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## Article

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## Analysis of the Current and Future of the Artificial Intelligence in Financial Industry with Big Data Techniques

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### A B S T R A C T

**Purpose:** This study finds the current and future trends of artificial intelligence techniques in financial industry.

**Design/methodology/approach:** This study tried to find trends in application of AI to financial areas using news data over last three years of 2017 to 2019 to predict new opportunities in financial area with technologies in AI. Text mining and social network analysis are used to analyze the news data containing AI applications in the financial industry. Network analysis on text from news is used for the analysis and modeling, eventually to get major key words as current and future trends.

**Findings:** The results of the analysis produced some meaningful implications. In 2017, the government's investments and the interests on developed countries formed domestic awareness of AI in each country. In 2018, AI accelerated the innovation in the financial industry from the interests by banks and customers in financial areas. In 2019, the investment leader in this area has changed from government to commercial enterprises. It means that in 2019, the introduction of AI technologies in financial industry created strong positive effects. Therefore, this study predicts that innovation will be accelerated in the financial industry using artificial intelligence over the next five years from 2020. In addition, there will be more diverse commercial sites in financial industry using AI based on the analysis of social network analysis in 2019. This study identified that keywords such as automation, customers, and services are associated together. As more and more content-based financial services are provided to customers in these days, this study predicts that AI-based transaction channels will be combined with the existing financial systems to satisfy the needs of customers in near future.

**Research limitation/implication:** The study uses news data from 2017 to 2019. The period of data collection can be extended to last 10 years to get more accurate trends. The study implies that techniques in big data can be applied to find trends using text data such as a news data.

**Originality/value:** The value of this study is to identify current and future patterns in the applications of AI in financial industry using techniques in big data. It can be used to respond to crises in the future and to predict possible opportunities in the future.

*Keywords: Finance, Artificial Intelligence, Big Data, Social Network Analysis, Future Prediction*

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## I . Introduction

Following the development of digital technology and the acceleration of the expansion and globalization of ubiquitous communication networks, the roles of enterprise, the attributes of value creation, and even economic structures are changing rapidly (Schwab, 2017). In the Davos Forum, held in Switzerland in January 2016, artificial intelligence alone with big data was counted as the core of the Fourth Industrial Revolution (Science and technology policy institute, 2016). When seen historically, the introduction of artificial intelligence is a process of automation that has continued for a long period of time. The mechanization in the late nineteenth and late twentieth centuries automated part of the manual labor that had been carried out by humans, and the advancement of information technology from the mid to late 20th century automated the standardized data processing that had been carried out by humans (Korinek & Stiglitz, 2017). According to Mustafa's research, expanding applications of modern information technologies and automation will bring an added advantage (Mustafa & Rahman, 2015). The emerging new technologies in the 4<sup>th</sup> industrial revolution such as big data, artificial intelligence, block chain and IoT are changing our economy and society. There are more and more companies equipped with such new innovative technologies.

FinTech is a word from combining finance and technology, representing technological changes in finance (McAuley, 2015). FinTech was introduced with the development of e-commerce with convenient payment systems in early 2000. The influence of FinTech on financial industries was limited at that time as most companies focus their innovation on the IT systems. Recent trend, however, shows diverse applications on credit analysis, loan management and asset management using block chain, AI and IoT, differentiating its uses from those of traditional technologies in FinTec (Bae, 2018). Unlike traditional financial systems, where the services are provided by financial service companies, these new financial

paradigm provides new opportunities, which the customers are free to select their favorite financial services. These new systems are considered to be a new growth engine as a next financial system in the time of 4<sup>th</sup> industrial revolution (Choi & Ham, 2015). AI is expected to be a major technology in financial industry in the future with more advanced technologies in AI (Chakravorti & Mazzotta, 2013).

International Data Corporation (IDC), a US market research firm specialized in IT, announced the following in October 2016: cognitive systems and AI that integrate, learn, and analyze data from vast and diverse sources of information will be distributed across a wide range of industries, and the global sales will grow from \$ 8 billion in 2016 to \$ 47 billion in 2020 (Marianne et al., 2018). This corresponds to an annual growth rate of 55.1% (IDC, 2016). Companies, along with government, in diverse industries invest on researches on artificial intelligence and its applications, especially focusing on finance, stocks and manufacturing (Kim, 2018). The greatest changes are expected in the area such as credit evaluation, asset management, stock exchanges, hedge fund management, following the report from the financial magazine in US, Euromoney (McCauley, 2016). They expect that financial companies can do more efficient portfolio and risk management through more accurate and insightful data analysis. Tractica predicts that the artificial intelligence system market for enterprises will grow rapidly at an annual average rate of 56.1%, from \$ 200 million in 2015 to \$ 11.1 billion in 2024 (Tractica, 2015). Most companies in financial area are aware of the risks and dangers from new emerging information technologies such as FinTech and AI. They began investing on these information technologies to transform their business into IT-based business systems (Kim, 2018).

On reviewing domestic financial transactions, it can be seen that the proportion of Internet banking continues to increase. The proportion of face-to-face transactions has declined from 28% in 2005 to 10% in 2017. In 2016, K Bank and Kakao Bank were selected as a specialized internet bank business operators and presented a business model differentiated

from existing banks focusing on face-to-face transactions (Bank of Korea, 2016). According to an announcement by the Bank of Korea, the number of stores of domestic financial institutions such as banks, insurance companies, and securities companies has been clearly showing a decreasing trend since 2013. The financial authorities are also responding quickly to the expansion of non-face-to-face transactions, such as allowing online contracts by easing the existing provisions for mandatory face-to-face conclusion of contracts (Bank of Korea, 2017). As such, due to 4<sup>th</sup> Industrial Revolution, new FinTech technologies are being activated in the domestic financial industry. However, the level of related technologies is far behind compared to leading countries such as the US and Japan. The level of technologies that is expected to greatly affect the future financial industry, such as convergence services, artificial intelligence, big data, and information protection in South Korea is evaluated to be much lower than that of developed countries. Another words, these technological innovations in South Korea are generally inferior to Japan and Europe, as well as the United States, which is the top technology leading country, and the gap in these technologies between South Korea and China is narrowing (ITTP, 2017). Therefore, financial industry in Korea will also change in the future with development of FinTech. If financial companies can't adapt to these changes, they can't survive in long term due to the problems in ROI. Bigger threat is coming from new competitors such as financial companies equipped with new IT platform. FinTech industry is still not competitive compared to US and UK, and its impact on financial industry is small. It is due to many reasons such as social and institutional factors.

To lead the financial industry in the era of the Fourth Industrial Revolution, efforts should be concentrated on securing the competitiveness of core technologies such as artificial intelligence, big data and FinTech. In particular, since the IT service sector, which is closely related to the financial industry, is the most important industry that is directly related to the various core fundamental technologies of the

4<sup>th</sup> Industrial Revolution, it should actively respond to the rapid changes in the environment of the financial market. Therefore, this study is intended to examine solutions to responses to crises due to the new environment and the artificial intelligence technology, which is the most rapidly emerging among leading technologies. This study finds keywords related to the financial industry with a view to presenting the directivity of artificial intelligence technology in the domestic financial industry and predict the future. This study analyzes news articles on FinTech and AI and finds trend from the main keywords and their relationships. Text mining and social network analysis are used to find major keywords and their relationships. It will help us find current trend of FinTech and AI in short term period, and it also help us predict future trend of them in long term view. This study suggests below research questions:

**Research Question 1.** What are major keywords in FinTech and AI?

**Research Question 2.** What are the relationships among these keywords?

## II . Literature Review

### A. Policy of the Korea financial industry

The emergence and growth of FinTech companies worldwide has transformed government policies related to the financial industry. In order to revitalize the FinTech market by easing barriers to entry, Korean government has eased the capital requirements of companies involved in the electronic financial industry from 500 million won to 300 million won and simplified the registration process for them. As a result, the number of companies involved in the electronic finance industry increased from 67 in 2014 to 104 in 2017 (Choi and Kim, 2019). In addition, the government abolished the obligation to use *ID Certificate* and *OTP (One Time Password)*. Joint Open platform for financial institutions was established to drive the emergence of innovative FinTech services

in August 2016. The joint open platform for financial institutions is an infrastructure that provides financial services of banks in a standardized form so that FinTech companies can conveniently develop financial services. It consists of Open API and test-bed (Choi and Kim, 2019). Special Act on Financial Innovation, Amendment to the Special Act on Promotion of Information and Communications Technology, Vitalization of Convergence Thereof, Etc. and Enactment of the Special Act on Financial Innovation Support, so called *FinTech Regulatory Sandbox*, was enacted to ease strict regulations on existing financial companies and give a boost to FinTech industry. The Special Act provides opportunities for a designated financial service provider to try new financial services in the market without being subject to the regulations of financial related laws for a certain period. It also stipulates that related public organizations will promptly confirm the application of laws and regulations related to services to be provided to companies facing uncertainty. Besides, the Financial Services Commission announced Financial Settlement Infrastructure Reform Plan, which includes opening a financial settlement network to FinTech companies and permitting the issuance and transfer of accounts in the same way as commercial banks in the long run. The Korean financial industry is regulated by laws related to financial services and information. Communication protection laws aim at stability of the financial market and consumer protection. Therefore, the main reason that hindered the development of Korean FinTech industry is financial regulation. Specifically, the core regulations related to Internet banking are Separation of Banking and Commerce<sup>1)</sup> and Commerce and the sharing of customer information. Under this system, potential candidates, including ICT companies, are virtually blocked from entering the FinTech industry. Sharing customer information is an essential task among joint ventures or allies in order for internet banks to innovate the financial industry. In order to provide a low interest rate in loan service, an

individual's credit rating is required. And this is possible through information sharing. However, as the related legislation on the personal information of the customers of three major card companies in Korea leaked in 2014, it was revised from November of that year. The revised law allows that financial companies can share information without customer consent for internal management purposes only and such information cannot be shared for business purposes. In this environment, since customer information is encrypted with unidentifiable information, there is a limit to customer analysis using big data techniques. This means that Korean companies' participation in FinTech industry is bound to decline. As the financial industry is complex and diversified, it must act as an intermediary for new technologies and industries. However, Korea's financial market and financial industry regulations are preventing these new functions. Therefore, the regulations need to be shifted from pre to post regulation. Korea, which was called an IT powerhouse, is moving away from the global trend in FinTech field. They were obsessed with Internet banks and consumed many capabilities. Koreans have already missed the leading position in the payment market, despite the fact that mobile payment of 600 trillion won a year is already being made. Even so, only Samsung Pay, which has smartphone devices, has entered the global market. The mobile payment market, a representative example of FinTech, has already been dominated by Paypal and Alibaba, while VISA and AMEX dominated the credit card market in the past.

## B. FinTech Industry in South Korea

As human society has become an intelligent and information based society thanks to the 4<sup>th</sup> Industrial Revolution, the vitalization of the data industry has become an important in most companies. In particular, the big data in the financial industry has become an important asset to the extent that they determine the direction of the construction of infrastructures. Ernst & Young defined the traditional FinTech and

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1) It is a regulation, which means Company and Bank need to be separated.

the emergent FinTech separately according to the degree of financial innovation. First, traditional FinTech is a facilitator that is included in the value chain of existing financial services together with the existing electronic finance to enhance the efficiency of services and plays the role of supporting innovation so that financial services can be automated and be efficient through ICT. Emerging FinTech enterprises, on the other hand, are emerging FinTech enterprises that are disruptors that can disrupt the existing financial service delivery systems and they are in charge of the core of the value chain of financial business by getting out of the role of as financial companies and directly communicating with customers. The emergent FinTech enterprises are not financial companies but are start-ups and venture businesses with innovative technological prowess that advanced into the financial industry by implementing their business ideas into services, and they are providing financial services differentiated from those of existing financial companies. As such, aided by technological advancements, emergent FinTech enterprises are launching new types of financial services and products, such as biometric authentication, robo-advisers and cryptocurrency. They are dividing the financial business by function to build new business models (Ernst & Young, 2014). This trend shows that FinTech is being recognized as a new growth engine. A leading FinTech powerhouse is the UK. The UK actively pursued the fusion of financial circles and IT industrial circles since the 2008 global finance crisis.

Therefore, the number of FinTech workers in the UK was estimated to be 135,000 and it was revealed that there are around 1,800 FinTech enterprises in London alone. The US is promoting the FinTech industry as a latecomer, but US seems to catch up with the UK soon. The US is actively promoting the FinTech industry centering on Silicon Valley and New York. The FinTech industry has been rising actively to the extent that 83% of the amount of money invested in FinTech was concentrated on FinTech start-ups in the US as of 2013 (Robert & Maria, 2014). However, on looking into the domestic finance enterprises in comparison with other countries,

it can be seen that the amount of R&D investments is much smaller compared to developed countries. As of 2015, the amount of South Korean financial companies' R&D investments was \$6 million, which was much smaller compared to that of US, UK and Germany. As of 2014, among the amounts of R&D investments by financial companies by country, the amount in US was \$4.1 billion, more than 800 times that of South Korea, and that of UK was \$500 million, more than 100 times that of South Korea (Miroudot & Nordström, 2019). In addition, according to the OECD, the number of patents registered in relation to the financial industry in South Korea was smaller than that of developed countries such as US, Japan and EU as well as that of China. The countries that applied for the largest number of PCTs of financial industry related patents are US and Japan and the relevant number of South Korea since 2015 was shown to be 467, which was smaller than that of China. In this situation of the current times, the importance of technology prediction is increasing for the establishment of future technology strategies as it will enable rational prospects of the speed and direction of development of technologies considering customer needs and changes in competition environments (Coates et al., 2001). Information regarding a company's business performance is one of many concerns of external users. In fact, a company always faces many uncertain situations in the modern business environment (Do Nguyet, 2017). Therefore, recognizing the fact that the domestic FinTech industry has not been internationally activated, this study is intended to examine the overall situation of the domestic FinTech industry and give direction to financial industry, future trends in applications of AI in domestic financial industry.

### C. Artificial Intelligence

The biggest event in which artificial intelligence has attracted attention from around the world was the Go match of the century between the ninth grader Lee Sedol and the artificial intelligence Alpha Go

played from March 9 to 15, 2016. Artificial intelligence can be defined as a technology that applies systems to machines so that machines can think like humans. However, there is one thing here that should not be neglected. The way of thinking by artificial intelligence is similar to that of humans. Therefore, the definition of artificial intelligence should not be limited to systems that have ways of thinking similar to those of humans. Although their ways of thinking are similar to those of humans, they may surpass humans or may be simple (Kim et al., 2016). The first concept of artificial intelligence appeared in 1956 at the Dartmouth conference, where approximately 10 mathematicians and scientists gathered (Tractica, 2015). At that time, the concept of artificial intelligence was close to the concept of computers with the arithmetic function intended to unfold logics with machines to solve given problems. Thereafter, studies of artificial intelligence techniques began in the 1960s, but the studies encountered technological limitations in the 1970s so that questions about feasibility of artificial intelligence began to be raised. At the beginning of the 1980s, the development of database systems that manage data began and this led to the resurfacing of artificial intelligence. As the solutions provided by machines based on database attracted attention, artificial intelligence began to attract attention again. Thereafter, interest in artificial intelligence has rapidly increased from 1990 to the present and related studies have been conducted actively. In particular, artificial intelligence is magnified greatly thanks to the Alpha Go phenomenon. The prospects for the artificial intelligence market vary by institution. However, it is expected that the artificial intelligence market will grow fast in the future with the growth in technological evolution in this area.

According to Tractica, a specialized market research firm, the artificial intelligence market is expected to grow at an annual average of 82.9% from about 300 billion won in 2015 to form a market of about KRW 5 trillion by 2020 (Tractica, 2015). To infer a prospect of artificial intelligence through the market scales of Japan, South Korea, and the US, EY Research Institute in Japan surveyed the

scale of artificial intelligence-related markets and predicted that the scale would increase from about 32 trillion won in 2015 to about 240 trillion won by 2020 with an annual growth rate of 44%. KT Economy and Management Research Institute predicted that the scale of the domestic artificial intelligence market would become 2.2 trillion won in 2020 and 27.5 trillion won by 2030 (Kim et al., 2016). In addition, IBM in the US predicted that the scale of the artificial intelligence market would reach 2,000 trillion won by 2025, and McKinsey predicted that the relevant scale would reach a higher figure of 7,000 trillion won. Therefore, this study predicts that the scale of the market for artificial intelligence will grow further in five years and takes note of the active growth.

#### D. Present Situation of Use of AI in the Financial Industry

At the time of the 4<sup>th</sup> Industrial Revolution alone with artificial intelligence, or more precisely, 'recognition automation', the strategy for digital transformation of financial services is shifting away from simple service differentiation, to the separation of financial services that appears as the barriers in the financial disappear. According to Article 98 (1) 3 of the Financial Investment Services and Capital Markets Act of South Korea, the act of inviting those who are not Certified Investment Advisors or investment managers to conduct investment advisory business or discretionary investment management services is prohibited (Lim et al., 2018). However, in accordance with the amendment of the enforcement decree of the relevant act issued by the Financial Services Commission on June 27, 2016, item 1-2 of Paragraph 1 of Article 99 of the Financial Investment Services and Capital Markets Act was newly established to allow investment advisory services using robo-advisers that satisfy the investor protection conditions (Financial Commission, 2016). According to Hyundai Research Institute, the 'robo-adviser', which plays the role of making asset management in the financial industry

to be carried out by artificial intelligence, is a compound word of robot and adviser, which means minimizing human intervention and providing software based automated financial advisory services. The artificial intelligence technology based on big data and machine learning is being combined with financial theories so that computers manage assets on behalf of humans. As was shown in the results of a questionnaire survey conducted by CFA Institute in 2016, in response to a question, 'Which promising technology will have the largest effect on the financial services industry?', 40% of the respondents selected robo-adviser as the most promising technology five years later. As such, it can be seen that the AI-based industry has become highly recognized by people as an industry in the financial industry.

As artificial intelligence is inferring based on big data and processing unstructured data into meaningful data through interactions with humans, financial services, which had been felt difficult, are becoming easier to access thanks to artificial intelligence. Through the concept of PSS (Product-Service System), financial services are used as a means of servitization (Lee, 2008). As the artificial intelligence technology is transplanted into financial services, productization and servitization are accelerated (Hitoshi et al., 2013). In particular, financial services using artificial intelligence are rapidly encroaching on human domains, including not only investment decision making on stocks, bonds and foreign exchanges, but also loan approvals, effective asset allocation, financial counseling, and core decision making (Olanrewaju, 2014). The technology engines of artificial intelligence are ranked in many technology groups that can realize artificial intelligence-related services such as delayed word processing engines, decision making engines, and user interface engines and it is expected that artificial intelligence technology will improve productivity in most industrial areas (CBInsight, 2017). In the era of the 4<sup>th</sup> Industrial Revolution, operation models in companies should be fundamentally redesigned, and core approaches necessary for innovative operation models should be comprehensively and continuously used for financial businesses to continuously increase profits, reduce

costs, and improve customer satisfaction.

## E. Social Network Theory

The social network theory is based on the perspective that the structural characteristics of social relations affect behavior, and it uses social network analysis techniques. Social network analysis is a method of modeling the relationships between individuals and groups as nodes and links to quantitatively analyze the structure, diffusion, and evolution of the topology. It shows how independent entities are connected within the network, indicating the flows between knowledge, information, people, and organizations, which is used in various fields. In the existing supplier relationship management, the attribute data of each supplier have been analyzed according to the traditional data analysis procedure using statistical methodologies. However, social network analysis is a technique that quantifies and analyzes the connecting relationships of individuals, not attribute data. It gives a value of 1 when nodes are connected with each other and a value of 0 when nodes are not connected with each other, and it conducts quantitative analysis based on the values (Kim & Kwahk, 2013). The big data analysis methods for social network analysis include not only data analysis, but also all stages to collect and preprocess data. Therefore, in this study, data analysis procedures and methods were divided into four stages: data collection, data preprocessing, data analysis and visualization.

### 1. Data Collection

Today, huge amount of data is accumulated in digitized information exchange spaces. Big data means extracting valuable information by collecting, managing, and analyzing such huge amounts of data. Gartner defined big data as "information assets that have the characteristics of large amounts, ultra-high speed, and diversity, which require new forms of processing for better decision making, finding implications, and process optimization." (Beyer &



Laney, 2012).

Big data analysis has diverse advantages. As computer analysis is performed based on algorithms, time, manpower, costs can be reduced after constructing the system. Since there is no problem of reliability between coders because data coding is carried out without human coding. As diverse relationships can be identified because large scale data are utilized, the possibility to make type II error is reduced (Park, 2013). In addition, since it is data-driven, there is an advantage that the possibility for the researchers' bias to be involved in interpretation is reduced.

When collecting big data, automated methods using a computer are utilized. Methods for collecting large-scale data can be divided into methods using an open API (Open Application Programming Interface) and methods such as web-crawling and log collector. In this study, a representative web-crawling technique is used. The R program was used as a web scraping tool to collect the Naver news data for the last three years between 2017 to 2019.

## 2. Data Cleaning

Although purifying the collected data into a form for analysis is required for all data, data preprocessing is more essential and difficult for unstructured data. In particular, data cleaning is essential for text-based big data collected in an automated way because the scales of such data are huge. Data cleaning utilizes the 'text mining' technique and standardizes unstructured data using Natural Language Processing (NLP). In the stage of data cleaning, text data preprocessing and morphological analysis are carried out.

## 3. Data Analysis and Visualization

In this study, the target of data analysis was limited to unstructured text data. The statuses of individual suppliers according to their network topologies and potential critical suppliers will be evaluated. Therefore, centrality analysis, that is to find the most highly utilizable keywords from the analysis of network topology of each node, was carried out. In this study,

data mining, correlations, and clustering techniques were applied to analyze the data, and the results were visualized through the NodeXL program.

## III. Research Methodologies

In this study, to achieve the study purpose and necessity presented in the introduction, chapter 1, and chapter 2, based on previous studies on artificial intelligence, social network analysis was conducted to predict the changes in the future environment of the financial industry through the artificial intelligence technology. Related words were collected centering on the keywords of finance and AI with a view to predicting what risk factors and opportunity factors would occur in the future.

Therefore, news data for the past three years were collected based on the time when interest reached its peak to figure out what factors make the relevant technology to be magnified. In the big data analysis, effort was made to secure credibility based on public news data rather than private data and figure out the changes in future environments in the financial industry made by that artificial intelligence technology.

The text data set was collected through web crawling which is carried out by the researcher after implementing the codes through the R program. The data collected in the form of texts were cleaned with the R program, and the data mining technique was applied to the data for frequency analysis and correlation analysis. The centrality analysis and cluster analysis were carried out using the NodeXL program, and the results of the study were visualized to examine the network structure.

## IV. Analysis and Results

The statistical values calculated through the

NodeXL program are as shown in Table 1. Vertices refer to the total number of nodes in the network, and Unique Edges refer to the number of nodes connected. Edges with Duplicates mean the nodes that are connected in duplicate among all nodes. Total Edges mean the total number of connections, and Self-Loops means that one node is associated with itself. Connected Components refer to the number of groups to which a node is connected, and Single-Vertex Connected Components refer to the number of independent nodes that are not connected to any other node. Maximum Vertices in a Connected Component refer to the maximum value of the connected nodes, and Maximum Edges in a Connected Component refers to the maximum value of the number of connected nodes. Maximum Geodesic Distance (Diameter) refers to the shortest path distance that one node must pass when moving to another node, and Average Geodesic Distance refers to the average connection distance between nodes. Graph Density refers to the degree of connectivity between nodes in a network. Larger density values

of a network can be interpreted as indicating that information exchanges among the nodes in the network were activated further so that information is more actively exchanged between the nodes (Rowley, 1997). The network density values are derived in a range of 0 ~ 1, and through the analysis, a quite low value was obtained through calculation as the network density value (<0.05). This suggests that the keywords for FinTech technology are not organically connected with each other leading to exchanges, but exchanges are concentrated around a small number of certain keywords (Moon & Kim, 2020). NodeXL is used to calculate the network structure.

In network analysis, identifying the roles of nodes in the network or the effects of the nodes according to the relationships between nodes in the network is basically important (Jeong et al., 2017). The network centrality analysis method is expected to configure networks on links that mean the interrelationships among the nodes that represent individual actors. It is important to determine the

**Table 1.** Network statistic value (2017-2019)

Graph Metric	2017 Value	2018 Value	2019 Value
Vertices	58	54	61
Unique Edges	103	93	90
Edges With Duplicates	107	117	120
Total Edges	210	210	210
Self-Loops	0	0	0
Reciprocated Vertex Pair Ratio	0.14516129	0.112903226	0.086614173
Reciprocated Edge Ratio	0.253521127	0.202898551	0.15942029
Connected Components	1	1	1
Single-Vertex Connected Components	0	0	0
Maximum Vertices in a Connected Component	58	54	61
Maximum Edges in a Connected Component	210	210	210
Maximum Geodesic Distance (Diameter)	6	6	6
Average Geodesic Distance	3.112961	2.904664	3.044343
Graph Density	0.042952208	0.048218029	0.037704918
Modularity	-	-	-
NodeXL Version	1.0.1.423	1.0.1.423	1.0.1.423

\* Excerpt from NodeXL Pro Program

correlations between the networks (Jeong et al., 2017). In particular, the interpretation of the center such as which node plays the role of the hub and which node plays the role of an intermediary is the most important. Identifying the roles, locations, characteristics, and influences of individual nodes in the entire network is also important.

The main keywords in the FinTech and AI news regarding Research Question 1 of this study are induced using text mining technologies. The primary purposes of this study are to identify patterns AI, which is an innovative technology, shown in the present situation of the domestic financial industry, which changes rapidly following the initiation of the 4<sup>th</sup> Industrial Revolution, respond to crises, and also to predict future economic trend more quickly. In order to predict new opportunities following the new changes, those trends that are emerging rapidly were analyzed based on the major areas that have recently become issues in the financial industry. It also finds the uses of AI to identify what patterns are shown. On reviewing the top 10 major keywords over the last three years shown in Table 2, it could be seen that words such as ‘enterprise’, ‘government’, ‘business’, ‘technology’, ‘market’ and ‘service’ had high connection centrality. The fact that a keyword has high connection centrality means that the keyword is a core keyword that is highly likely to merge with other keywords. As for connecting centrality, whereas words such as ‘enterprise’, ‘government’ and ‘business’ were found to have connection centrality in 2017 and 2018. Words such as ‘news’, ‘development’, ‘channel’, ‘growth(Rise)’, ‘transaction (automatic)’, ‘automation (automatic)’ newly emerged in 2019 indicating that the trend pattern was changing. When considered based on these results, it can be seen that the role and weight of AI in the financial industry has become gradually more important from 2019.

The major results of the network analysis in this study are as follows. As a result of the analysis of keywords in 2017, keywords such as enterprise, government, market, and domestic were found to have high betweenness centrality. Betweenness centrality of a keyword means that the relevant

Table 2. Result of centrality (Top 10)

No	Core Keyword	2017			2018			2019			
		D.C	B.C.	E.C.	D.C	B.C.	E.C.	D.C	B.C.	E.C.	
1	enterprise	17	752.236	0.0083	15	285.775	0.0083	15	732.703	0.0072	0.046
2	business	16	375.625	0.0074	14	403.258	0.0083	14	609.133	0.0072	0.051
3	government	13	598.469	0.0072	12	349.583	0.0084	12	371.592	0.0071	0.051
4	technology	12	267.383	0.0067	11	392.554	0.0085	11	360.959	0.0068	0.033
5	market	9	587.525	0.0072	10	486.055	0.0083	8	205.531	0.0061	0.028
6	domestic	9	416.521	0.0074	10	162.468	0.0077	8	266.052	0.0065	0.021
7	service	8	263.467	0.0067	9	281.395	0.0079	7	243.078	0.0062	0.020
8	support	8	109.043	0.0069	9	105.897	0.0079	7	173.404	0.0064	0.026
9	last year	8	276.784	0.0069	8	50.212	0.0076	7	154.294	0.0065	0.034
10	finance	7	98.040	0.0069	8	98.690	0.0072	7	70.825	0.0067	0.027

D.C.: Degree Centrality (Sum of In-Degree and Out-Degree)  
 B.C.: Betweenness Centrality  
 C.C.: Closeness Centrality  
 E.C.: Eigenvector Centrality





found to be affected by keywords such as finance, investment, transaction, bank, and technology while affecting keywords such as Naver, government, small and medium enterprises, and growth. It was shown to exchange effects with the keyword support. The keyword 'development' was found to be affected by keywords such as algorithm, robot, and system while affecting keywords such as application, research, business, and plan. It was shown to exchange effects with the keyword technology. Given that information, that is the trend in which the role of AI in the financial industry was mainly supported by government, enterprise-led technology, and service development, domestic business has been changed greatly as keywords such as growth, transaction, and automation were newly magnified. From this we can infer that AI is growing in the financial industry. In addition, it can be seen that the development of diverse services and the activation of transaction channels are necessary in financial industry.

The primary purpose of this study is to identify future patterns in AI in financial industry. Revolution, respond to crises, and predict economy more quickly. In order to preoccupy new opportunities following new changes, those trends that rise suddenly were analyzed based on those major areas that have recently become issues in the financial industry and in the use of AI to identify new patterns in the future

On reviewing year-by-year based on cluster analysis, it can be seen that in 2017, the keywords finance, Finance + AI, domestic, investment, market, last year, record, rise, this year, and news were mapped to group 1 within the network. Other keywords problems, settlement, analysis, citizen, policy, government, Donald Trump, USA, president, and possibility were grouped together into group 2. The keywords, forecasting, the first, industry, industrial revolution, future, research, result, technology, science, and development were grouped into group 3. Given the results as such, it can be seen that 2017 was the early stage in which the AI-based financial industry affected South Korea due to government investments and high interest in the US.

In 2018, the keywords service, data, big data,

analysis, possibility, explanation, channel, and news were strongly connected to each other into group 1. The keywords offer, domestic, event, progress, management, program, bank, and customer were mapped into group 2. In addition, it can be seen that keywords forwarding, problem, government, growth, economy, and revolution were grouped into group 3. Given these results, it could be seen that in 2018, the potential of big data-based AI was in the process of being recognized. It can be seen that the government and the economy were interested in and supported innovation, and it can be inferred that it had positive effects from the connection of keywords such as government, growth, economy, and revolution with each other.

In 2019, the keywords news, today, Naver, channel, YouTube, record, subscription, world, and USA were mapped into group 1. The the keywords Finance + AI, Dealing, volume, investment, enterprise, bank, customer, and finance were mapped into group 2. In addition, the keywords automatic, system, construction, offer, information, customer, service, and using were grouped into group 3. In 2019, unlike in 2017 and 2018, new patterns were found. On reviewing group 1 and group 3 in 2019, it could be seen that commercial sites such as YouTube and Naver were activated rather than investments by enterprises and the government.

Based on the analysis results, the relationships between the major keywords corresponding to Research Question 2 are identified. This suggests that the finance industry should be developed into the AI industry, and customer interest was increasing through the commercial enterprises. In addition, the fact, that 2019 was the last stage of gradual verification of the potential of AI in the financial industry, was supported by group 3 in 2019. It can be seen that transactions through financial AI were recognized by customers and that the biggest background for financial AI to be recognized by customers has changed. In 2017, the government's investment and the interests of developed countries formed domestic awareness of AI, while in 2018, AI accelerated the innovation of the financial industry with the interests

of banks and customers through big data analysis. In 2019, when there was a greatest change in trend, the pattern shifted from government investments to commercial enterprises. This means that in 2019, the introduction of AI technology by the financial industry formed positive effects as the development of cutting-edge ICT and existing financial services were combined in the age of the 4<sup>th</sup> Industrial Revolution.

This study has several academic contributions. Firstly, a major contribution of this paper is finding pattern of AI in financial industry under the new situation triggered by 4<sup>th</sup> industrial revolution, eventually to prepare future opportunities and dangers. The study finds roles of AI from the analysis of text data in news between 2017 to 2019, showing trend of technological evolution of AI in this period. This study analyzed the data to find trends and patterns in emerging issues in applications of AI to financial industry, which will lead to new opportunities.

Secondly, this study applies network analysis technique, which is a popular tool in computer sciences, business and economics, to future prediction, which shows technological trend and future technologies.

Thirdly, this study has a contribution that it uses text from news, while other future predictions mostly based on human decision making. Reliable source of data is essential to find current pattern and to predict future. News is one of the reliable media from which we can find issues most people are interested in. It is important to secure reliable data source to predict future (Baini et al., 2011; Bizer et al., 2012). Based on the analysis of text data in news from 2017 to 2019, innovation in financial industry will be enhanced and accelerated over next 5 years.

Fourthly, the approach suggested in this study can be used together with other traditional future prediction methods such as delphi, scenario and environmental scanning methods to predict future. It can also be applied to producing strategies and policies in all industries other than financial industry.

This study has several practical contributions. Firstly, this research studies AI, most innovative

technology in the time of 4<sup>th</sup> industrial revolution. This study also focuses only on financial industry as an application area of AI. It finds major influence of AI on financial industry and their trend in the future.

Secondly, this study induces key issues in AI in financial industry from the analysis of news data, eventually suggesting future technologies and future trends. The social network analysis in this study finds major key words such as automation of service, customers and services. More and more commercial sites on this will be introduced in the market. Therefore, new strategy satisfying customer needs is necessary in the field of contents based financial services. Virtual reality and augmented reality will also influence contents based financial services market alone with AI. This study also confirms that video contents providers such as YouTube is shown as an import keyword in financial industry, on which financial companies should focus in the future. Other related keywords on this word such as venture, small and medium sized companies, establishment, and growth support this fact. As the power of technological innovation is shifting from large corporation to small and medium sized companies, the impact of AI in financial industry will be bigger in future.

## V. Conclusion

The primary purpose of this study is to identify current pattern in the application of AI in financial industries. It can be used to respond to crises in the future and to predict opportunities in the future more quickly. In order to predict new opportunities following new changes, those new trends were analyzed in area of finance & AI, which recently became issues in the financial industry. This study used text mining and social network analysis techniques to find patterns in the area.

Since there are much content-based financial services, provided to customers these days, this study predicted

that there will be more and more AI-based transaction channels combined with the existing financial system to satisfy the needs of customers these days. The recent decision of Microsoft Co. to focus on virtual reality and augmented reality instead of wearable computers for future investments is expected to have significant effects on the development of content-based business worldwide. In addition, the association between the domestic financial industry and the commercial video content site such as YouTube has high correlations in this study. The keywords such as venture business, small and medium enterprises, construction, and growth further support this. As the role of big enterprises are getting reduced, that of small business will be enlarged. There also will be many small businesses based on these new technologies such as AI and virtual reality in financial areas.

## References

- Angelina, K., & Imran, G. (2014). Landscaping UK FinTech. *UK Trade & Investment*.
- Bae, J. (2018). A Study on the Legal, Institutional, and Technical Factors for Activation of Domestic FinTech Industry: Focusing on the Consensus Delphi Technique. *Asia-pacific Journal of Multimedia Services Convergent with Art, Humanities, and Sociology*, 8(1), 101-112.
- Bank of Korea. (2016). deposit and withdrawal basis.
- Bank of Korea. (2017). the Number of Stores in Korean Financial Institutions.
- Batini, C., Cappiello, C., Francalanci, C., Maurino, A., & Gianluigi, V. (2011). A capacity and value based model for data architectures adopting integration technologies. *AMCIS*, 327.
- Beyer, M. A., & Laney, D. (2012). The importance of 'big data': A definition. Available at <http://www.gartner.com/id=2057415>.
- Bizer, C., Boncz, P., Brodie, M. L., & Erling, O. (2012). The Meaningful Use of Big Data: Four Perspectives - Four Challenges. *ACM Sigmod Record*, 40(4), 56-60.
- CBinsight. (2017). AI 100: The Artificial Intelligence startups redefining industries. Available at <https://www.cbinsights.com/research/artificial-intelligence-top-startups>.
- Chakravorti, B., & Mazzotta, B. D. (2013). *The cost of cash in the United States*. Institute for Business in the Global Context. The Fletcher School, Tufts University.
- Choi, C., & Ham, H. (2015). Theoretical study on the business model of FinTech enterprises. *The e-Business Studies*, 16(4), 85-100.
- Coates, V., Farooque, M., Klavans, R., Lapid, K., Linstone, H. A., Pistorius, C., & Porter, A. L. (2001). On the future of technological forecasting. *Technological forecasting and social change*, 67(1), 1-17.
- Do Nguyet, A. (2017). The Impact of Earnings Volatility on Earnings Predictability. *Global Business and Finance Review*, 22, 82-89.
- Financial Commission. (2016). Enforcement Decree of the Capital Markets and Financial Investment Business and Legislative Notice for Amendment of Financial Investment Business Regulations.
- Hitoshi H, Kaushalesh L., & Shinkai N. (2013). Servitization, IT-ization and innovation models, Routledge.
- IDC. (2016). Worldwide Semiannual Cognitive/Artificial Intelligence Systems Spending Guide.
- IITP. (2017). ICT Technology Level Report. Available at <https://www.iitp.kr/main.it>.
- Jeong, D., Yi, M. A., & Shin, D. (2017). Study on the Link ability of Public Information Using Social Network Analysis. *Journal of the Korean Society of Surveying, Geodesy, Photogrammetry and Cartography*, 35(6), 461-470.
- Kim, D., & Kwahk, K. (2013). Investigating the Global Financial Markets from a Social Network Analysis Perspective, *Journal of the Korean Operations Research and Management Science Society*, 38(4), 11-33.
- Kim, J. (2018). Tasks and Current Status of the Uses of Artificial Intelligence (FinTech AI) in the FinTech Industry in the USA. *Journal of Payment and Settlement*, 10(2), 185-214.
- Kim, Y., Rue, S., & Kim, W. (2016). Impacts of A.I on FinTech, *Korea Institute of Information Technology Magazine*, 14(1), 23-28.
- Korinek, A., & Stiglitz, J. E. (2017). Artificial Intelligence and its Implications for Income Distribution and Unemployment. *The National Bureau of Economic Research*, JEL No. D63, E64, O3.
- Lee, J. (2008). Evaluating the interactivity of ubiquitous service: an integrated metric based on UCD (User-Centered Design) principles. Available at <http://s-space.snu.ac.kr/handle/10371/11633>.
- Lim, H., Ryu, D., & Yang, H. (2018). Economic Analysis of Robo-advisor Industries: A Case Study. *Korean management review*, 47(3), 725-749.
- Marianne, D., David, S., & Swati C. (2018). IDC's Worldwide Semiannual Cognitive/Artificial Intelligence Systems Spending Guide Taxonomy. Available at <https://www.idc.com/getdoc.jsp?containerId=US44264118>.
- Miroudot, S., & Nordström, H. S. (2019). *Made in the World Revisited*. Robert Schuman Centre for Advanced Studies Research, Paper No. RSCAS 2019/84, 33.
- McAuley, D. (2015). What is FinTech, Wharton FinTech.
- McCauley, D. (2016). *Ghosts in the machine: Artificial*



- intelligence, risks and regulation in financial markets*. London: Thought Leadership Consulting ([www.euromoneythoughtleadership.com/ghostsinthemachine](http://www.euromoneythoughtleadership.com/ghostsinthemachine)).
- Moon, J., & Kim, J. (2020). Technology Predicting the Future using Data Mining Techniques. *International Journal of Recent Technology and Engineering*, 8(5), 4204-4208.
- Mustafa, M., & Rahman, M. (2015). Financial inclusion and per capita real GSP growth across fifty US states and the district of Columbia: Evidence from panel cointegration and GMM estimates. *Global Business & Finance Review*, 20, 87-94.
- Olanrewaju, T. (2014). The Rise of the Digital Bank. *McKinsey on Business Technology*, 33. Available at <https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/the-rise-of-the-digital-bank>.
- Park, D. (2013). Analysis of news information network as a big data analysis method of news articles. *Korean Journal of Journalism*, 57(6), 234-262.
- Robert, G., & Maria, G. (2014). The Rise of FinTech-New York's Opportunity for tech Leadership. *Accenture*.
- Rowley, T. J. (1997). Moving beyond dyadic ties: A network theory of stakeholder influences. *Academy of management Review*, 22(4), 887-910.
- Schwab, K. (2017). The Fourth Industrial Revolution, Portfolio/Penguin. Geneva, Switzerland: Crown Publishing Group, 184. *Science and technology policy institute forum*, 26(2), 12-15.
- Tractica. (2015). Artificial Intelligence for Enterprise Applications: Deep Learning, Predictive Computing, Image Recognition, Speech Recognition, and Other AI Technologies for Enterprise Markets-Global Market Analysis and Forecasts. Available at <https://tractica.omdia.com/wp-content/uploads/2015/04/AIE-15-Brochure.pdf>.