

COPY RIGHT



ELSEVIER
SSRN

2023 IJIEMR. Personal use of this material is permitted. Permission from IJIEMR must be obtained for all other uses, in any current or future media, including reprinting/republishing this material for advertising or promotional purposes, creating new collective works, for resale or redistribution to servers or lists, or reuse of any copyrighted component of this work in other works. No Reprint should be done to this paper, all copy right is authenticated to Paper Authors

IJIEMR Transactions, online available on 07th Sept 2023. Link

[:http://www.ijiemr.org/downloads.php?vol=Volume-12&issue=Issue 09](http://www.ijiemr.org/downloads.php?vol=Volume-12&issue=Issue 09)

10.48047/IJIEMR/V12/ISSUE 09/11

Title REVEIW OF IMPACTFUL DISRUPTIVE INNOVATIONS DURING PRE AND POST PANDEMIC ERA

Volume 12, ISSUE 09, Pages: 92-100

Paper Authors **Kayal Padmanandam, Subetha T , Rashmita Khilar**



USE THIS BARCODE TO ACCESS YOUR ONLINE PAPER

To Secure Your Paper As Per **UGC Guidelines** We Are Providing A Electronic Bar Code

REVIEW OF IMPACTFUL DISRUPTIVE INNOVATIONS DURING PRE AND POST PANDEMIC ERA

Kayal Padmanandam
BVRIT HYDERABAD College of
Engineering for Women
Hyderabad, India
kayalpaddu@gmail.com

Subetha T
BVRIT HYDERABAD College of
Engineering for Women,
Hyderabad, India.
subethiyagu@gmail.com

Rashmita Khilar
Department of Information Technology
Saveetha Scholl of Engineering
Saveetha Institute of Medical and
Technical Sciences, Saveetha University
Chennai, India
rashmita.khilar@gmail.com

Abstract— The term DISRUPTIVE INNOVATION introduced by Harvard professor Prof. Clayton Christensen is an oxymoron where contradictions appear in conjunction. It is a progressive process where innovative products or services typically change the well-established markets strategies and create a new market and business value. It is a highly influential way to discern innovation-driven growth in any growing or well-established sector. There are different dimensions to measure the potentiality of disruption, a product or service has exhibited based on targeted performance, targeted customers, and the business model that encompasses process and cost. A well disruptive product or service would have amended performance with new or enhanced attributes that exhibit simplicity and opportuneness to the user. A prominent disruptive innovation will primarily target innovations that are affordable and accessible to the wider population.

In this paper, we will discuss disruptive innovations, their occupancy in various sectors, a few potential disrupting innovations with technologies during pandemics, a comparative discussion on sustaining and disruptive innovations, communal adoption, and survival scenario during the pandemic era.

Keywords— Disruptive Innovations, Sustaining Innovation, Disruptive Technology, Linear thinking, Non-linear thinking, Covid 19 technological adoptions.

I. INTRODUCTION (HEADING 1)

The term DISRUPTIVE INNOVATION introduced by a Harvard professor Prof. Clayton Christensen is an oxymoron where contradictions appear in conjunction. He defines the term as “Wild and unexpected changes that radically restructure markets typically by harnessing new technologies.” He says if a certain technology plays a vital role in disruptive innovation it can be called as Disruptive Technology [1]. Disruptions can be revolutionary or evolutionary. Revolutionary disruption makes a radical change to the existing structure. Demonetization is the best example of the revolutionary disruptions, where 86% of old currencies were demolished overnight and the new ones were introduced. This is considered as the best Disruptive policy innovation since the 1991 reforms. It was quoted as Creative Destruction of a Destructive Creation. This disruptive innovation did not sojourn emerging in any of the business segments. Evolutionary disruptions take adaptive time to evolve over humankind. Realizing the practice of computer system advancement from Mainframe to Personal computer (Pcs) would be the best example of evolutionary disruptions. The progress in data formation, computing power, and device connection and disruptions acceleration are depicted in Figure 1. Disruption in technology is huge, for instance, Xerox plain paper copier disrupted the market for offset printing, Sun Microsystems Workstations disrupted the market for mainframe computers, PCs disrupted the market for workstations and it retains disrupting. In this innovative row, Mobile phone is

considered as the giant disruptive innovations, because it has almost slain many earlier innovations like fixed landlines, wristwatches, calculators, clocks, planners, music system, camera and made them all a product of extinct. Even existing technocrats are worried about disruptions and started to think out of the box alike Netflix stirred from DVDs to online streaming. Subsequently in Finance, the Fin Tech revolution is a magical combination of Technology and Financial engineering. It has changed the way how millennials of the globe look at money and the consumer’s behaviour of resembling money too. Amenities like Digital interfaces, Peer-to-Peer lending club, Independent payment systems made no bulky system anymore and slowly revolutionized “no paper money”. Besides, disruptive innovation did not dispense biotechnology. Clustered Regularly Interspaced Short Palindromic Repeats (CRISP) [2] is one of the breakthrough technologies which may fearsomely disrupt pharmacology. The Covid-19 pandemic has intensely impacted human lives, relations, societies and the global economy and its impending evolution relies uncertain. The global lockdown is seeing a huge downfall in demand and supply scenario. The scope and swiftness of impact across various economic sectors are gigantic. For instance, sectors like FinTech, Education, Healthcare, Tourism are drastically taking a reshape to exist in the market.

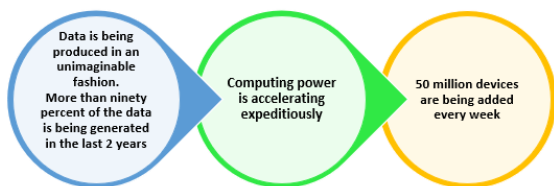


Figure 1: Progress in data formation, computing power, and device connection and disruptions acceleration

II. LITERATURE REVIEW

The paper [3] says Disruptive innovation can happen in any markets due to the advancement in technological and non-technological factors. It is a complex theory and not well understood by many says [4]. The usage of different technology and its ambiguousness have been discussed in [5]. Many debates on understanding the concepts and difference between Disruptive Innovation, Disruptive Technology, Emerging Technology are in place and well discussed in [6]. Actually, the concept of Disruptive Technology was familiarized in late 90's and it has been reframed as Disruptive Innovation in 2000 by Prof. Clayton Christensen. The reason behind this change is to include innovations that not only happen with technology [7]. The concept of disruptive innovation has grown substantially amid practitioners despite extensive misunderstanding of its philosophies. This was studied in detail in [8] where the history and directions for future use have been discussed. In [9] the continuous disruption and the process dynamics associated with disruptions have been studied in an evolutionary & temporal perspective. In [10] the authors have discussed how potentially disruptive innovations could be identified before an organizational disruption can occur.

III. DISRUPTION IN DIFFERENT SECTOR

Digital disruption has its advantages and the same time, a threat for many businesses and industry survival. The new start-ups are investigating ways to reinvent the commercial activities to contend with and extricate bindings. Some rampant breakthroughs in technological disruption are swiggy, Netflix, Byju, Urban Company, and Ola. This disruption is progressively influencing various sectors and it is illustrated in Figure 2. This section discusses the disruption breakthroughs in many sectors.

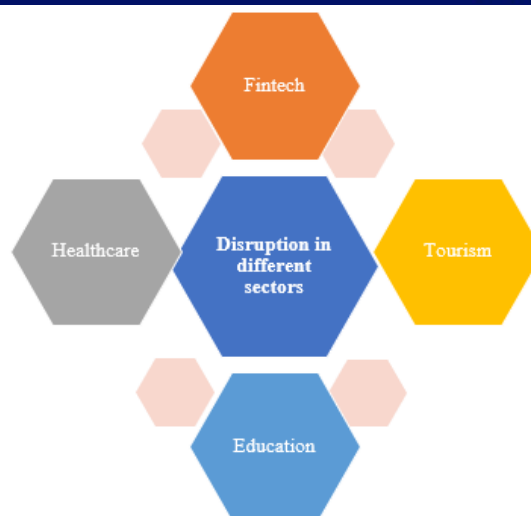


Figure 2: Disruption in different sectors

A. Fintech

FinTech is a magical combination of Finance and Technology for financial digitization that benefits large pool of customers. Fintech is considered as one of the imperious revolutionary shifts in the financial sector by placing customer in the apex of the financial eco system. Technology acts as the backbone of this financial revolution. The use of technology in various ways and the analytics that is being possible with Artificial Intelligence and Data Science will reinvent the fintech future. The digitized behaviour of the customer and so to provide best customer experience the banking space has completely been automatized and made the system presence less, paperless and cashless[11].

B. Education

More than everything, due to COVID 19 outbreak, there is a massive disruption in Educational system, which is the backbone of any nations development. Governments across the globe are forced to shut the educational institutions in an attempt to contain the global pandemic. Due to this, the traditional education system is disrupted to a large extent and new standards of digital education system is taking a hype. In spite of this revolutionary shift to e-learning provoked by the pandemic has risen enduring issues of inequality to education which is believed to be addressed by impending economic/education/digitalization policies. Different e-learning technologies are growing exponentially and the educational business landscape will transform swiftly than any year previous.

C. HealthCare

Healthcare is stumbled to manage people in crowd. The human touch is the core disease protective measure but which the pandemic has wiped it out. The world is now a sensitive touch not plant. At this juncture, medical

practitioners are following different strategies to care people. Technology is playing a big role in these uncertainty like online consultation, visit free consultation, robotics consultation, simulations, chatbot consultations etc., Many software tools have been used to trace people with covid symptoms, and to deal with medical emergencies. Besides, they are extensively used in various potential treatments and in the drug/vaccine discovery to advance and speed up the research contracting it to days than of months.

D. Tourism

Tourism is considered as a huge socio-economic activity of any nation. But, during this pandemic, it has become one of the hardest hit industry with losses ranging from 60 to 80% and it is believed that it would be the last industry to recover [12]. The industry has been predicted to see a loss of 100.8 million jobs in 2020 across the globe[13]. Digital Innovation Hubs and Digital Innovation Ecosystem are trying to find solutions to the challenges. E-Tourism research, which is the field of scientific inquiry that focus the system and information technology expansion aligned with the essential problems in tourism, should elevate and get prepared to discover solutions to the critical and significant inquiries apropos the role of IT in the better future of tourism and society [14]. The diminished tourism with the absence of travellers, tourism boards, hotels and destinations have turned to virtual reality (VR) technology to keep visitors engaged during this hardship time.

IV. POTENTIAL DISRUPTIVE INNOVATION WITH TECHNOLOGY

This section discusses the promising disruptive innovations and the overall technologies grouped in Figure 3, and the usage of these technologies is summarized in Table 1.

TABLE I. TECHNOLOGY AND ITS USAGE

Paper	Technology	Usage
[15][16]	IoT	Healthcare sector, Business, Public area safety and security, Robotics, and Manufacturing
[17]	Robotics	Automatic swab collection, Smart cleaning, Autonomous driving, and Personal Assistant
[18][19][20][21]	3D printing	Ventilators, protective equipment like PPE, medical

		devices, testing devices like Nasopharyngeal (NP)Swab, personal accessories like face masks, and even emergency isolation wards[20]
[22][23]	Cloud Computing	DDoS attacks, Phishing Malware, Cloud Sprawl

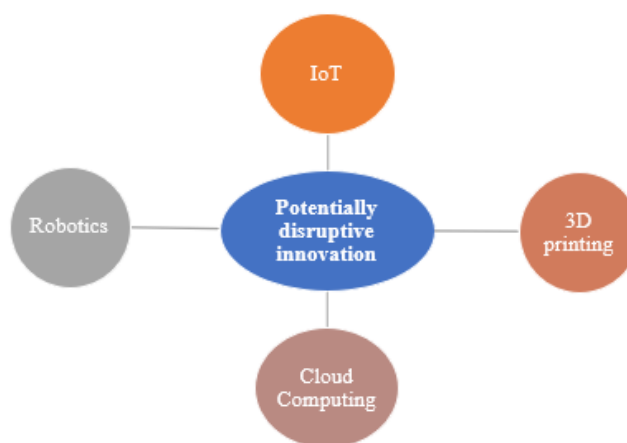


Figure 3: Potential Disruptive Innovation

A. IoT

Internet of Things (IoT) will play an immense role in revolutionizing healthcare, catastrophe and disaster prevention, public area safety and security, and in mass manufacture and production. Many businesses oriented and service-oriented organizations has seen the importance of IoT in continuing the business during pandemic. Specially in healthcare sector, the usage of IoT helped for effective quarantine measures. The rise of smart speaker ownership is an evidence for this scenario and as per the research results released by NPR and Edison research[15]. According to Asia Consumer Index recent survey, the use of high-tech smart cleaning robots which are deployed for cleaning and disinfection applications can reinstate the confidence of people in public area safety during the ongoing COVID-19 pandemic situation. These scientifically proven solution can reconstruct trust and confidence among people in the public area recreational venue safety[16].

B. Robotics

Robotics the is the study of technology about designing, construction, operation, and application of robots. Robots

are drastically changing the work style of human and it reduces the occupational risks involved with human life of healthcare professionals during pandemic. As Robots can be easily disinfected, it has been used in medical centres [17] to serve in the frontline defence to contain person-person covid transmission. Using Artificial Intelligence and Computer Vision, doctors and engineers are developing robots for automated swab collection from human. Another most popular robot used globally during pandemic is the UV - Disinfection Robots. These robots take the job to sterilize critical care units, operation theatres etc to keep the locality safe. Other than this they have be utilized to monitor pandemic rules, supply the needs for patient keeping the doctors and nurses to get involved in other vital tasks [17]. Owing to advancement in technology, involvement of robots is making many impossible and hazardous jobs easier. Sooner the robots will be ubiquitous working with human on par by lessening the human burden.

C.3D Printing

The Covid outbreak has immensely disturbed the global demand supply chain in various sector especially in Healthcare. Many healthcare product production companies were left defenseless due to the sudden surge in demand but inappropriate circumstances due to suspended production and problem with deliveries to supply it.

The global adaptability towards 3D technology helped to handle the situation, including manufacturing of ventilators[18] and other protective equipment like PPE[19], medical devices, testing devices like Nasopharyngeal(NP) Swab, personal accessories like face masks and even emergency isolation wards[20] were manufactured and built with a rapid response.

Next to healthcare, the automotive industry has seen a huge disruption in production continuity during pandemic as most of the automotive industry rely on orders abroad where the production has been already suspended. Many automotive giant companies like Volkswagen, Renault, Michelin have stopped production and remained closed. 3D printing technology were used by the manufactures to minimize the loss and to maintain the production line. Another advantage of 3D printing is, it helps rapid prototyping and manufactures functional parts faster and cheaper. Additive manufacturing technology do exist in manufacturing industry but it is really appreciable where this technology enters nowadays [21].

D. Cloud Computing

Cloud Computing services has facilitated a large volume of global population to collaborate, communicate and work efficiently online during the pandemic. It performs as a major facilitator in the global digital transformation across industries and acts as a perfect platform in numerous ways in the uncertain times. The ease with cloud platform, entices organization to reverberate their network infrastructure and thus meet their technical needs at any time. Beyond easiness, keeping the network infrastructure secured is very important. The organization should ensure the usage of right cloud solutions and follow best practices to guard crucial

data and applications from DDos attacks, Phishing Malware, Cloud Sprawl [22]. Besides various discussion on Cloud usage and security, this technology has helped directly and indirectly in various ways to contain the pandemic [23].

V. PREDICTING THE DISRUPTION -LINEAR VS NON-LINEAR THINKING

Advancement in digitalization across industries compels the market innovators to predict due disruption in the domain for their organization endurance. Non-linear thinking would rather help to sustainable business solutions. Many research debates have been taken place in the theory and the literature of disruption to predict the early stage of disruptive innovation through pragmatic evidences.

The ability to foreknow the conceivable changes an existing or emerging technology will undergo, helps an organization to protect from competitive coercions and fortifies its uniqueness [24]. For Instance, Microsoft vision on desktop at every work desk and home will disrupt computing technologies has become true and gave unparalleled triumph for Microsoft

Abundant theories are available in the adoption and dispersion of innovations. According to the assumptions of influential theory of diffusion[25], an individual will adopt innovation via linear decision process through five different stages as knowledge acquisition (where the individual uncovers the innovation), persuasion (where the individual becomes curious and seek further material evidences), decision making(where the individual measures the strengths and weaknesses of the innovation and decides to ensue or repress it), implementation(where the individual applies the innovation in a framework and understands better) and confirmation(where the individual consolidates the opinion about the innovation and takes decision for further enactment) [26].

VI. SUSTAINING INNOVATIONS VS DISRUPTIVE INNOVATION

Sustaining innovation is a type of innovation where customers expectation about the product are met at rudimentary level. These innovations can develop and improve the existing product stage by stage. No new market or value market can be created but it creates existing product with improved value targeting high end customers. Usually well-established market competitors will win the sustaining innovations through their experience, readily available resources, customers and be more risk-averse. A best example of sustaining innovation in the recent market would be the smartphone market. Market producers of smartphones are regularly improving their products by identifying essential and sophisticated features, targeting all ends of customers.

According to the theory of Clayton Christensen, **Disruptive innovation** is a reinvention of technology or business or strategy. They may start weedy and have little consistency, because the market, the customer is all unpredictable. The innovation that has come looks dramatic

but it may become a game changer. It chooses the nonlinear path and also subject to serendipity it may be applicable to different domain of industries. The best example would be the arise of smartphone a decade back. It has almost slayed many markets like the sales of calculators, personal digital assistance, camera etc and invaded the global market. Deciding the suitable innovation for the business market is quite complex as positive and negatives are both possible either way. In general sustaining innovations are enduring while disruptive technology is precipitous and it is given in Figure 4.

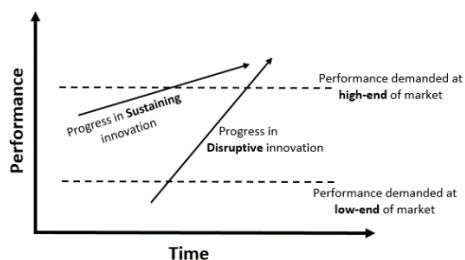


Figure 4. (Clayton Christensen's chart on sustaining and disruptive innovation)

VII. PREPARING OURSELVES TOWARDS DISRUPTION- A SURVIVAL SCENARIO

The term "Survival of the fittest" is originated from Darwinian evolutionary theory to describe the natural selection mechanism. The symbiotic relationship with the statement and the Disruptive market is, the stronger and the faster adopter will survive. A firm's survival is subject to their early move to adopt a new business model or to transform the existing one to take lead pro in the disruptive innovation. The latter would be easy for existing brands, the best example would be the Netflix and its transformation to over-the-top (OTT) media services. The next example would be the Kodak who missed to adopt to the commercialization of photography digitization. They have understood the business as taking pictures, but indistinct on sharing the same [27]. This is considered as one of the biggest disrupted markets in the centuries.

A. Few Survival Scenario Recommendations

- ✓ It is always wise to understand the business, for tomorrow as well.
- ✓ Prioritise to assess impending technologies
- ✓ Sudden swift readiness to abandon exiting business and establish new one on need.
- ✓ Proactive measurement of the change resistance in the business.
- ✓ Exploring new venture merger opportunities on need [27].

VIII. DISRUPTIVE TECHNOLOGY ADOPTION DURING COVID-19

Adoption towards disruptive technology will mainly be focused on economical and societal factors. To stay competent in business, digital operations, maximum utilization of information and communication technologies to give remote work for the workforce, government and non-governmental activities for digitizing social services,

digitization of commerce (digital currencies) due to contactless civilization, adoption of simple business strategy where production and consumption happen in identical geographical arena, divergent supply chain management where product and services are procured from various suppliers, would be the suggested trends to leverage, adapt and innovate during the disruptive era [28].

IX. CONCLUSION

Despite innovation, Disruptive technology plays a major role in today's economy. Acceptance of disruption always vests new business value market, and effortlessly overcome probable market risks that helps to stay viable in business. It is obvious to see the ubiquitous growth of disruptive technologies in every domain of work. We could also perceive the incremental growth in the innovations, and firms reinforcing their perseverance, dominance and techno innovations. As technocrats say it is true that, "Unfortunately, disruption theory is in danger of becoming a victim of its own success". And so, it is the duty of every individual to adopt the practices that is appropriate for one's business. To conclude, as Gerd Leonhard says, the best practice would be, **"When Disruption is ubiquitous, Transformation becomes everyone's job"**.

REFERENCES

1. Bower JL., Christenson CM. (1995). Disruptive technologies: catching the wave. *Harvard Business Review*, 73(1), 43-53.
2. Schmidt, M.J., Gupta, A., Bednarski, C. *et al.* Improved CRISPR genome editing using small highly active and specific engineered RNA-guided nucleases. *Nat Commun* 12, 4219 (2021). <https://doi.org/10.1038/s41467-021-24454-5>
3. Christensen CM., Leslie D. (1997). *The Innovator's Dilemma*. Harvard Business School Press.
4. Danneels E. (2004). Disruptive technology reconsidered: a critique and research agenda. *Journal of Product Innovation Management*, 21(4), 246-258.
5. Linton JD., Walsh ST. (2008). Acceleration and extension of opportunity recognition for nanotechnologies and other emerging technologies. *International Small Business Journal*, 26(1), 83-99
6. Li MN., Porter A. L., Suominen A. *Technological Forecasting & Social Change* (2017), <http://dx.doi.org/10.1016/j.techfore.2017.09.032>
7. Christensen CM., Overdorf M. (2000). Will disruptive innovations cure health care? *Harvard Business Review*, 78(5): 102.
8. C. M. Christensen, R. McDonald, E. J. Altman, and J. E. Palmer, *Disruptive Innovation: An Intellectual History and Directions for Future Research*, vol. 55, no. 7. 2018.

9. Kumaraswamy, Arun & Garud, Raghu & Ansari, Shaz. (2018). Perspectives on Disruptive Innovations. *Journal of Management Studies*. 55. 10.1111/joms.12399.
10. Nagy, D., et al., Defining and identifying disruptive innovations, *Industrial Marketing Management* (2016), <http://dx.doi.org/10.1016/j.indmarman.2015.11.017>
11. The FinTech Revolution in Banking.” <https://www.livemint.com/brand-stories/the-fintech-revolution-in-banking-11617194177586.html> (accessed Jun. 30, 2021).
12. How digitalisation can support tourism in crisis | Interreg Europe. <https://www.interregeurope.eu/carpedigem/news/news-article/10187/how-digitalisation-can-support-tourism-in-crisis/> (accessed Jun. 01, 2021).
13. Loss in global tourism jobs due to COVID-19 by region 2020 | Statista. <https://www.statista.com/statistics/1104835/coronavirus-travel-tourism-employment-loss/> (accessed Jun. 01, 2021).
14. Handbook of e-Tourism | Zheng Xiang | Springer. <https://www.springer.com/gp/book/9783030486518> (accessed Jun. 01, 2021).
15. COVID-19 quarantine boosts smart speaker usage among U.S. adults, particularly younger users | TechCrunch. https://techcrunch.com/2020/04/30/covid-19-quarantine-boosts-smart-speaker-usage-among-u-s-adults-particularly-younger-users/?guccounter=1&guce_referrer=aHR0cHM6Ly93d3cuZ29vZ2xlLmNvbS8&guce_referrer_sig=AQAAAEt8HAFtR3j8bWVIOFTWg9hkIk2FLoCJrWYt8vHQvK4TVw1EIkKKUHVDn4VLRmMK5zC7bBi3LmW1vS6YmTh0IpJuUhhk8Tc1gC2aWyNymYFWJ9NBZzGkCxmJfbbbrwMogtSmXq5y_DaZ-TgeIy4q2woNnpvgs2GEH380RBvPbK- (accessed May 25, 2021).
16. Smart cleaning robots raise confidence in public area safety - FutureIoT. <https://futureiot.tech/smart-cleaning-robots-raise-confidence-in-public-area-safety/> (accessed May 25, 2021).
17. How Robots Became Essential Workers in the COVID-19 Response - IEEE Spectrum. <https://spectrum.ieee.org/robotics/medical-robots/how-robots-became-essential-workers-in-the-covid19-response> (accessed Jul. 13, 2021).
18. Additive Manufacturing Industry Grows To Almost \$12 Billion In 2019 (forbes.com)
19. Bishop, E. G. & Leigh, S. J. Using large-scale additive manufacturing (LSAM) as a bridge manufacturing process in response to shortages in PPE during the COVID-19 outbreak. *Int. J. Bioprint*. 6(4) <https://doi.org/10.18063/ijb.v6i4.281> (2020).
20. Choong, Y.Y.C., Tan, H.W., Patel, D.C. et al. The global rise of 3D printing during the COVID-19 pandemic. *Nat Rev Mater* 5, 637–639 (2020). <https://doi.org/10.1038/s41578-020-00234-3>
21. <https://3dgence.com/3dnews/how-3d-printing-can-transform-the-production-line-during-coronavirus-pandemic/>
22. How COVID-19 is Affecting Cloud Security—and What to Do About It.” <https://www.dsm.net/it-solutions-blog/covid-19-cloud-security> (accessed Jul. 13, 2021)
23. Ravi Pratap Singh, Abid Haleem, Mohd Javaid, Ravinder Kataria and Sandeep Singhal "Cloud Computing in Solving Problems of COVID-19 Pandemic", *Journal of Industrial Integration and Management* Vol. 06, No. 02, pp. 209-219 (2021)
24. Christensen, C. M. (2013). *The innovator's dilemma: When new technologies cause great firms to fail*. Boston, MA: Harvard Business Review Press.
25. Rogers, E. M. (2010). *Diffusion of innovations*. New York, NY: The Free Press.
26. Krotov, Vlad ,2019. Predicting the future of disruptive technologies: The method of alternative histories, ScienceDirect
27. *Surviving Disruptive Technologies | Maryland Smith*. <https://www.rhsmith.umd.edu/news/surviving-disruptive-technologies> (accessed Aug. 30, 2021).
28. *The Impact of COVID-19 on Disruptive Technology Adoption in Emerging Markets*. https://www.ifc.org/wps/wcm/connect/publication_s_ext_content/ifc_external_publication_site/publications_listing_page/disruptive-tech-adoption-covid-19 (accessed May 16, 2021).