

Advanced data integration in banking, financial, and insurance software in the age of COVID-19

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Abstract

This study contributes to our understanding of how the emergence of the COVID-19 pandemic changes the global Banking Financial Services and Insurance (BFSI) landscape. Before the COVID-19 pandemic, BFSIs corporate strategy was solely aligned to the quest for operational efficiency. However, during the ongoing COVID-19 pandemic, global BFSIs are forced to adopt digital transformation in their operations due to a rise in transaction volumes. The ongoing COVID-19 pandemic already triggers holistic innovations concerning the global BFSI's product, process, concept, trend, or idea. Thus, the BFSI cannot survive without efficient and innovative system software for global operations. The study plots the hype cycle to identify relevant technologies to deal with real-world business problems. The hype cycle indicates that the need for advanced data integration is growing and COVID-19 pandemic has already triggered it. The study argues that the incorporation of data integration might be challenging initially for BFSIs but eventually it may result in an efficient model to handle these types of pandemic or unexpected circumstances.

KEYWORDS

blockchains, COVID-19, Fintech, integration, IoT, Neurotech

1 | INTRODUCTION

Data revolutions bring both opportunities and challenges to the organizations in every sector. Today all industry sectors heavily rely on the data for overall operational and cost efficiencies to gain strategic advantages. Each day huge amounts of data are generated, and it is really very difficult to estimate accurately how much amount of data is generated per day. Figures show that in every second each person creates 1.7 MB of data which amounts to 2.5 quintillion bytes of data approximately that are generated by humans each day.* Internet, social media usage and development in communications channels all together leads to the extraordinary growth in the amount of the data. Financial industry more often termed as the Banking Financial Services and Insurance (BFSI), is also known to be heavily data driven for its innovative process management. Today most of the BFSI organizations have fully or semi-automated daily operation activities to reduce the overall errors by limiting the human interventions. The scope of fully or semi-automated daily operation activities lies with the BFSI's are wide. Namely today BFSI's demands for AI and automations in their daily operation activities

related to the back office activities, AML (Anti Money Laundering) analysis, KYC (Know Your Customer) verifications, shared services and others. Hence, BFSI's business processes models are the combination of networks of complex technologies that automate the overall operations as required by the various clients.¹ The scale of the opportunity for virtual workforce in BFSI is so large that sometimes it becomes a challenging task for the BFSI to identify the hidden process automations that will deliver the most value. This automated process generates an enormous amount of the unprocessed or raw data which is now termed as the Big data. Generated raw data is of no use or value unless and until it is further processed to transform it into useful information. To get full insights of this unprocessed data for the business purpose expert breaks it down into four scopes namely volume, variety, velocity and veracity. At all levels of a BFSI organization needs relevant processed data (information) available timely and with reduced cost.^{2,3} This could only be made possible by a network of the communicating devices coupled with the advanced business analytics that integrates the data at different levels. BFSI's service providers across the globe are in a process of transition from traditional business models to the complete digital transformation.^{4,5} Driven by exploding data volumes with time, BFSI organizations are rethinking their approach to data management. Hence, BFSI organizations across the globe are striving to prioritize shifting customer preferences,^{6,7} data integration at the international level, complying with the industry regulations, and combating financial crimes. Today the financial industry (BFSI) is known to be the heart or barometer of an economy as it plays the fundamental roles related to the fund flows and resources allocation. A stable financial system means a stable economy. Financial (BFSI) industries across the world today are looking for efficient and effective data driven solutions for daily operations. *"The most important business priorities for today's BFSI organizations are to make trusted data actionable at scale so it can be readily used by people, apps, machine learning, and more; and to turn data management challenges into opportunities"*.[†]

Presently the impact of COVID-19 is realized in every sphere including the BFSI. The COVID-19 pandemic drove the BFSIs to reconsider their traditional products, business strategies and models. COVID-19 begins the digital drive while at the same it raises several challenges. Now most of the BFSIs already implemented contingency business models. But it is important to look into how these business models accomplish digital values in the long run. Digital values in terms of doing the business easier and cheaper. Digital values can only be achieved through successful digital transformation and data integration. Most of the BFSIs have already started working on the business continuity plans. However they might not entirely be able to discourse the continuously changing and unseen risk factors that outbreak from the COVID-19 pandemic. The COVID-19 pandemic has already trained BFSIs about transfer to the cloud infrastructures. Consequently, today's BFSI organizations are thinking differently about the data Integration architecture. COVID-19 pandemic seems to be an incessant event although in the beginning postulation was different. COVID-19 pandemic accelerated remote work culture and forced the BFSI to adopt the business agility for successful digital transformation. Which indicates that the BFSI's are now optimizing locally and managing globally. All of these together lead to the business process reengineering and demand advanced data integration for controlling a distributed organization globally. Continuous technological transformations, distribution systems and fierce competition among the BFSIs have triggered extraordinary development in the financial services industry. The BFSIs are working towards building an advanced data integration architecture that would be useful for the long run. This is not possible without efficient harnesses of the technology and data to create real value for clients.[‡] Thus, BFSI cannot go alone without efficient and innovative system software. A system software for systems development, systems integration, digital transformations, systems maintenance, shared services, and others. Henceforward, it is important to understand the key trends, opportunities and challenges that are lashing the BFSI's transition towards the data integration development, and way forward. With these backgrounds the present study is taken to fulfill the existing literature gaps. This study contributes to our understanding of how the emergence of COVID-19 pandemic changes the landscape of the global BFSIs. Thus, continuous technology advancement is expected to further shape the future trend and escalate the business process aspect of the BFSIs. The present study is hereafter structured into following sections: current state of research; key drivers; potential application scenarios and challenges related to the financial industry's transition towards the data integration and way forward, followed by the conclusion.

2 | RELATED STUDIES

Industrial revolution brings automation⁸ across the world and in the last few decades also witnessed the impact of the technological advancement that changed the world as a whole as shown in Figure 1. First two phases of the industrial revolution brought industrialization across the globe and mostly related to the manufacturing process.

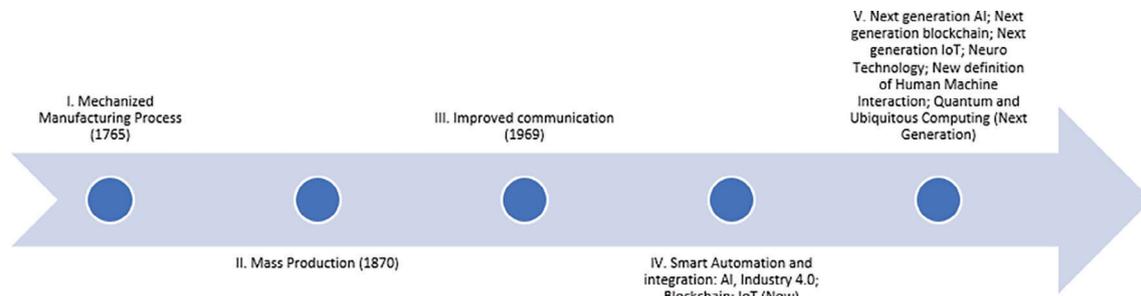


FIGURE 1 Different phases of industrial revolution. *Source:* Authors [Colour figure can be viewed at wileyonlinelibrary.com]

During the Phase I of the industrial revolution manual processes of manufacturing were replaced by the machines for achieving faster processing and higher precision of the overall end products. Further technological developments during Phase II lead to the concept of mass production to achieve economies of scales. Phases I and II of the technological revolutions is more often known as the industrial revolutions. Third phase of the industrial revolution is termed as the digital revolution. Which begins during the second half of the twentieth century. Digital revolution made an almost complete transformation of the mechanical and analogue process to the digital process. Digital revolution brings digitization of the overall process such as ease of the communications, ease of accessibility to the information, reliable sharing of the information and others. Industrial revolution of Phase III and onwards brings us into the era of information or age of information.^{9,10} Further revolution of information brings the demand for much improved version of the data informatization and integration. Some of the experts believe that currently we are in the fourth phase of industrial revolution whereas others believe that we are in the transition point from Phases IV to V of the industrial revolution. Industrial revolution that we have achieved in terms of technological advancement especially between the Phases I and III raises several questions on technological sustainability such as: “*Are we using these technologies for sustainable development*”; “*Development of technologies and its impact on overall society*”; “*Are we using the technology for good*” and so forth.^{11,12} The Phase IV of the industrial revolution is likely to bring advanced integration among the BFSI organizations’ business models. Now organizations are giving more importance to the social and environmental aspects in their business model over only efficiency or productivity in focus to achieve competitive advantages.¹³ Also during the first two phases of the industrial revolution, organization’s business models are more inclined towards the usage of technology for automation with higher degree of human interventions. However since the beginning of the Phase III of the industrial revolution, organizations are more inclined towards the complete business process automation process with lesser degree of human interventions.

Different phases of the Industrial revolution also impacted the BFSI from time to time as shown in the Figure 2. During the Phase I and Phase II of the industrial revolution especially banking operations got mechanized with the invention of Pantelegraph in the year 1865. Pantelegraph is known to be the successor of today’s fax machine through which images of the signatures are sent for verifications for different financial transactions over normal telegraph lines. Thereafter Transatlantic telegraph cable was laid down across the Atlantic ocean for telegraph communications. Transatlantic telegraph cable not only speeds up the flow of information from one continent to the other but also within the continents. The effect of Transatlantic telegraph cable has an immediate and direct effect on the business

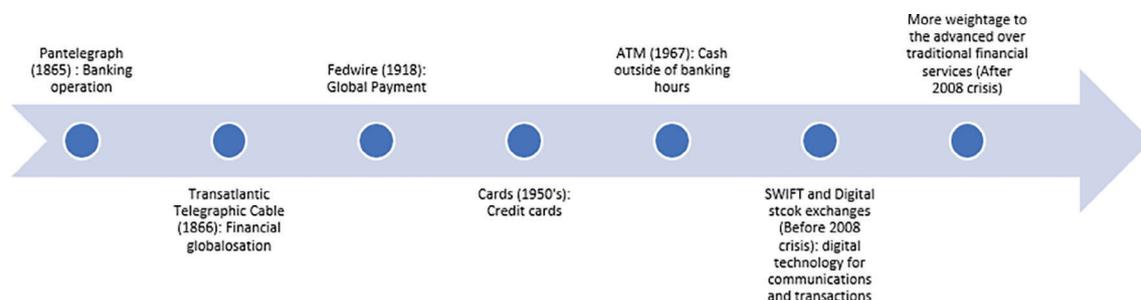


FIGURE 2 Technological revolution in financial industry. *Source:* Authors [Colour figure can be viewed at wileyonlinelibrary.com]

models. Transatlantic telegraph cable created exogenous shocks on the financial industry by connecting the world's economic actors and globalized the financial markets.^{14,15} Due to globalization of the information. There is a meaningful price convergence seen between the share and commodity prices listed on stock exchanges (London and New York). Since then today also transoceanic cables are used often for transferring financial data. The transatlantic telegraph cable reduces the communication barriers by making the information available in a timely manner across the globe.

Between Phases II and III of the industrial revolution communication improved significantly.¹⁶ During the early 1900's interbank payments were settled through the physical means of the cash or gold. In the year 1918 Fedwire global payment system was established. Establishment of the Fedwire made the interbank payments more real time and online; secured and reliable; and faster with much reduced overall cost of the financial transactions. Fedwire is well known as the first of its kind for a real time gross settlement system for electronic fund transfers, although today we have many alternative modes available for electronic fund transfers. Credit cards were initially introduced by the Diners Club in 1950 as a new method of paying for purchases. The question that remains important here is how it is different from the previous method of paying? Through credit cards one can make purchases on credit from several merchants instead of just one. Later this concept led to the innovation of the bank credit card system. To make cash readily available to the customers outside the banking hours for the first time Barclays Bank introduced the ATM (Automated Teller Machine) in the year 1967. Thereafter Phase III of the industrial revolution brings revolutions of data communications across the global networks. Before the Financial crisis of 2008 several notable developments seen especially in the financial industry (BFSI) such as stock markets were digitized, improved communication and payment channels were established with the blessing of evolving technologies. Now we are in the era of Industry 4.0 or industrial revolution Phase IV. The foundation of Industry 4.0 is based on the Internet of Things (IoT).^{17,18} The Internet of Things (IoT) not only improved the overall channel for data communication and automates the process, but at the same time it is integrating the whole system to achieve real time synchronization. Phase IV of the industrial revolution or Industry 4.0 is not only limited to the improved data informatization but it also includes data integration. COVID-19 pandemic fundamentally changed the process of the fourth industrial revolution in the way people live and work. The fourth industrial revolution is just not about the advancement of technology but has features to impact society. Data visibility and data sharing remain critical for the BFSIs organization in the 21st century. The COVID-19 pandemic opened up avenues for the innovation in the supply chain for mapping the global trade in the fourth industrial revolution. § The data remains the heart of the digitization and competitive advantages of any BFSI lies with the speed in adopting the technological changes. Thus, the digital revolution is not going to die. It is too early to comment on where COVID-19 pandemic is shifting us towards the fifth industrial revolution. So what could we expect from the industrial revolution (Phase V)? It should consist of more sustainable technological advancement in data integration bearing in mind the social, environmental, legal, and economic aspects as a whole.

Figure 3 shows the monthly (January 2004 to October 2020) Google search trends globally for the following terms 'informatization', 'data integration', and 'financial industry'. Data integration seems to be in much priority for BFSI

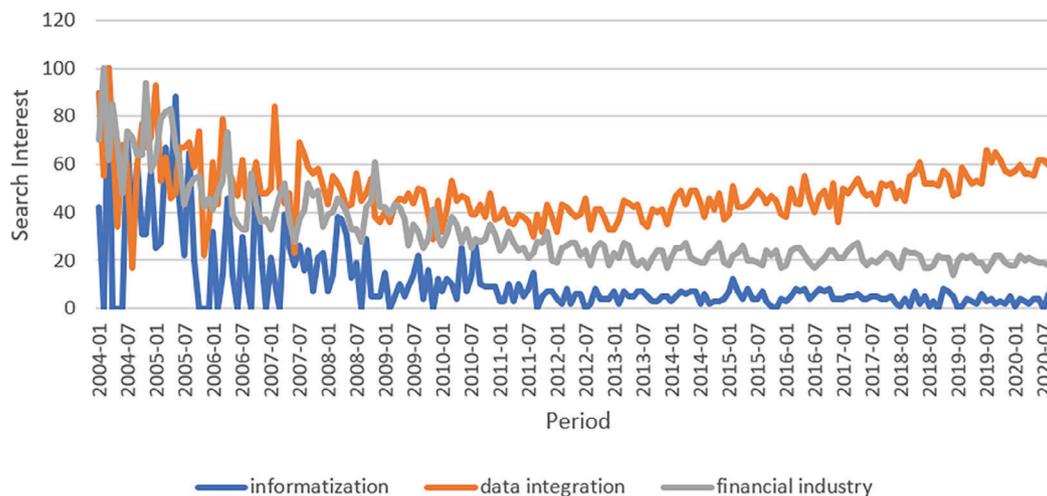


FIGURE 3 Google trends. Data Source: Google [Colour figure can be viewed at wileyonlinelibrary.com]

institutions beyond Phase IV of the industrial revolution as now data integrity models create security vulnerabilities. Figure 3 also indicates that before the financial crisis of 2008 all of these three terms namely ‘informatization’, ‘data integration’, and ‘financial industry’ showed higher spikes during early 2004. There is an overall percent decrease seen in the search interest of the terms ‘informatization’ and ‘financial industry’ after the financial crisis of 2008. Interestingly high volatility is observed in the search interest of the term ‘data integration’ and moreover it shows percent increase in the search interest globally since the financial crisis of 2008. Google trends data on global reaction to the term ‘data integration’ indicates that people are currently interested in and curious more about the term ‘data integration’.

3 | KEY DRIVERS

Following are the possible key drivers that enable BFSI transition towards the advanced data integration.

3.1 | Volume of data

Data informatization refers to the size of adaptation of the information by the geographical area, an economy or a society.

The first two phases of the industrial revolution brought automation to the manufacturing or production process due to improved machineries and electrifications. Whereas development of the Information and Communication Technology (ICT) brings Phase III industrial revolution that further improves the process automation with overall reduction of the cost and improved quality dimension of the end products. Development of the information and communication technology not only connected the world but at the same time it increased the size of the information based labour force or information based economy as shown in the Figure 4. Advancement of networking and communication channels globalized the world and likewise made human machine interaction possible at a certain level during the Phase IV of the industrial revolution. Globalization and informatization together brings growth in the share of the services sector across the world.^{19,20} Globalization and informatization “*is not just a phenomenon and not just a passing trend but it redefined industries, politics, cultures, and perhaps the underlying rules of social order*”. Data is the key driver of the Phase IV industrial revolution and beyond. Today organizations are efficiently managing their resources and innovating themselves by utilizing the available key information while making the strategic decisions.²¹ The ongoing COVID-19 pandemic accelerated the data volumes of the BFSIs enormously in the form of digital payments, trading volumes, claim settlements, shared services, and others. The large volume of data raises several challenges for the BFSI namely higher levels of fault tolerance, data protection, and others. However, timely dealing with such an increase in the volume of data is not easy in a real time business scenario. Today most of the organizations are managing their data following the 4 V’s (Volume, Velocity, Variety, and Veracity) concept of big data for value creation as shown in Figure 5.

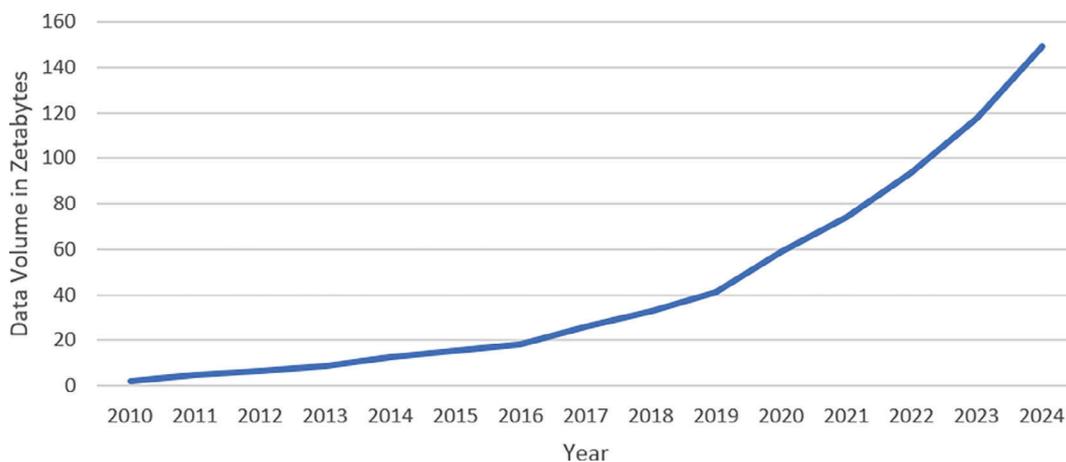


FIGURE 4 Year wise data volume in zettabytes. *Data Source:* Statista 2020, <https://www.statista.com/statistics/871513/worldwide-data-created/> [Colour figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com)]

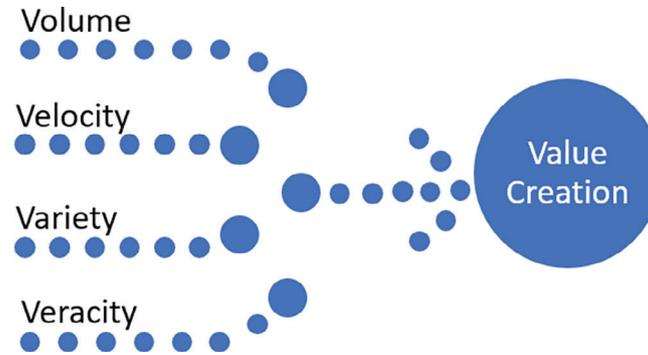


FIGURE 5 Value creation from the data. *Source:* Authors [Colour figure can be viewed at wileyonlinelibrary.com]

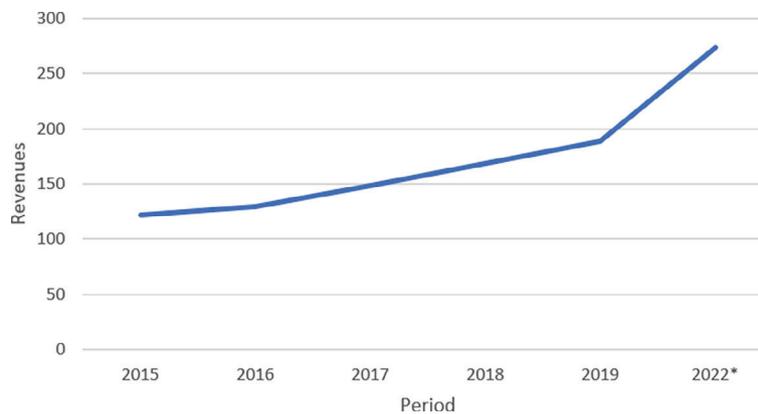


FIGURE 6 Global big data revenues in USD (billions). *Data Source:* <https://www.pcmag.com/news/the-big-data-market-is-set-to-skyrocket-by-2022> [Colour figure can be viewed at wileyonlinelibrary.com]

Today large volumes of data generated are extremely beneficial for the organizations as organizations are leveraging data for decision making and revenue generations.^{22,23} Data is the new currency today²⁴ and Figure 6 shows revenues generated year wise investing in data. No doubt the BFSI is one among the top three industries that invest heavily in building the big data infrastructure.^{25,26}

Today the BFSI plays an important role as an intermediation among the households, businesses or governments. To manage the information more effectively development of the advanced data integration techniques is BFSI's key area of focus.

3.2 | Computing speed and supportive technologies

Today computing speed could be best explained in terms of the Moore's Law where he made the perception that the number of transistors on a microchip doubles in every 2 years with the cost reducing of computers to halved.²⁷ Moore's Law extensively states that the computing speed and capability of computing devices will grow exponentially in every couple of years with reduced cost. No doubt that the past, present and future of computing speed is going to follow even more than Moore's law.²⁸⁻³¹ Today it is true to say that the "Moore's law is used as a metaphor for anticipated rapid rates of changes-not only in case of semiconductors, but in economic and social context". Higher computing speed along with the supportive technologies like AI and subsets, block chains, cloud computing, IoTs, Industry 4.0, Neuro tech and others will reduce the overall data handling time and cost. Explaining in mark of Moore's law: computing speed for the big data handling for creating organizations value will increase in every couple of years and associated cost will be minimized consequently. Hence, with due progress of the Phase IV of industrial revolution and beyond, the process of data integration will accelerate in every couple of years with cost mitigation.

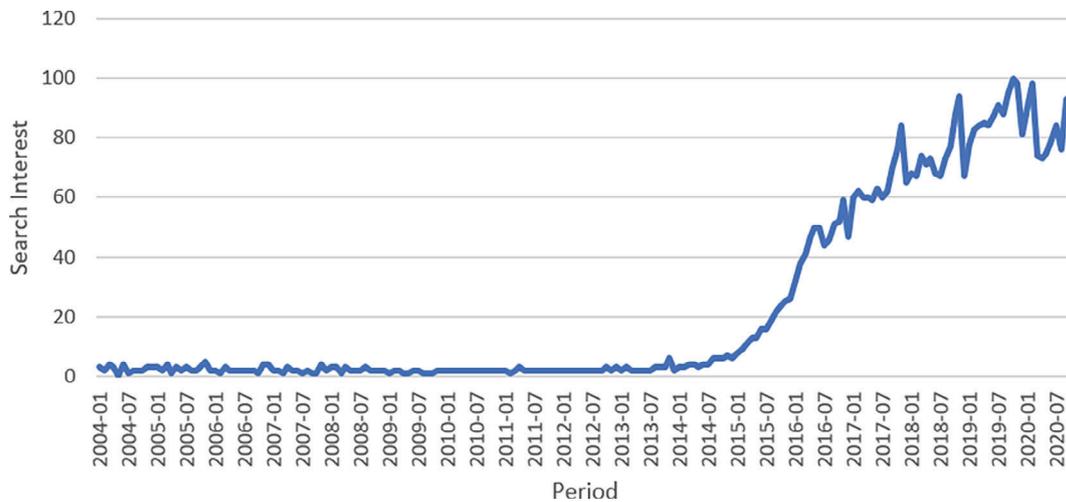


FIGURE 7 Monthly Google trends for fintech. Data Source: Google [Colour figure can be viewed at wileyonlinelibrary.com]

Today the BFSI is heavily technological driven and the last decade has seen significant development in Fintech (Financial technology).^{32–39} Since the COVID-19 lockdown alone in Europe witnessed a 72% rise in the usage of the fintech apps among the consumers.¶ The ongoing COVID-19 pandemic has both short term and long term impact on the BFSIs business process. In the short term BFSIs are adopting new technologies to meet their customers' requirements and reduce their overall service time. But in the long run BFSIs are looking for the more innovative technologies that provide avenues for the cost cutting, advanced integration, security, and business process management. Google trends data on global reaction to the term 'Fintech' in Figure 7 indicates that people are currently interested in and curious about the term 'Fintech' and moreover it shows an exponential percent increase in the search interest globally since 2014. Development of next generation fintech will drive the financial industry's transition towards advanced data integration.

3.3 | Improved communication

Successors of each phase of the industrial revolution have seen significant improvements in the global communication medium. Today effective communication is the basic need or necessity to both of an individual and organizations. An individual or organization does communicate in several forms such as written communication, verbal communication and non-verbal communication. The central objective of any communication system is transmission of the information effectively, and each communication system is connected with the integrated computing system. The success of the organization or individual today is directly linked to the overall effective communication process achieved.⁴⁰ To be a successful individual or organization one needs to quickly adopt the use of new communication technology and successfully integrate it into the system. Maslow's hierarchy⁴¹ of need or motivation theory says that each person has a different set of needs at different points of time in his life. Following Maslow all the needs of an individual and organizations communications could be mapped in a hierarchical order of communications according to their importance as shown in Figure 8.

Today individuals, organizations and governments are well connected through ICT in the globalized world. The present ongoing situation of COVID-19 pandemic highlighted the importance of social and governance factors in any organization. The social factor of any organization deals with the sensitive issues such as the human capital, employee relationship, customer relationship, stakeholder relationship, and others. Several global organizations choose layoffs to cope with the ongoing COVID-19 pandemic. As a result many people lose their jobs and it creates a negative image among the stakeholders about the organization. Similarly many organizations choose to reduce employees salary over layoffs. On the other hand there are organizations that continue to operate as previously. Likewise few organizations provided higher cooperation to their employees during the COVID-19 pandemic. All of these above instances highlighted that the COVID-19 pandemic accelerates the importance of social and governance factors in any organization. To maintain a good

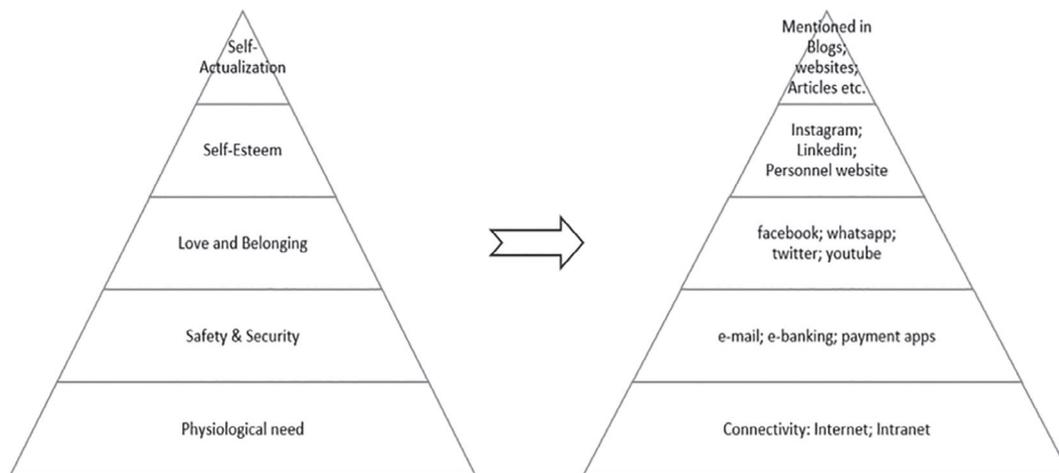


FIGURE 8 Maslow's hierarchy mapped into hierarchical order of communications. *Source:* Authors

social and governance among the stakeholders, organizations need to communicate effectively. Effective communication is the heart of any BFSI business process model for providing better services to its clients.

It is important to further look into how well the information and communication technology is accepted by the individuals, organizations and governments? How do people or groups or organizations transfer information to another? Previous study shows that technology use is driven by motivation. Motivation is related to ICT acceptance and online communication.^{42,43} So, it is important to know how we (individuals and organizations) interact with the world around us for decision making. Figure 8 shows how Maslow's hierarchy of needs could be mapped into the hierarchy of ICT for unified communications. According to Maslow's hierarchy of needs, until the physiological needs are satisfied, the others would not serve as motivators. Here in the hierarchy of ICT for unified communications, internet connectivity forms the fundamental or base layer of the hierarchy. Second layer of Maslow's hierarchy of need is 'safety and security' that includes health, employment, property and social stability whereas e-mail, e-banking, payments, e-health records and communication stability forms the second layer of the ICT hierarchy. Love and belongings contribute to the middle layer of the Maslow's hierarchy of needs, similarly social networking and social media like Facebook, Twitter, WhatsApp, and YouTube forms the middle layer of the ICT hierarchy. Fourth layer of the Maslow's hierarchy is self-esteem that includes confidence, achievement and uniqueness whereas Instagram, LinkedIn and personal websites from the fourth layer of the ICT hierarchy. Top layer in the Maslow's hierarchy of needs is self-actualization which includes creativity, acceptance and inner potential whereas mentioned in the social media such as blogs, newspapers, journals, articles and business reports and so forth, forms the top layer of the ICT hierarchy. Maslow's hierarchy of need or motivation theory says that each person has a different set of needs. Similarly, the hierarchy of ICT for unified communications indicates that each individual or organization has a different set of communications to meet a range of different needs. Today decision making is the heart of the successful management functions and good communication could be the controlling factor. Development of the ICT brings an additional social dimension to the definition of Informatization that has many far-reaching consequences in society.⁴⁴ ICT has a direct impact on the growth of the financial industry and economic development.^{45,46} Hence, further development of the ICT will provide the strong backbone to the financial industry in transition towards the advanced data informatization and integration in near future. Further improvement in the ICT infrastructures will not only enhance the BFSI organization service quality and cost efficiency, but at the same time BFSI organization will gain agility and time to market (TTM).^{47,48}

4 | APPLICATION SCENARIOS AND CHALLENGES

Following are the potential application scenarios and challenges that are related to the financial industry's transition towards the advanced data integration.

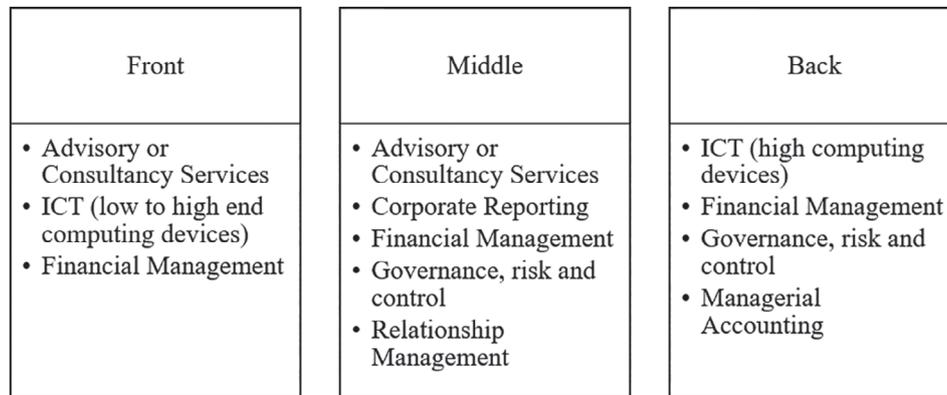


FIGURE 9 Key operational areas of BFSI organization. *Source:* Authors

4.1 | Operational areas

In general operational areas of a BFSI organization could be classified into three groups namely front end; middle; and back end as shown in Figure 9.

Front end of any BFSI deals with clients directly and are the key contributors to the performance and profitability of the BFSI organization. Front end needs ICT support for the most updated and real time data for its operation. Both low to high end computing devices are used for data processing, analysis, visualization, modeling, and coding and so forth, for client services. Front end professionals of BFSI organizations are directly supported by middle end professionals that provide relevant and timely performance data to interface with the BFSI clients. Middle end professionals look into the internal control measures and inter corporate strategy of the BFSI organizations. Middle end professionals handle on an average high volume, velocity, variety, and veracity of data as compared to the front end professionals. Back end consists of HR and administrative; Finance and Technology related functional roles that generally do not face the client directly. Most of the BFSI have their own in-house built in software and applications for different services. Back end professionals of BFSI also look at the very important aspects of BFSI's business factors such as accounting and compliance with local and foreign government regulations and internal regulations to ensure smooth operations. Back end operations are very critical for any BFSI organization and require advanced ICT backbone for overall smooth operations. Back end professionals generally deal with the data with high volume, velocity, variety, and veracity. Back end of any BFSI organization consists of a messy network of various high computing devices, equipment, tools, hardware and software. For smooth operation of BFSI at all levels starting from front to the back end, it needs the highest degree of data integration. Currently the operating data integration model of most of the BFSI faces issues with data loss and governance that creates security vulnerabilities. Hence, further development in the level of data integration is required to address both local and global aspects of accounting, compliances, laws and regulations, securities to counter all types of frauds and crimes in near future. Risk management and cyber security will be the key focus area of BFSI in the near future.⁴⁹⁻⁵¹ The greatest challenge of all that lies with BFSI is that current cybersecurity operating models do not match the real time operation speed. The ongoing COVID-19 pandemic fundamentally changes the course of BFSIs operational risk from efficiency to corporate planning. Post COVID-19 to maintain the BFSIs business operational resilience will play a key role. These include developing new operational models, branch operations, ATM operations, communications, security and surveillances, remote work, offshore operations, global operations, real time applications, and others.

4.2 | Available resources focus

Today BFSIs are offering different ranges of financial services that includes retail banking, corporate banking, investment banking, merchant banking, payment services, cards, Forex, investments, credits and others. For offering such financial services today BFSIs are heavily ICT driven. To support ICT driven business models BFSI needs technologically skilled professionals.⁵² Previous studies also stressed on the fact that organizations should not ignore the importance

of intangible assets such as human capital in their business models.^{53–55} BFSI needs to rethink on developing a new resources based model that could be able to unified the available tangible and intangible resources. Integrating the human forces with the continuous ICT development for performing different functions is the key challenge lies with today's BFSI. Currently there is a rise in the practice of Application Programming Interfaces (APIs) based financial products and services among the BFSI.⁵⁶ BFSI needs to share vast amounts of data across various departments and stakeholders efficiently, and APIs are playing a great role in achieving the same. Today BFSI are using mainly three categories of the APIs namely: External, internal and shared. External APIs are those APIs that are developed by the external entity and are available publicly whereas internal APIs are developed by the specific BFSI organization based on their business requirement and not available to the public. Shared APIs are those APIs that are shared among the business partners. Today most of the BFSIs are developing internal APIs to gain overall efficiency with reduced cost. Hence, the challenge before the BFSI is how well they could train their human assets so that in return they could be able to develop in-house technology platforms and APIs for efficient global operations. These could only be possible by efficiently utilizing the advanced data integration framework as the business requirements of individual BFSI do differ. There is no doubt that the BFSIs are the front lines that face the unprecedented risks that arise due to the ongoing COVID-19 pandemic. Global BFSIs are making enormous efforts to support their stakeholders and fight the economic slowdown. It will be interesting to watch how the global BFSIs will align their available resources for competitive gains post COVID.

4.3 | Virtual presence: Neobank

Recently there is an increase in the presence of a new type of bank known as the Neobank.⁵⁷ Neobank works similar to traditional banks except it completely operates online unlike physical branches in case of traditional banks. The Neobank concept is relatively very new but recently it has gained significant attention globally. Google trends data on global reaction to the term 'Neobank' in Figure 10 indicates that people are currently interested in and curious about the term 'Neobank' and moreover it shows an exponential percent increase with a spike in the search interest globally in 2020. During the COVID-19 crisis the demand for the Neobanks steadily picks up and appears as one of the future avenues of the banking post COVID-19 pandemic. Neobank has certain advantages such as operating cost is low, technology friendly, fast processing, and easy to use. Due to the low cost operating model of the Neobanks, customers could enjoy lower service fees and higher rates of interest than the average. Currently several dozens of Neobanks are operating across the world including many countries like Australia, Belgium, Argentina, Brazil, Canada, China, France, Germany, Japan, UK, USA, Netherland, Spain, Russia and South Korea and so forth. Neobank could be a good option for bringing the non-banking population under the umbrella of the financial system. Currently leaders of the financial industry as well started recognizing the importance of the Neobank products. Good example of this could be Bank of

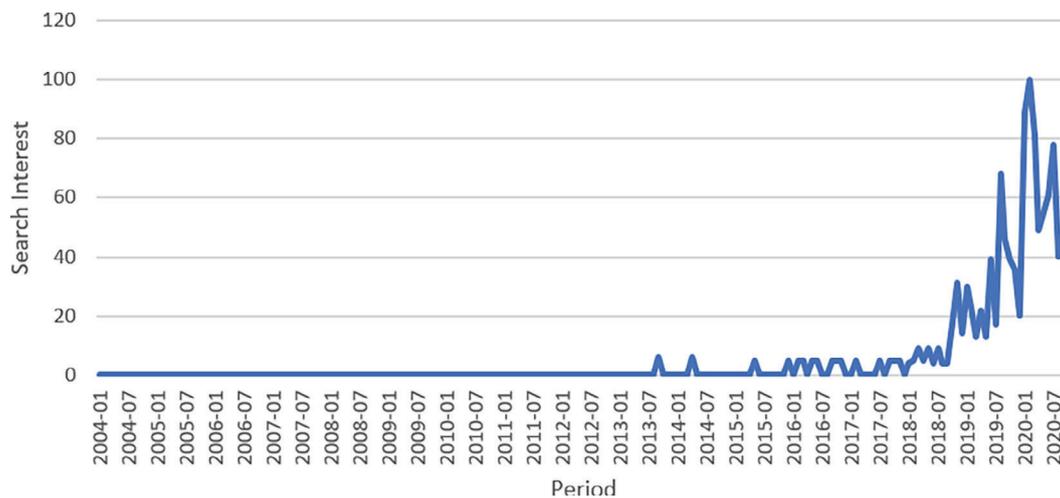


FIGURE 10 Monthly Google trends for Neobank. Source: Google [Colour figure can be viewed at wileyonlinelibrary.com]

America's mobile based app "Erica" that offers an artificial-intelligence-driven virtual financial assistant to its mobile banking clients.⁵⁸

Neobanks do have certain drawbacks too such as it is less regulated than the financial institutions and entirely based on ICT infrastructures. Hence, any kinds of security breaches and technical errors could lead to potentially serious consequences. Although the COVID-19 pandemic has opened up the fertile ground of opportunities for the Neobanks. It will be interesting to watch whether Neobanks is the next banking revolution, as Neobank and digital banks are not the same concept. The challenge lies here with the BFSIs is to develop advanced ICT infrastructure to create value from the available business data to avoid such serious technical errors or security breaches in near future.

5 | BEYOND INDUSTRY 4.0

Above discussion indicates that ICT developments during the Phase IV of the industrial revolution gave a new definition to the information. Invention of the internet laid the foundation for the development of the Internet of Things (IoTs), Industrial Internet of Things (IIoTs), and Industry 4.0 and so forth. ICT development and globalization⁵⁹⁻⁶¹ together creates a data revolution and consequently provides a new definition to the information. Development of the ICT leads to significant increase in the data volume and big data solution providers are helping the BFSIs in value creation from the data. Internet of Things (IoTs) made possible the network of the physical objects in connecting and exchanging data with other devices and systems over the Internet. Certainly it gives rise to slightly modified concepts of Internet of Everything (IoE), Industrial Internet of Things (IIoT) and Industry 4.0 in application. Cloud computing, security improvements, fintech and artificial intelligence are among the other very crucial smart technological developments that are achieved during the Phase IV of industrial revolution or Industry 4.0.

Beyond Phase IV of industrial revolution or Industry 4.0 certainly one could expect significant improvement of the currently operating data integration model of the BFSI to mitigate data loss and good governance to improve the overall security. Further development of the smart technologies such as next generation IoTs, next generation AI subsets (Machine learning, deep learning, expert systems and others); next generation fintech solutions will boost the current cybersecurity operating models of the BFSI's to match the real time operation speed.^{62,63} BFSI has to prepare for delivering the real time and on the go services to meet the customers demand in near future. Beyond Phase IV of industrial revolution or Industry 4.0 will continue to witness exponential growth in the computing speed and capability of computing devices with cost efficiency due to the supportive technologies such as ubiquitous and quantum computing as shown in the Figure 11. In the upcoming years BFSIs have to focus more on the development of their intangible resources such as human forces to promote more inhouse technological development to achieve overall operational efficiency with

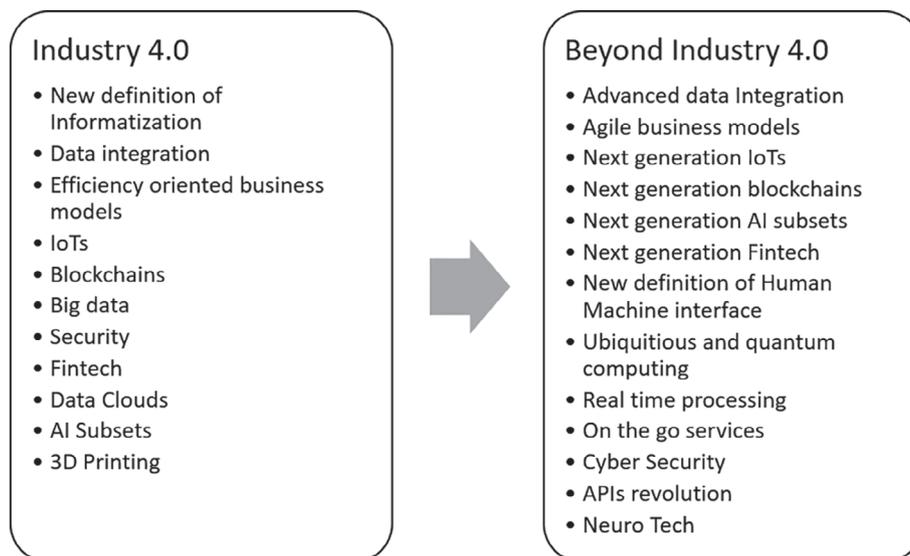


FIGURE 11 Mapping beyond Industry 4.0. Source: Authors

reduced cost. Now most of the BFSI organizations have efficiency based business models with one of the objectives to reduce overall human interventions. However beyond Phase IV of industrial revolution or Industry 4.0 it is going to be transformed and BFSI's business model will have higher involvement of the human forces. Advancement of Neural network and computing already made a significant impact on various financial applications and researches.^{64–68} Today Neurotech solutions are making significant footprints across the industries with their products.^{63,69} Further development of these neurotech solution providers will redefine the present definition of human machine interface. Due to all of these technological developments BFSI organization's current business model will gain agility and time to market (TTM) beyond the Phase IV of industrial revolution or Industry 4.0. All of these above evidence that the digital revolution is not going to die. The ongoing COVID-19 pandemic embraces digital transformation of the global BFSIs operation model. There is no doubt that the ongoing COVID-19 pandemic catalyzes the Phase IV of industrial revolution.⁷⁰ However it is too early to comment on where COVID-19 pandemic is shifting us towards the fifth industrial revolution.

6 | KEY FINDINGS

Last two decades have seen a significant number of studies done on Industrial Information Integration Engineering but hardly any study that comprehensively evaluates the impact of data integration on the development of the BFSI.⁷¹ Study finds that after Phase III of the industrial revolution significant development was seen in the field of ICT infrastructure. Resulting into the digital revolution and to support the ICT backbone, other related technologies grow aside. Previous studies have confirmed that technological innovation has a direct impact on the BFSIs. The Phase IV of the industrial revolution and beyond innovative data integration seems to be in much priority for BFSI. The Google trends data on global reaction to the term 'data integration' also indicates that people are currently interested in and curious more about the term 'data integration'. The ongoing COVID-19 pandemic forced the global BFSI to embrace digital transformation and use the integrated technologies for managing services. This indicates that the BFSI cannot go alone long term without efficient and innovative system software support.

The study finds that growth in the volume of data, increase in the computing speed and improved communication platforms are the key factors that drive the BFSI sector towards the adaptation of advanced levels of data integration. Today large volumes of data generated are extremely beneficial for the BFSI organizations. BFSIs are leveraging data for decision making and revenue generation. The ongoing COVID-19 pandemic puts a great challenge to the global BFSIs in handling the data volumes resulting from the digital payments, trading volumes, claim settlements, shared services, and others. The challenges include higher levels of fault tolerance, data protection, and others. However, timely dealing with such an increase in the volume of data is not easy in a real time business scenario. Higher computing speed along with the supportive technologies like AI and subsets,⁷² IoTs, Industry 4.0, Neurotech and others is continuing to dominate in the BFSI business operational model for reducing the overall data handling time and cost. Higher computing speed for handling the big data gives an extra edge to the BFSI organizations to create value from these data. Ongoing COVID-19 pandemic significantly increased the overall usage of the fintech apps among the BFSI consumers and the trend seems to be sustained even in the aftermath of the COVID. The global BFSIs now left with only two choices either to integrate with the fintech's or develop inhouse software for the global operations. Successful Fintech integration will be the core strategy of the global BFSI in the coming years for global operations. Innovative system software will play the key role in the Fintech Integration Process of the global BFSIs.⁷³

The importance of the social factor of an organization was ignored to a larger extent. The ongoing COVID-19 pandemic brings the importance of social factors of an organization. The social factor of any organization deals with sensitive issues like human capital. To coordinate and manage it successfully, improved communication is essential at all levels of the organizations. Aftermath of the COVID pandemic global BFSI organizations would witness greater transformation in the way they communicate to its stakeholders. Thus, BFSI organization certainly will gain agility and time to market (TTM) with further improvement in the overall communication platform.

Global BFSIs transition towards advanced data integration would not be so simple as it looks. To implement the digital transformation successfully BFSIs would have to face several challenges related to the operational areas and existing resources allocations. These include issues related to the data loss and governance, risk management and cyber security appears to be the priority focus area of BFSI. Moreover BFSIs greatest challenge lies with the circumstance that the current cybersecurity operating models do not match the real time operation speed. In the coming days BFSI will invest

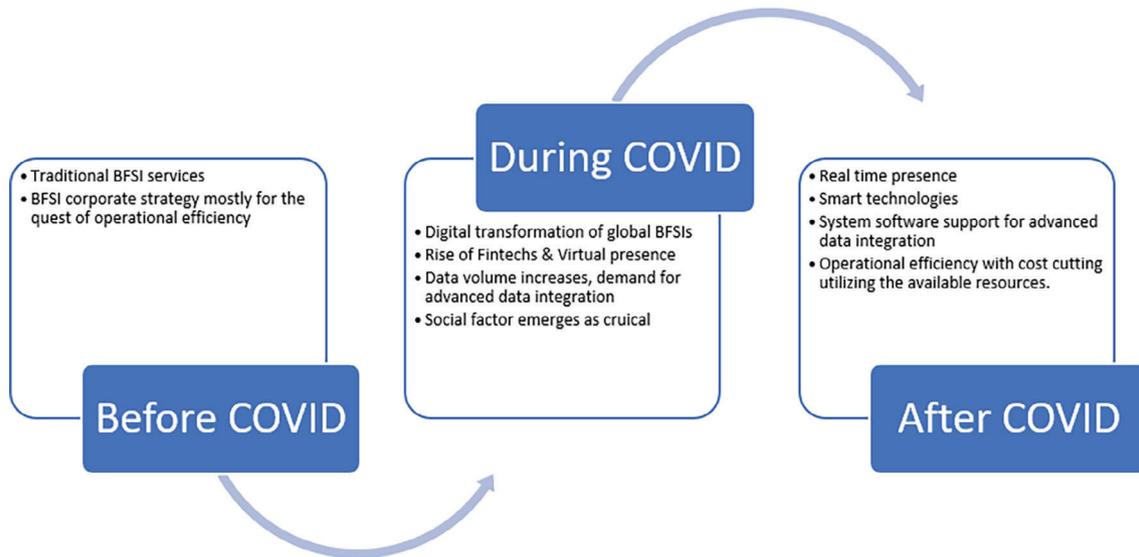


FIGURE 12 COVID impact on the BFSI. *Source:* Authors [Colour figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com)]

more towards developing the human forces to encourage in house technological development for cost reduction. Beyond the Phase IV of industrial revolution or Industry 4.0, the BFSI sector will demand applications of smart technologies in their daily operations such as next generation IoTs, next generation AI subsets, next generation fintech, advanced computing environment & optimization,⁷⁴ and neurotech and so forth. Technological revolution beyond Industry 4.0 going to redefine the characterization of the existing concepts of human computer interface and big data. Industry 4.0 has already enriched the perceptions of informatization but beyond Industry 4.0 data integration is the key to success for BFSI. Ongoing COVID-19 pandemic has already accelerated the usage of information integration significantly across the global BFSIs. In the near future innovative information integration system software design could be the solution to achieve sustainability during pandemic like situations.^{75–79}

Figure 12 above visually represents the impact of COVID on the global BFSIs. Before the COVID-19 pandemic most of the global BFSIs offered traditional services to their consumers such as branch banking, ATMs, and others. BFSIs corporate strategy is aligned to quest for operational efficiency. During the ongoing COVID-19 pandemic global BFSIs are forced to adopt digital transformation in their operations due to rise in transaction volumes. The ongoing COVID-19 not only paralyzed the economic developments but it disrupted the global supply chains. Due to which effective communications between the stakeholders and all levels of the organizations emerges as the crucial factor for business. COVID-19 pandemic highlighted the importance of social factors and pointed out that BFSI should not ignore it for achieving the long term sustainability. All of these circumstances demand innovative business process models for the global BFSIs aftermath of the COVID pandemic. It demands for the holistic system software support for advanced integration, utilization of the available resources and cost cutting.

Some of the empirical evidence includes banking stocks in domestic markets performing with a significant crisis and stress.⁸⁰ The borrower assistance and measures of liquidity support results in undercapitalization and with limited fiscal strength which can be mitigated by using advanced data integration. Recently, the Central Bank of the United Arab Emirates (CBUAE) supported financially with an AED 256, based on online surveys and financial decision-making for every sector.⁸¹ Some more empirical evidence can be cited from,⁸² which refers to an immediate requirement of Birr 17 Billion in Ethiopia as analyzed by Ethiopian Private Banking system to cope up with the post-COVID FinTech scenario. The incorporation of data integration may initially take time and manage issues but eventually, may result in an efficient model to handle these types of pandemic or unexpected circumstances.

7 | CONCLUSIONS AND CHALLENGES AHEAD

Figure 13 shows how global BFSI's technology trends have moved along the hype cycle. The ongoing COVID-19 pandemic already triggers holistic innovations with respect to the global BFSI's product, process, concept, trend, or idea.

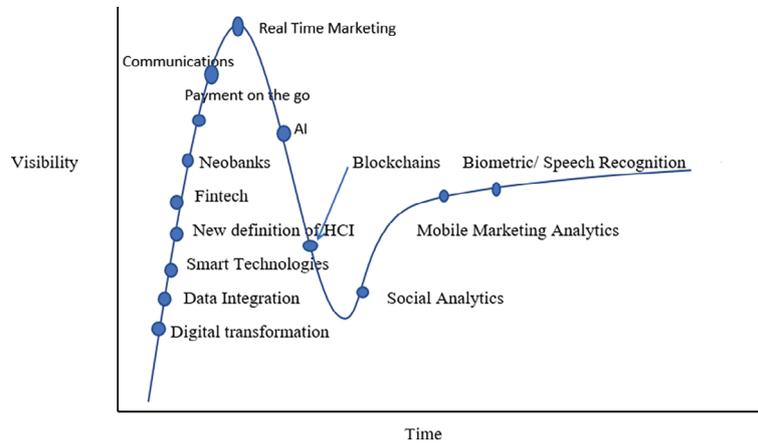


FIGURE 13 Hype cycle for BFSI. Source: Authors [Colour figure can be viewed at wileyonlinelibrary.com]

The ongoing COVID-19 pandemic triggers following innovations in the field of BFSI's namely digital transformation, data integration, smart technologies, new definition of Human Computer Interaction (HCI), Fintech, Neobanks, payment on the go and communications at all level of the organizations. Real-time marketing becomes the peak of the inflated expectations during the COVID-19 pandemic. Currently global BFSIs are now looking for meaningful value beyond initial success stories adopting advanced levels of the AI, blockchains, Next generation IoTs, and others. The social analytics lined up at the Slope of Enlightenment phase of the hype cycle. Biometric/Speech recognition and mobile marketing analytics are already built around the technology in the global BFSI space as an ecosystem of relevant products and services emerges. At each stage of the hype cycle (Figure 13), certain decisions would help global BFSIs to adopt technology effectively as per their business needs. Hype cycle has certain limitations such as it does provide a true picture of changes over time in the speed at which technology develops. However it certainly helps BFSIs to identify the relevant technologies to deal with the solutions to real world business problems.

Although the current trends show that the global BFSIs are now set on the digital transformation track, but there are a lot more to go. Data will remain the lifeline for the BFSIs and unitizing available resources for effective integration of the new technologies⁸³ will facilitate the BFSIs business management process. It is apparent that if the global BFSIs play its card well, it can achieve remarkable progress in restructuring the current business process especially in the aftermath of the Corona crisis.

ENDNOTES

*<https://www.socialmediatoday.com/news/how-much-data-is-generated-every-minute-infographic-1/525692/>

†<https://www.informatica.com/in/solutions/industry-solutions/banking-and-capital-markets.html>

‡<https://www.bankinghub.eu/banking/finance-risk/data-integration;>

§<https://www2.deloitte.com/us/en/insights/industry/financial-services/financial-services-industry-outlooks/banking-industry-outlook.html>

¶<https://www.weforum.org/agenda/2021/01/how-covid-19-has-accelerated-the-shift-towards-tradetech/>

‡https://www.ey.com/en_gl/financial-services-emeia/how-covid-19-has-sped-up-digitization-for-the-banking-sector

DATA AVAILABILITY STATEMENT

Data sharing not applicable to this article as no datasets were generated or analyzed during the current study

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