there are differences in identifying the "leading" authors in scientific journals. On the other hand, a few names are well known for their important contributions and influence in a number of scientific fields. These people, along with a great number of others, have significantly influenced their disciplines by their study, findings, and contributions to scientific publications. Current and future generations of scientists are influenced and inspired by their work, especially those notable authors on fintech adoption research who have had a significant impact on the banking industry and are taken into consideration in this study.

The field of study, the type of research, etc., can all have a significant impact on the distribution and impact of publications over time. In this study, banks take into account developments in fintech when measuring various metrics, including citation counts, h-index, and journal impact factors, in an effort to quantify the impact of publications. A systematic bibliometric review might be helpful in understanding the development of fintech in order to completely comprehend a variety of qualitative and quantitative elements as well as the interactions between banks and fintech.

The purpose of the study is to examine how the literature on scientific research has evolved over the past ten years via significant fintech research conducted by a good number of notable authors and their impacts on publications over time. Fintech is widely used in banking institutions, however there are still obstacles in the way of realizing its full potential. This raises a concern about whether the banking industry has reliable information when making policies that transform traditional business practices and to understand that the main forces at work, including big data, blockchain, artificial intelligence, and machine learning, offer the possibility for banking systems to achieve desired levels of fintech services.

2. LITERATURE REVIEW

Fintech (Financial technology) transforms the banking industry and banks (Martincevic et al., 2022) are accepting this change and adapting Fintech in their banking products and services (Kumar et al., 2022). They applied qualitative analysis using Google Scholar with the help of

document and citations analysis of referred journals and authors of leading countries. They found significant topics of artificial intelligence, blockchain and robot-advisory and their usage in banking management. Brika (2022) studied bibliometric analysis of Fintech trends and digital finance. He used the Science Direct database of 343 articles using content analysis. The objective was to summarize how scientific research has developed on the connection between Fintech and digital finance. The method was a bibliometric measurement approach and analyzed publications in the database. They found the trend has been increasing on using digital finance, but publications have declined since 2006.

Cuenca-Jimenez (2022) examined bibliometric analysis of financial services technology companies between the periods of 2008- 2021. The objective was to summarize scientific literature on Fintech for financial services. Method was collecting previous studies from the Scopus and Web of Science database. Their results disclose that attention is growing towards the study of Fintech as publications have been increased and this will support a better understanding of Fintech development which has a potential social impact, efficiency of financial markets, and mitigation of transaction related risks (Thakor, 2019).

Ali et al. (2022) studied bibliometric analysis of microfinance on a global trend. The method was quantitative using the Scopus database. The objective was to analyze historical trends of publications, authors, journals, renowned academic institutions and highlight the shortcoming of the Scopus database. Their analysis shows emerging Fintech, crowdfunding, and financial literacy but limited attention towards using them for poverty alleviation. Li and Xu (2021) examined Fintech bibliometric and science mapping analysis. The objective was to systematically analyze the past and present studies of Insights in Fintech. The method was bibliometric and science mapping analysis obtaining data from the Web of Science. They took 848 publications and fundamental characteristics they analyzed are types, annual publications, hot research directions, countries, institutions, authors and journals. Their findings reveal the cited authors, journals, and references that help scholars find appropriate research entry points and conduct in-depth research.

Nobanee (2021) examined big data in Finance and method was bibliometric analysis to highlight the current trends. Their findings suggest a future research agenda in this field. Martínez-Climent et al. (2018) studied financial return crowdfunding and the aim was how crowdfunding generates financial return. The method was analyzing articles published in Web of Science in the field of crowdfunding. Their findings suggest future research. Yao and Song (2021) studied the impact of Fintech on different sizes of banks economic capital through the application of Fintech. The method used the GMM estimation technique from 2011-2019. They found large banks have benefits in scale, capital and experience compared to small and medium size banks. Also, findings show that the impact of Fintech is significantly heterogeneity on the profitability of different types of banks (Saphyra et al., 2021).

Yao and Song (2021) examines the relationship between Fintech and economic capital of commercial banks in China. The method was a panel dynamic system method of moment approach for the period 2011-2019. They found Fintech has reduced cost of information on both sides of the transactions, increased the transparency, and reduced the economic capital. The

study also found that Fintech provides a large amount of data for banks to conduct market analysis, makes banks profit driven preferences, and higher risk tolerance. The impact is different depending on the size of the banks. Nguyen et al. (2020) studied Fintech applications for the modernization of the banking system in Vietnam. The method was based on a survey on 40 experts and their findings suggest that Fintech companies in Vietnam faced challenges in legal corridor, infrastructure, Fintech companies, customers and human resources which are very low and need to be better addressed in the future to support modernization of the banking system (Thakor, 2019).

Bholat & Susskind (2021) studied on artificial intelligence and financial services. They found the effect of AI on financial services is transformative, but the impact remains complex and uncertain. Dashottar & Srivastava (2020) studied the use of blockchain on credit decisions although blockchain has leveraged the effectiveness of corporate banking products. Their findings suggest improving the regulatory framework using Regtech (regulatory technology) to support unified data available in the banking system which will help make more informed credit decisions. Chang et al. (2020) examined the application of big data and IoT (Internet of Things) by banks. Their findings suggest that the banking industry frequently generates big data from off and online channels and social banking activities. Banks can use big data to reduce financial risks, develop more accurate marketing strategies, reduce transaction costs, and provide better service to customers (Sanga and (Aziakpono, 2023).

There are a good number of studies on bibliometric analysis in Fintech such as Fintech and Islamic Finance, Fintech companies, Fintech and micro-finance, Fintech and crowdfunding, Supply Chain and Finance using big data analytics. But very few studies are found on specific bibliometric analysis of Fintech and banking. However, no studies are found on bibliometric analysis of Fintech application in banking which means literature is still insufficient in scientific publication and not systematic in this area. The author has considered this as a research gap, and to bridge this gap a bibliometric analysis needs to be performed from 2016-2022.

In the current study, Fintech application-related publications and researchers were subjected to structural categorical analysis. The following six basic research questions are formulated to address.

RQ1. How has the literature on scientific research developed between 2016 and 2022?

RQ2. What are the most leading authors?

RQ3. What are the major studies in Fintech application?

RQ4. What are the distributions and impacts of publications over time?

RQ5. Are the results compatible with Lotka's Law?

RQ6. Are the results compatible with Bradford's Law?

3. METHODOLOGY

Fintech has been applying in different fields as it is not limited to only business and economics. Following Ali et al. (2022) and Brika (2022), a keyword search with only Fintech, there are 2385 documents published in Scopus database (limiting with business, finance and economics, there

are only 860 articles). As our study is focused on purposely in the banking industry, we applied specific keyword search. The keyword search with 'artificial intelligence AND bank' (16 articles) 'machine learning AND bank' (33 articles) 'big data AND bank' (11 articles) and 'blockchain AND bank' (22 articles) provide very few articles in the Scopus database. However, when we apply keyword search with 'Fintech AND bank' there are 85 articles, keyword search with 'Fintech and application' there are 7 articles, keyword search with 'Fintech application AND banking' there are 2 articles, keyword search with 'Fintech application' there are 3 articles.

Since the keywords search with 'Fintech and bank' has 85 articles including all other articles related to Fintech application in banks under different keywords search. Therefore, this study considers applying RStudio programming for bibliometric analysis of 85 articles (Cuenca-Jiménez, 2022). Database selection is from the Scopus which is a large database for bibliometric analysis. The author has applied automated search of relevant articles from the Scopus database, manual filtering of those articles limiting subject area to Economics, Econometrics, Finance, Business, and Management including the keywords limited to Fintech, Banking, Banks, Bank, Application, and the language is English with only articles.

4. RESULTS AND DISCUSSION

Scientific Productions on Fintech and Banks

The table 1 shows annual scientific publications have increased gradually from 2016 (only 1 publication) but there was a rapid change in publication in 2020 (18 publications), 2021 (25 publications) and 2022 (32 publications). So, Fintech and bank related articles published highly in the last few years as it has been drawing attention for banking industry development. There was a growth and an increasing trend since 2016 in Fintech and bank related scientific research publications.

Table 1. Annual Scientific Productions

Year	Articles	Percentage	Cumulative (%)	Growth (%)
2016	1	1.17647059	1.176470588	-
2017	2	2.35294118	3.529411765	200
2018	3	3.52941176	7.058823529	100
2019	4	4.70588235	11.76470588	66.66667
2020	18	21.1764706	32.94117647	180
2021	25	29.4117647	62.35294118	89.28571
2022	32	37.6470588	100	60.37736
N	85			

The table 2 under the following shows average citation per year per article. As the number of publications was very low in 2016-2019, average citation was higher than the later years in which publications have been increasing rapidly. However, average citation has been increased from 2020 onwards.

Table 2. Average Citations Per Year

Year	N	Mean TC per Article	Mean TC per Year	Citable Years
2016	1	37.00	6.17	6
2017	2	49.00	9.80	5
2018	3	87.33	21.83	4
2019	4	7.75	2.58	3
2020	18	6.00	3.00	2
2021	25	10.04	10.04	1
2022	32	1.84	-	0

Most relevant sources

The following figure 1 represents the most relevant sources of Fintech and bank related scientific research have been published. The highest is the Finance Research Letter (6), then Financial Innovation (4) followed by Business and Management (2), International Journal of Electronic Finance (2), International Journal of Islamic and Middle Easter (2), International Review of Financial Analysis (2), Journal of Banking Regulation (2), Journal of Payment Strategy and Systems (2), Technological Forecasting and Social Change (2) and the remaining articles have each with one publication.

Figure 1. Most relevant sources

Bradford's law

The following table 3 shows source clustering using Bradford's law. Out of 85 relevant sources on Fintech and bank related articles, Bradford's law trends them from top down and of them first ten publisher's names are presented in the table. Finance Research Letters are still highest for sources followed by Financial Innovation the second.

Table 3. Source Clustering Through Bradford's Law

source	rank	Frequency	Cum. frequency
Finance Research Letters	1	6	6
Financial Innovation	2	4	10
COGENT Business and Management	3	2	12
International Journal of Electronic Finance	4	2	14
International Journal of Islamic and Middle Eastern Finance and Management	5	2	16
International Review of Financial Analysis	6	2	18
Journal of Banking Regulation	7	2	20
journal of Payments Strategy and Systems	8	2	22
Technological Forecasting and Social Change	9	2	24
Accounting and Finance	10	1	25

Most relevant authors

The following table 4 shows the most relevant authors clustered through Bradford's Law. In the author information, as the most relevant author is shown in the table 4 below, Barber H. is on top by publishing 3 articles and other 9 authors in a row published 2 articles each.

Table 4. Relevant authors

Authors	Articles	Articles Fractionalized
Baber H.	3	3.00
Banna H.	2	0.58
Brochado A.	2	0.67
Campino J.	2	0.67

Kowalewski O.	2	1.00
Jiu J.	2	0.67
Pisany P.	2	1.00
Rabbani M.R.	2	1.50
Rosa A.	2	0.67
Shen Y.	2	0.67

Lotka's law

The Lotka's law presented in the Figure 2 shows the author's productivity through frequency of publication during the period of 2016-2022. The figure shows the productivity of 92% where authors (95) published scientific research articles on Fintech and banks. Proportion is very high on a single topic, only 6% authors (14) published scientific articles related to Fintech and less than 1% author (1) published article in another topic related to Fintech.

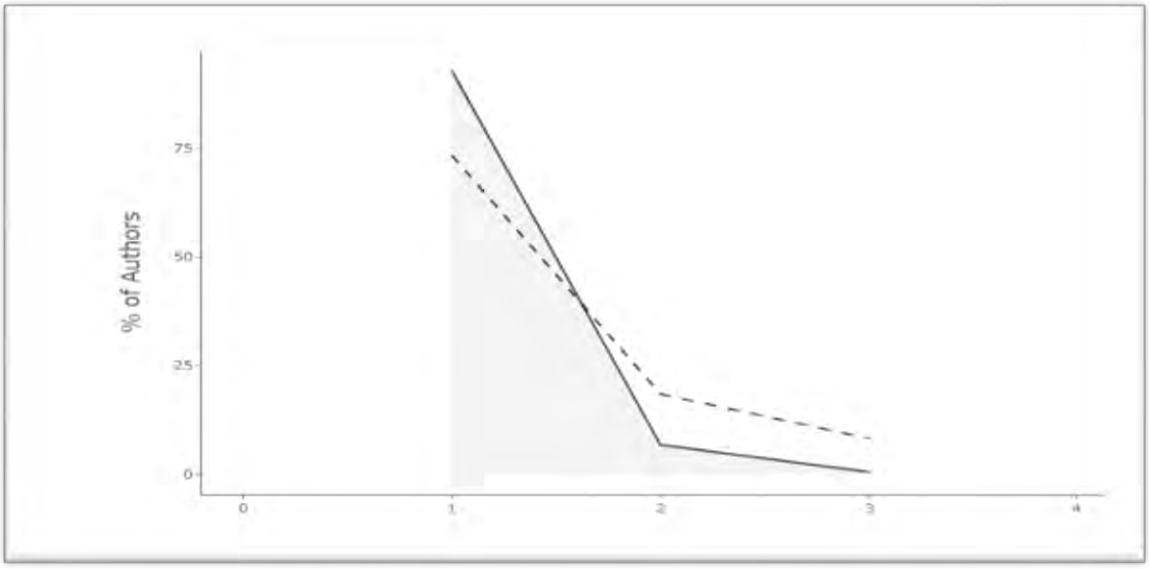

Figure 2. Author Productivity Through Lotka's Law

The most cited 10 authors and their impacts through h- index ((shows in table 5) which is a measure for a scientist's productivity and impact. Here, the most cited author is Baber H. (25 citations) for 3 publications. Banna H., Liu J., Rabbani M.R. and Wang R. are the second highest cited authors with productivity of 2 publications each in the year of 2020 and 2021. Agarwal S., (15 citations) and Ali M.H., (10 citations) for 1 publication each are also the most cited authors.

Table 5. Author's Impact

Authors	High Index	Total Citation	Number Publication	Publication Year
Baber H.	3	25	3	2019
Banna H.	2	15	2	2021
Liu J.	2	24	2	2020
Rabbani M.R.	2	18	2	2020
Wang R.	2	27	2	2021
Agarwal S.	1	15	1	2020
Ahmed R.	1	6	1	2022
Alam M.M.	1	4	1	2021
Alam M.R.	1	6	1	2022
Ali M.H.	1	10	1	2020

The figure 3 below shows the affiliation of the most cited authors by ranks of which University of Economics and Law has 7 articles published (2022) followed by Southwestern University of Finance and Economics (5 publications), Universitas Indonesia (4 publications), ZheJiang University of Finance and Economics (4 publications), Erasmus University Rotterdam, Hunan University, Imam Abdul Rahman Bin Faisal University, ISCTE- Instituto Universitário de Lisboa, Jilin University, Murdoch University each with 3 publications.

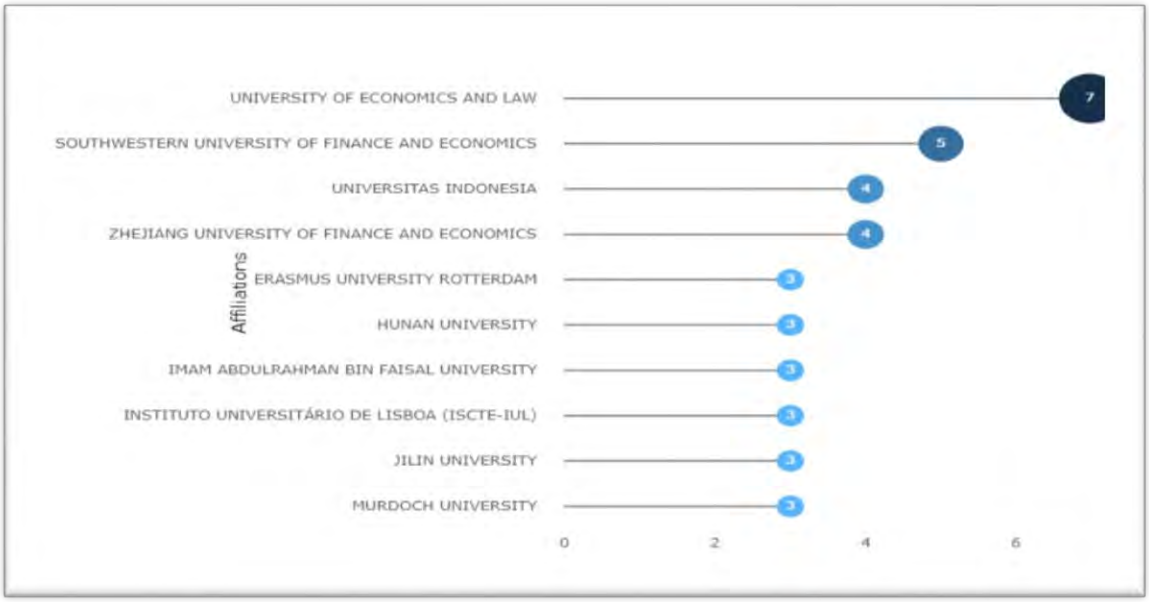

Figure 3. Author's Affiliation

Country scientific production

The Figure 4 below shows the country specific production where the articles published in Scopus database. Among them, the top scientific production represents in China (54), the US (22) is the second and third is Indonesia (13) followed by Italy, UK, Ukraine, and Malaysia each with 10 publications.

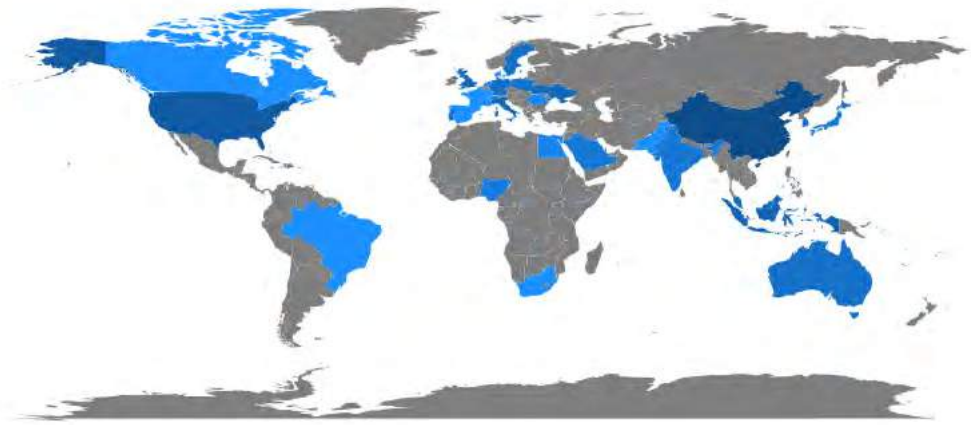

Figure 4. Country Scientific Production

Corresponding author's country

The corresponding author's country is shown in the Figure 5 below. According to figure 5, 16 articles have been published in China out of which 13 articles are SCP (single country production) and 3 articles are MCP (multiple country production) while in the US, out of 7 scientific publications 4 MCP and 3 SCP. From Asia, Indonesia, Korea, Malaysia, Vietnam, Japan, and Singapore are also included for corresponding authors but no MCP except Malaysia and Singapore. From Europe, Germany, Italy, Poland, UK, Sweden, Switzerland, Netherland are mostly with the SCP. Overall, China is the top for highest publications including SCP and the US is the second highest for MCP publications and Malaysia is the third for MCP publications.

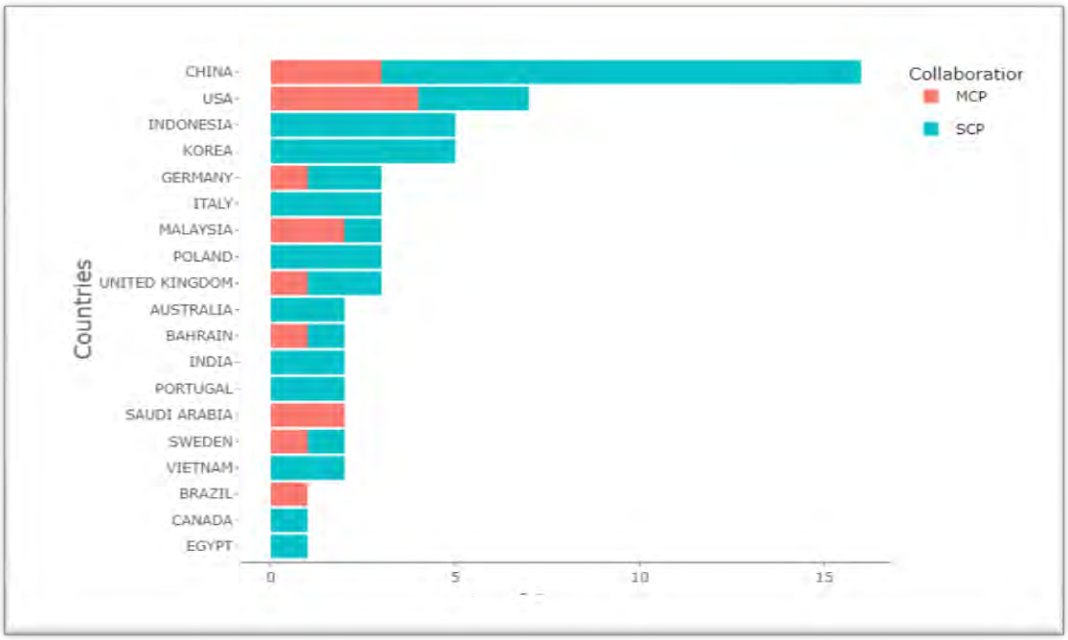

Figure 5. Corresponding Author's Country

5. CONCLUSION AND FURTHER RESEARCH

In conclusion, the study is focused on Fintech and bank related scientific literature on artificial intelligence, machine learning, blockchain, and big data that has been developed in the last 7 years from 2016-2022. Although there are very few articles published on artificial intelligence, machine learning, big data and IoT, blockchain application in banking industry but Fintech and bank related articles are a good number (85 scientific publications). The most influential studies are on finance, banking, payment system, technological change etc. and the leading authors are Baber H. with 25 citations for 3 publications, Banna H., Liu J., Rabbani M.R. and Wang R. are the second highest with productivity of 2 publications each. Agarwal S., with 15 citations and Ali M.H. with 10 citations for 1 publication each are also the most dominant authors. The main studies are modernization of commercial banking system, economic capital of commercial banks risk and promotion of Fintech application.

The distributions of literature on scientific research published related to Fintech and banking are mostly in Asia where China is on top followed by the US is the second. Indonesia, Korea, Malaysia have also contributed to Fintech related scientific publications. The impact of the publications over time are found as Baber H. (25 citations) for 3 publications, Banna H., Liu J., Rabbani M.R. and Wang R. are the second highest with productivity of 2 publications each. Agarwal S. with 15 citations and Ali M.H. with 10 citations for 1 publication each.

Both the Lotka's and Bradford's law support the compatibility of the results. Productivity is high which is 92 percent of scientific research publications on a single topic related to Fintech and bank. Author's impact is also very high with a good number of citations with the affiliation of the authors. However, there are scopes of doing scientific research on Fintech applications using cutting edge-technologies such as artificial intelligence, big data, machine learning, and blockchain in the future.

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The Role of Emotional Intelligence in the Career Decision-Making Case study: Project Manager and Project Consulting on Industries Corporates Jeddah Saudi Arabia

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Abstract

Emotional intelligence is the ability to identify and manage one's emotions as well as the emotions of others. In the world of work, it helps build stronger relationships, build resilience, and achieve our goals. Being able to anticipate one's feelings and emotions in a given situation would make it possible to better assess the reaction of one's interlocutor in a similar environment. And in doing so, to create more favorable social interactions on both sides. This article aims to explore the role of adopting emotional intelligence (EI) in career decision-making difficulties; meanwhile, discussing the examination of the Bar-On Emotional Intelligence, and decision-making career. We use a quantitative method with a survey distributed to project managers working in Industries companies. Many authors distinguish models of mental skill, focusing on the ability to process affective information then mixed models that conceptualize EI as a complex construct, including aspects of personality, motivation as well as the ability to perceive, assimilate, understand, and manage emotions.The result of this article interprets Emotional Intelligence as having an impact positively on the decision-making process of the employees or employers in the corporation.

Keywords: Emotional Intelligence, Career Decision-Making Difficulties, Emotional Quotient Inventory

1. INTRODUCTION

Many theoretical as well as applicative studies of career decision-making argued that the more increasing rate of development, innovations, and the ability to face changes in workplaces requires a continued environment of learning new skills, adapting new ways of thinking, and using modern technologies to increase the job performance from current situation to future one throughout the one's lifetime that is stressed by Gati, Krausz, Osipow (1996). Within this context, Gati and al (1996) proposed and empirically validated the taxonomy of many different difficulties associated to career choice in that an individual could experience through time (Di Fabio & Blustein, on 2010). Gati and al. model (1996) indicates that there are three main types of difficulties that are related to the career decision–making process obviously: 1) lack of readiness, 2) lack of information, then 3) inconsistent information. The first type of difficulty that it is often encountered prior to the beginning of the decision-making process is a Lack of readiness in which it may happen due to a lack of motivation, indecisiveness, and dysfunctional beliefs. Sampson, Reardon, Peterson and Lenz (2017) address the cognitive information processing theory which includes the role as well as the impact of dysfunctional career beliefs in the career decision-making process (Kronholz, J., 2015). On the other side, there is a lack of information

encountered during the decision-making process related to decision-making itself, specific occupations, or the way of obtaining information (Nevo, 1987); while the third difficulty is inconsistent information (Di Fabio, Palazzeschi & Bar-On, 2012). So, we can ask the question which test to measure Emotional Intelligence?

In the same way that there is a test to assess the intelligence quotient (IQ), there is a test to define the emotional intelligence quotient (EQ) created by Bar-On (1988). "It's a measure that we compare to a standard," says our expert, after answering different questions divided into several categories (self-perception, individual expression, stress management, decision-making, human relations...). They are not fully representative of a person's emotional intelligence.

The result gives an overall overview of the level of emotional intelligence, but it is to be refined with scenarios, which are not measurable with a tool. The most recognized and used EQ test in the world is the EQi 2.0 (Emotional Quotient Inventory) diagnosis developed in 1997.

Despite not being a current term, emotional intelligence, or EI, has recently gained significant importance in corporate environments due to the quick changes occurring in multinational corporations. The social, political, and economic environments were all affected by these shifts. Moreover, utilizing technology in the company brought about many developments. In the current millennium, Emotional Intelligence is becoming increasingly apparent in how people think, which influences how they react to managers and other leaders. It also influences those who make decisions (Santos et al., 2018; Al Tahee, 2004).

The difference between Intelligence Quotient (IQ) which reflects the accumulated knowledge intelligence, and Emotional Intelligence (EI) which means the ability of people (leaders, managers, department chiefs in universities) to face threats; becomes very obvious because the second depends on the exchangeable effects among employees in organizations and/or among students in universities who are starting to think about their careers in future (Ran et al., 2022; Cherniss & Goleman, 2003).

This has led us to pose the following problem: Does Emotional Intelligence (EI) can support people in making comprehensive decisions? In other vision, identifying the function of EI in a particular decision-making process could aid people in comprehending the various challenges that occur during the decision-making process.

The first part will present the history of the term Emotional Intelligence and all the variables related and its impact on career decision-making. In the second part, we will discuss the results of the quantitative study conducted. In conclusion, some avenues of research will be developed.

1. LITERATURE REVIEW

The literature recently reveals Emotional Intelligence (EI) as a represented considerable variable in the career decision-making process (Di Fabio & Blustein, 2010; Di Fabio & Kenny, 2011; Di Fabio & alazzeschi, 2008, 2009; Di Fabio, & Gati, in the press, Di Fabio, and al, 2012). EI plays a crucial role in the career decision-making process based on contextual perspective (Brown, Crran & Smith, 2003; Di Fabio & Blustein, 2010); while Young Valach, and Collin (1996) offered the action theory of career development, which means that the career can grow and develop through everyday actions (Jiang, 2014). According to this theory, emotions are embedded in an individual's internal process, and they relate to needs, goals, plans, projects, and decisions.

Although, EI began appearing in publications in the early 20th century with Thorndike's (1920) as he referred to as (social intelligence) that is closely related to EI, but EI becomes a major area of interest in many scientific aspects during the last decades which currently referred to (social-

emotional intelligence) as for (Bar-On, 2000, 2004, 2006), researchers introduce the concept EI to examine its relation to career- related issues (Brown et al., 2003; Carson & Carson)

2.1. Emotional Intelligence

Lelord and André (2001) defined emotion as "a sudden reaction of our whole organism, with physiological, cognitive and behavioral components". In 2005, Goleman mentioned the etymology of the term "emotion", consisting of the word "motere", meaning "to move" in Latin, and, reflecting a tendency to act outwards. The author explained that each emotion plays a specific role, preparing us to act in a certain way in a given situation, for the purpose of survival. In addition, we can recite that our emotions help us to face tasks too important to be entrusted to he intellect alone. A quote from Damasio (1994) supports this view, explaining that 'feelings are indispensable for rational decisions'. Indeed, from an anatomical point of view, feeling emotions would involve different regions of the cortex (amygdala, hippocampus, or thalamus), which will receive sensory information and prepare us to act. This different knowledge thus leads to the conception of Emotional Intelligence.

2.2. Competence

Salovey and Mayer (1990) (cited by Hwang, Feltz & Lee, 2013), described Emotional Intelligence as "the ability to listen to our own emotions and those of others, to differentiate them from each other and to use the information to guide our own thoughts and actions".

In 1997, Mayer and Salovey (cited by Chan & Mallett, 2011) developed the Emotional Intelligence capacity model and thus supported the definition of EI: "The ability to perceive, use, understand and manage our emotions and those of others". As a result, the model is composed of four branches: perception, use, understanding, and management of emotions. These conceptions of EI are essentially based on the ability of EI, also called EI "skill". The literature shows that other conceptions have been developed, and contrast to the work carried out by Salovey and Mayer.

2.3. Trait

Petrides and Furnham (2001) (cited by Hwang, Feltz & Lee, 2013), have argued that EI is based more on the personality and behavioral dispositions of individuals. In other words, the authors consider EI to be innate, rather than acquired, as we have seen previously. This conception would then be considered as a personality trait.

In accordance with the literature, EI often presents two conceptualizations: (1) skills, which is acquired and can vary depending on the situation. It can be trained to be developed in individuals and is represented through maximum performance. (2) The trait is associated with the personality of the individual. It is more stable over time and situations and is represented according to a typical performance (Laborde, Dosseville & Allen, 2016).

2.4. Tripartite Model

In 2009, Mikolajczak devised a model to bring together three often opposing conceptions: EI ability as a form of intelligence, EI trait as a personality trait, and knowledge of EI. This model is called the Tripartite Model. Indeed, this new conceptualization proposes to bring together the three levels of organization of Emotional Intelligence: knowledge, skills, and traits.

Dosseville, Laborde, and Allen (2016) specified to use the existence of five emotional skills: identification, understanding, expression, regulation, and use of emotions. Each of these skills can be broken down according to the three levels previously stated .

Mikolajczak (2009) and Dosseville, Laborde, and Allen (2016) defined these three levels as follows: Knowledge: implicit and explicit knowledge that an individual can have about emotional skills. Episodic knowledge (memories of past experiences) and semantic knowledge (what to do in a given emotional situation) are present in each individual, which explains the wide individual differences.

Skills: consists of the ability to apply knowledge, to implement a given strategy, in an emotional situation. This differs from what people know. Indeed, we can very well know that a strategy is effective in reducing an emotion, and yet not implement it when confronted with it. For example, an individual is able to employ the distraction strategy in a situation that makes him angry, if it is Emotional Intelligence and Coach-Athlete Relationship asks him, but he would not necessarily have done it on his own. Trait: is defined as the propensity to behave in a certain way in emotional situations in general. This is what people "do", not what people "can do" (skills).

This alternative model makes it possible to take into consideration the different conceptualizations of EI, each of which has an interest in the success of individuals. Laborde, Dosseville, and Allen (2016) recommended using measures from all three levels of the tripartite model in EI studies, thereby providing a better appreciation of EI's role in sports performance. The authors explain that each level can feed another. And Columbus (2015), which used the EI tripartite model to establish an EI training program. This program acted on the levels of knowledge and skill, to promote the development of the EI trait in the long term.

However, knowledge does not always translate into skills, and skills do not always translate into disposition (trait) (Mikolajczak, 2009). We may know that the best strategy to implement before a major review is a positive reassessment of the situation but be unable to positively reassess our own review session Or, we may very well be able to positively reassess the situation when it is requested by a friend or a coach, when we do not usually use this strategy.

2.5. Performance and Emotional Intelligence

The researchers highlighted different properties associated with emotions. First, Pena-Sarrionandia and al. (2015) mentioned that emotions help in decision-making. Chan and Mallet (2011) explained that if emotions are used intelligently, they can help improve decision-making. However, it is important to emphasize that EI's skill depends on the emotional situation. Thus, certain factors, such as time pressure, for example, can impact this decision-making. We can also mention the study by Vaughan, Laborde, and Mcconville (2019), which suggests a positive link between athletes' expertise, EI, and the quality of decision-making.

The literature also reports that the notion of performance is positively correlated with EI. Indeed, the regulation of emotions makes it possible to achieve optimal functioning, and EI is associated with better adaptations in the areas of social support, social relationships (with better quality relationships), studies, and work (which leads to better performance) (Pena-Sarrionandia et al., 2015).

Labord and all. (2016) pointed out that athletes with a high level of EI perform better because they rate competition as a challenge and employ more effective coping strategies to respond to competition stress.

2.6. Leadership and Emotional Intelligence

Chan and Mallet (2011), as well as Laborde and al. (2015), highlighted the link between EI and leadership. Leadership was defined by Barrow (1977, cited by Vanden Auweele, Van Mele, Wylleman, and Durand, 1994) as "a process that influences individuals and groups in achieving

goals." In their 2011 study, Chan and Mallet mentioned that a coach needs leadership qualities in order to manage coach-athlete-performance relationships.

These leadership qualities include skills in the mental dimension of performance, such as EI, motivation, conflict management, and the ability to get athletes to join a common project. We can also read that in the leader-follower relationship, the ability of leaders to arouse emotions in followers increases engagement and leads to the achievement of common goals.

3. METHODOLOGY

The question posed in this research is whether there is a positive and meaningful relationship between EI and decision-making. Specifically, we test the general hypothesis that EI decreases decision-making. It means that Emotional Intelligence impacts positively or negatively the decision-making process of the employees or employer in the corporation.

3.1. Sample Selection

The interviewees were in continuous training with project managers at the KSA chapter specifically in the Jeddah area. They were taking the same Human Resources Management course. They had at least five years of professional experience. Most of them have had to exercise management responsibilities.

The questionnaire administered made it possible to collect general information including demographic variables: age, sex, level of education, or type of professional experience exercised. The sample is composed of 114 individuals, the vast majority of whom are women (27 men, 87 women).

3.2 Measuring Variables

Decision bias was measured using a questionnaire developed from the work of Simon and al. (2000) and Bazerman (2006). Five types of bias were studied: loss aversion, lack of cognitive flexibility, optimism, conjunction error, and overconfidence.

The degree of emotional intelligence of the study participants was assessed using the SREIT scale proposed by Schutte and al. (1998). The SREIT is a self-reported 33-item scale assessing the extent to which participants identify, understand, manage, and regulate their emotions and those of others. Each item is coded by a 5-point Likert scale.

In order to test the validity of our measures, we calculated a Principal Component Analysis (PCA) of participants' responses to the 29-item scale. This analysis suggests a five-factor structure explaining 45.6% of the variance.

3.3 The Conceptual Model

To better understand the context of the study, the conceptual framework is mapped out as follows:

The components of the relationship approach:

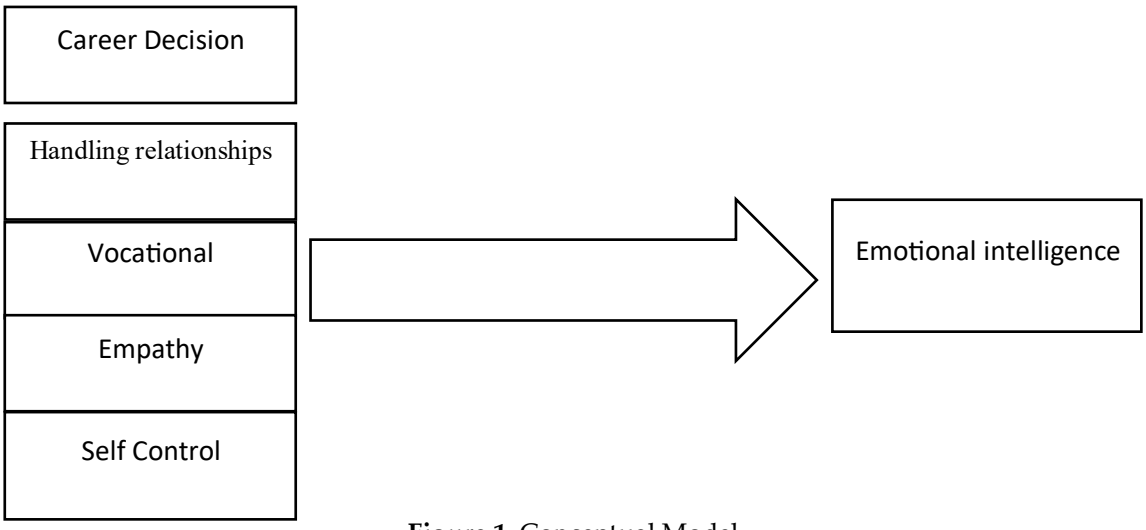

Figure 1. Conceptual Model

Through this model, we have reviewed five widely used measures of EI and made recommendations regarding their appropriate use. This article was written primarily for researchers and practitioners who are not currently experts on EI and therefore we also clarified the difference between EI and Career Decisions.

4. RESULTS

Table 1. Intercorrelations Between Emotional Intelligence and Career Decision

Variables	2	3	4	5	6
1. Career decision-making self-efficacy	–.48**	.12*	.34**	.11*	.30**
2. Vocational exploration and commitment		–.02	–.34**	–.02	–.41**
3. Empathy			–.29**	.37**	–.09
4. Utilization of feelings				.51**	.17**
5. Handling relationships					–.02
6. Self-control					

*$p < .05$. **$p < .01$.

The following statistically significant associations were found in the analyses, which further supported the ideas that higher EI is associated with more clarity and confidence for vocational exploration and commitment, as well as higher levels of self-efficacy while making professional decisions. Self-efficacy in making career decisions was positively correlated with each of the four EI characteristics.

When it comes to making career decisions, people who perceive themselves as having lower levels of self-efficacy than those who perceive themselves as having higher levels of self-efficacy

may feel more anxious or avoid decision-making tasks altogether. Empirical research on career exploration and decision-making behaviors has shown that individuals who move forward without the advantages of exploration are less likely than those who have engaged in exploratory behavior to experience successful decision-making and job implementation outcomes (Greenhaus & Sklarew, 1981; Grotevant, Cooper, & Kramer, 1986).

There are four-factor scores and a total score available from the Emotional Intelligence Inventory-Revised. The four-factor scores are described by Tapia (2001) as follows: (a) Empathy, comprising 12 items that evaluate the perception, appraisal, and expression of emotion (X = 42.4, SD = 6.20). (b) Utilization of Feelings: 11 items (X = 38.9, SD = 5.21) that are classified as emotional knowledge application and comprehension; (c) Handling Relationships: 9 items (X = 3019, SD = 5.43) that reflect emotional facilitation of thinking category; and (d) Self-Control: 9 items that describe emotion regulation (X = 37.52, SD = 5.50). The ranges for the total score and the four factor scores (self-control, handling relationships, empathy, and utilization of feelings) are 38 to 203, 11 to 59, 10 to 53, and 8 to 50, respectively. Tapia reported internal consistency reliability coefficients of.80,.73,.72,.77, and.69 for the total score and four factor scores, respectively, using Cronbach's alpha. Overall scales, a test-retest reliability of.83 was found.

Table 2.Multiple Regression Analysis for Variables Predicting Career Decision-Making Self-Efficacy

Predictor Variable	*B*	*SE B*	β	R^2	ᴰ R^2
1. *n 114*					
Step 1: Empathy	0.43	0.16	.12**	.01	
Step 2: Gender	0.01	3.74	.00	.01	.000
Step 3: Empathy ⊕ Gender	0.03	0.44	.03	.01	.000
2. *n* =114					
Step 1: utilization of feelings	2.22	0.31	.35***	.13	
Step 2: Gender	–0.34	3.48	–.00	.14	.000
Step 3: Utilization of Feelings ⊕ Gender	–0.26	0.63	–.14	.14	.000
3. *n* =114	,				
Step 1: handling relationships	0.83	0.34	.12*	.01	
Step 2: Gender	0.56	3.72	.00	.01	.000
Step 3: Handling Relationships ⊕ Gender	0.43	0.71	.22	.01	.000
4 *n* =113					
Step 1: self-control	1.60	0.26	.30**	.09	
Step 2: Gender	0.07	3.56	.00	.09	.000
Step 3: Self-Control ⊕ Gender	0.57	0.57	.27	.09	.001

*p < .05. **p < .01. . ***p < .001.

Students who reported greater understanding and analysis of emotion, as well as self-regulation of emotion, were more likely to display a highly clarified and confident level of career choice commitment, according to the inverse relationship found between the Utilization of Feelings and Self-Control. EI factors and vocational exploration and commitment. It makes sense that those who struggle with comprehending, interpreting, and controlling their emotions would find it difficult to commit, as they would be less conscious of the ways in which their feelings influence their decisions and behaviors, leading to an uncommitted position.

Greater confidence in one's decision and perspective for one's professional future is suggested by the negative association between career decision-making self-efficacy and vocational exploration and commitment.

This result was not surprising; rather, it is in line with previous research that has indicated that a high level of dedication to one's career choice and in-depth exploration are linked to increased confidence in one's capacity to achieve one's professional objectives (Brown, C., George-Curran, R., & Smith, M. L 2003). Given that professional choice commitment is a manifestation of one's affirmation and confidence in concepts that align with career behaviors, it stands to reason that one's confidence in making.

5. DISCUSSION

In terms of the level of practice and its possible effects on participants' EI levels or their perceptions of the interdependence of their relationships, many effects were observed: the level of EI-trait is greater around Jeddah area and the empathy and the utilization of feelings. So, we can interpret Emotional Intelligence as having an impact positively on the decision-making process of the employees or employers in the corporation.

However, this result is different from what the literature highlights Pena-Sarrionandia and al. (2015), as well as Laborde et al. (2016) identify a positive link between EI and athlete performance; Vaughan, Laborde, and Mcconville (2019) suggest a significant positive link between expertise, EI-trait and athletes' decision-making quality. These studies would then lead us to envisage that dyads at a national level have a higher level of EI treatment than those at a regional level.

The performance of high-level dyads is higher, and their decision-making is higher. This difference can be explained by the "self-reported" format of the TEIQue questionnaire, which we will develop within the limits of this study.

6. CONCLUSION

As a result, still career decision making difficulties should be considered more seriously in other cultures and larger universes in the future. Because the career decision making changed over time and it should focus on other aspects such as health factors, resilience, and well-being as well, especially if the EI considered as a malleable factor that could improve through training and innovating as described in literature (Bar- On, Maree, & Elias, 2007; Di Fabio & Kenny, 2011; Judge et al., 1997). These results could be different in other aspects of business according to the services that are submitted in which EI might be more beneficial, meanwhile strengthening the effectiveness of the process of career decision-making.

EI has now become a modern subject seeking to establish itself in organizational practices. According to the results of literature reviews, emotions are our best professional allies, they form the backbone of the organization and allow us to develop strong, lasting, and positive interpersonal relationships, to predict success at work better than intellectual skills. Today, traditional management practices have been modified to give rise to the development of emotional skills of employees and managers. The ultimate objective of this article has been to highlight the importance of emotional awareness by the various stakeholders of the organization. Employees, project managers, and leadership were faced with a real challenge, that of compensating for the inadequacies of traditional management.

Theoretically, Emotional Intelligence should help employees develop stronger interpersonal relationships, and managers to positively influence work atmosphere and decision making, by instilling and understanding subordinates' emotions.

To test this proposed relationship, our next work refers to the study of empirical analysis of the variables linking emotional intelligence with career decision-making, with a closer look at the multidimensionality of the concept of performance.

Empirically, after this historical overview, we now need empirical research that tests the ideas proposed in this article. Given the complexity and multidimensionality of the concepts dealt with and the lack of empirical work to explore the notion of emotional intelligence in the Saoudian context, qualitative and qualitative methodologies seem promising to explore how emotional intelligence can contribute to decision-making.

Overall, we recommend that users should use single, complete tests where possible and choose measures of EI most suitable for their purpose (i.e., choose ability EI when maximal career decision is important and trait EI when typical career decision is important). We also point out that, across the majority of emotion-related outcomes, trait EI tends to be a stronger predictor and consequently we suggest that new users of EI consider using a trait-based measure before assessing alternatives.

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