INDUSTRIAL REPORT FOR COVID-19 HACKATHON, 2020

ADDRESSING CONSUMER DEMAND AND PRODUCER SUPPLY CONSTRAINTS DURING CRISIS

Problem ID : COVID – 30

Team ID : T143

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Submitted in partial fulfilment of the requirement of Bachelor of Technology (B. Tech.) in Electrical Engineering by:

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Abstract

The corona-virus (COVID-19) has led to a once in a generation crisis of an unprecedented magnitude. Not only in terms of deaths or the strain on the healthcare system, this pandemic has dragged the economy and psyche of the people to a breaking point. As more and more of the parts of the world remain under lock down, economies around the world are slowing down to a sloth pace. This report aims to identify the supply and demand side issues arising out of the pandemic as well as examining the role of behavioral and technological solutions using some historical background and macroeconomic analysis.

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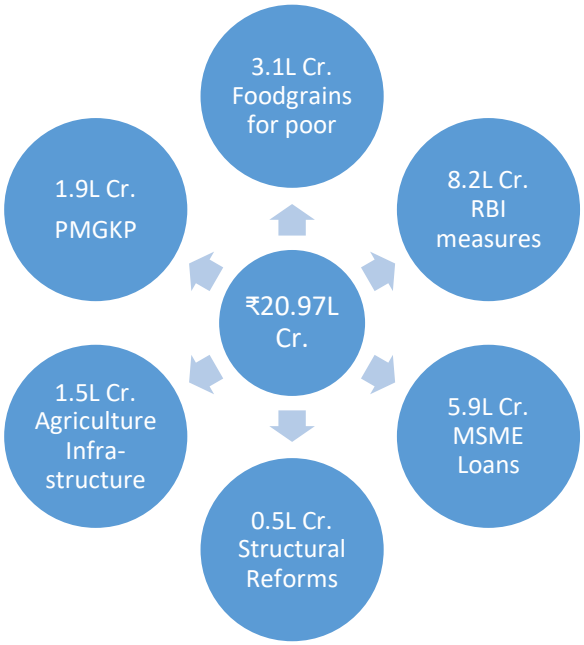
1. Introduction

The Coronavirus COVID-19 has threatened to become one of the most difficult tests faced by humanity in history. The spread of this pandemic has not only claimed a disastrous number of lives but also placed tremendous stress on different working sectors that run the known world. This involves the healthcare sector, political divisions, and the geopolitical domain, among others. The International Monetary Fund (IMF) predicts that the global economy faces its worst decline since the Great Depression of 1930. Half a billion people are expected to be plunged into poverty. [1]

Governments all over the world have been forced to take desperate measures, inflicting lockdowns, performing rapid tests, and announcing stimulus packages aimed to save a sustainable economy. In the USA, a $484 billion (13% of GDP) relief package was approved while the European Union introduced a €540 billion coronavirus aid package. India's Prime Minister Narendra Modi announced a ₹20L crore (10% of GDP) stimulus package to save the lockdown battered economy. The division of the same has been shown below.



**Figures are rounded off to first decimal*

1.1 Definitions

1.1.1 Behavioral Economics: Founded by Richard Thaler, Behavioral economics studies the effects of psychological, cognitive, emotional, cultural and social factors on the decisions of individuals and institutions and how those decisions vary from those implied by classical economic theory. [2]

1.1.2 Nudges: Nudge is a concept in behavioral economics, political theory, and behavioral sciences which proposes positive reinforcement and indirect suggestions as ways to influence the behavior and decision making of groups or individuals. [3]

1.1.3 Sustainable Business Model: "A business model that creates competitive advantage through superior customer value and contributes to a sustainable development of the company and society can be interpreted as a sustainable business model". [4]

1.2 Key phrases (behavioral issues)

1.2.1 Framing of policies matter. More likely to choose policy presented as death prevention as opposed to life saving.

1.2.2 Attention allocation by governments (overreaction to big problems as small ones may go unnoticed).

1.2.3 Confirmation bias may make people less able to analyse info conflicting with existing views.

1.2.4 Group reinforcement (peer pressure basically)

1.2.5 Illusion of similarity (thinking other people love a point of view as much as you do)

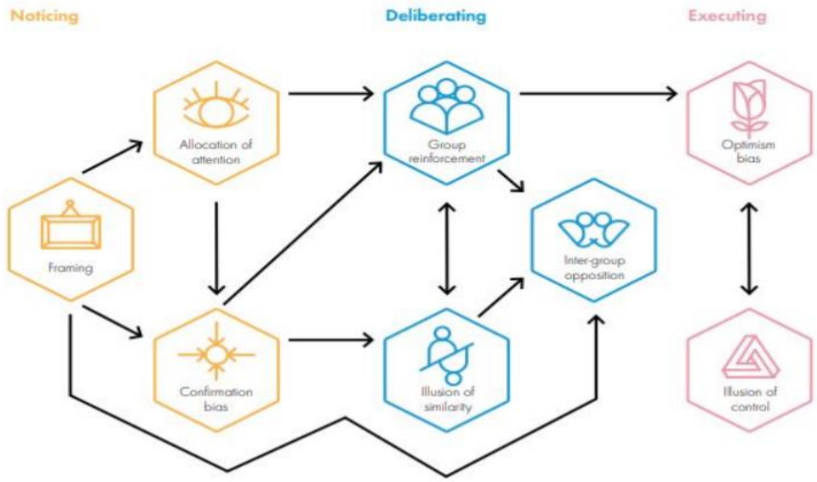
1.2.6 Inter group opposition (thinking a group's view is bad or stupid just because they are not on good terms with you)

1.2.7 Optimism bias (overestimation of abilities)

1.2.8 Illusion of control (decisions taken may not affect as much as you think they do)

1.3 Why Behavioral economics?

Governments are increasingly using behavioral insights to design, enhance and reassess their policies and services. Applying these insights means governments adopt a more realistic view of human behavior than they have done in the past and may achieve better outcomes as a result. To do this, we will be focusing on three core activities of policy making from behavioral side to assess the pattern: noticing, deliberating and executing.



Behavioral economics (BE) challenges the rationality assumption approaching a decision by evaluating a set of alternatives and then selecting the one alternative based on a systematic process inherent in traditional decision-making models. BE integrates the psychology, sociology, and neuroscience, and has flourished in recent years. Herbert Simon, often touted as the founder of BE, proposed a key cornerstone of BE, the concept of bounded rationality. Within the rational decision-making context, decision-makers often revert to heuristics, an approach more useful when decisions are routine and the environment is predictable than when there are time, complexity, and unfamiliarity constraints. However, time, complexity, and lack of familiarity constrain the rational model. BE scholars recognize the importance of the human element and that most decisions are made in less-than-ideal situations. Rather, decision-making is fraught with emotion, bias, and in-consistency.

2. Pre-Crisis

In the later sections of the report, we shall discuss more about addressing the demand and supply side issues through macroeconomic as well as behavioral measures. But these measures need to be seen in the light of the pre-existing growth slump in the Indian as well as the global context.

Even before the pandemic hit, the global economy showed signs of slowdown. Even before the giant axe of disease swung at it, various other factors including but not limited to increase in trade tensions between the United States and China with respect to trade and technology, geopolitical tensions, slowdown in global automobile industry, no-deal Brexit withdrawal of the United Kingdom from the European Union to many others. This threatened to disrupt supply chains and a fall in confidence in investment. As if this were not enough, the consequences of decades of climate change were on the horizon and manifested themselves earlier this year in the form of wildfires which further threatened the global economy [1].

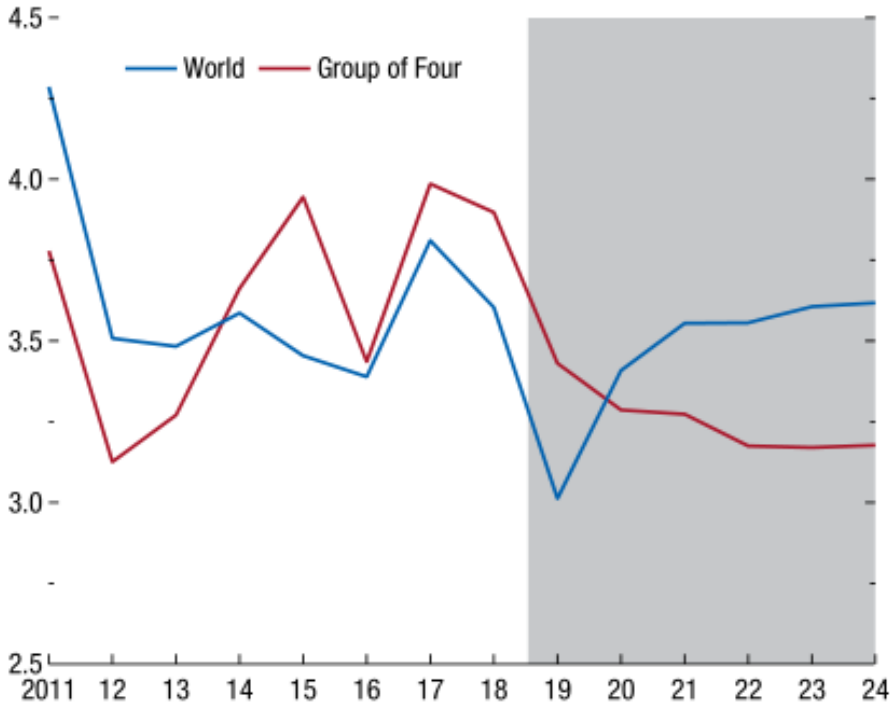


Figure 2.1 GDP Growth: World and Group of Four, World Economic Outlook, October 2019

As can be seen in the figure above, there was an upcoming downturn in the world economy which can be deduced from looking at the projections of Group of Four (China, Euro Area, Japan, and United States).

In addition, in early 2019 there was an inversion in the yield curve in the United States, i.e. 10-year Treasury yields fell below the rate on 2-year yields for the first time since 2007. Although, it later re-inverted itself and has not inverted again, this might be a bad signal for the American (and world) economy as yield curve inversions often predate a recession [5].

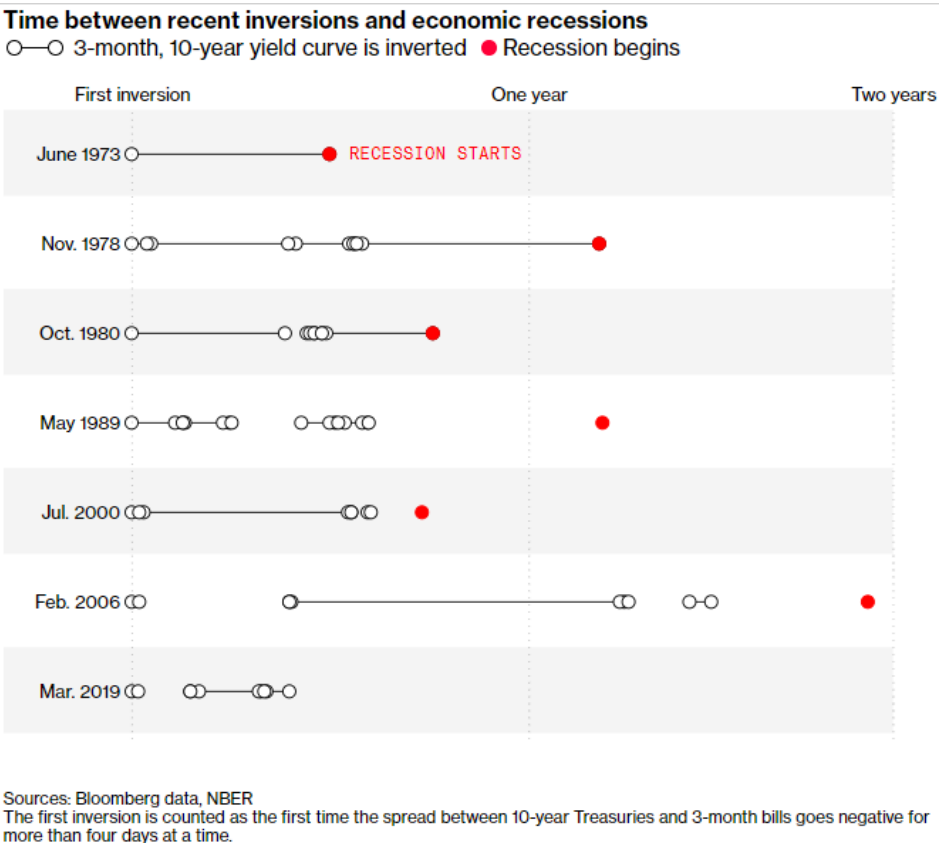


Figure 2.2 Bloomberg, October 2019

The Indian economy has been in a slowdown since early 2019. The GDP growth rate slowed down to a mere 4.5 % in the July-September quarter of 2019-20 [6]. The falling trend in growth

is a concern in itself but it comes at a time when the government spending has been on an increase.

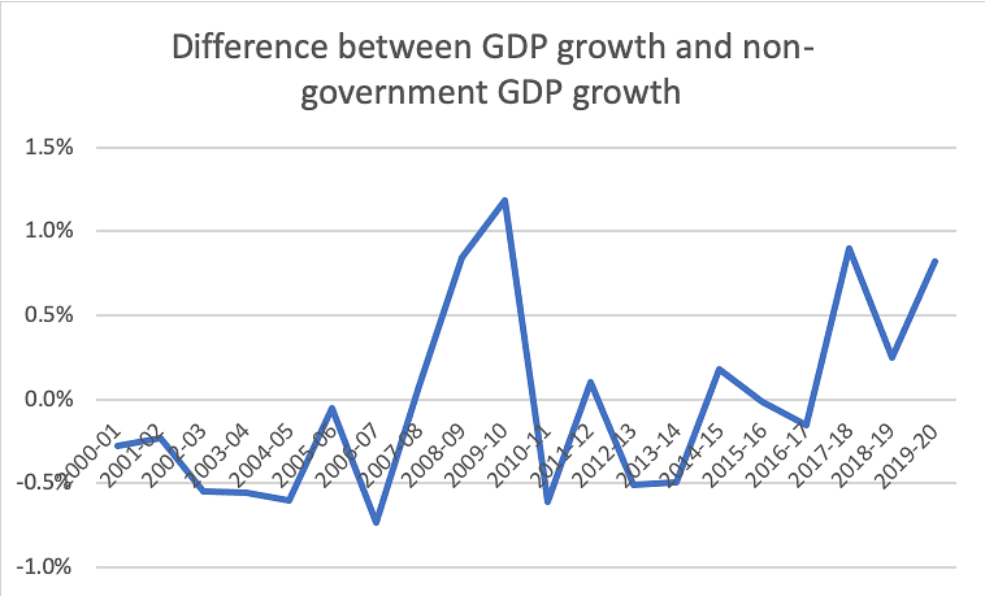


Figure 2.3 Centre for Monitoring Indian Economy and News Laundry

The difference between the GDP growth and non-government GDP growth has been on the rise which leads to inflation in the longer term as more money at disposal is used for consumption for the same amount of goods. Besides this, there has been a sharp decrease in the disposable income. Lowe disposable income leads to lesser spending and considering the fact that private consumption forms almost 60% of the Indian economy, this fall in consumption has had a major impact on the economy [7].

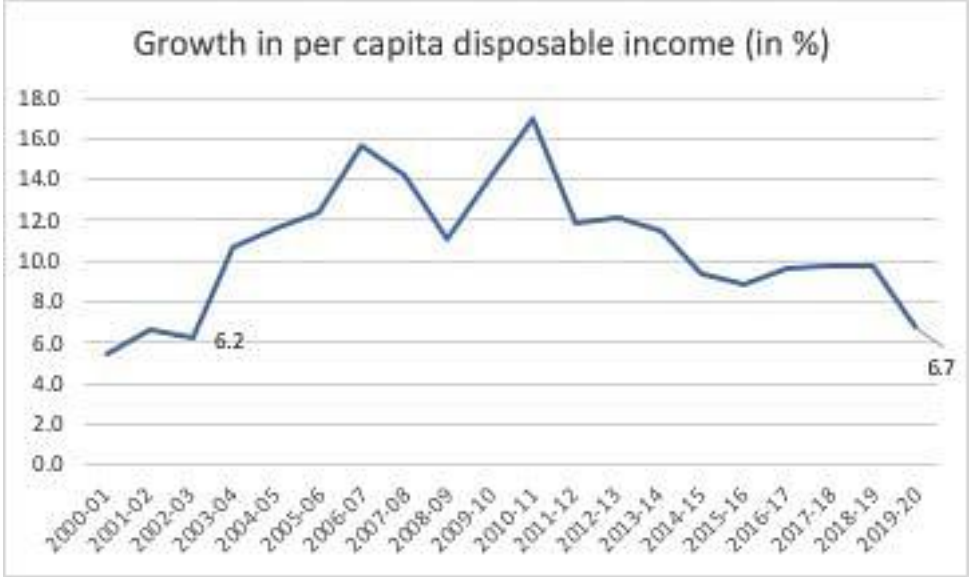


Figure 2.4 Growth in per Capita disposable income (in %)

This decrease in consumption is particularly visible in the case of fast-moving consumer goods (FMCG). Quoting from *Economic Times, "We expect 2Q and 3Q FY20 to see a further slowdown in revenue growth of our coverage universe to about 5%. This will make FY20 the slowest year of growth for FMCG in 15 years. The last period of such low growth was 2000-03* [8]*."*

As if these were not enough, most Indian banks have hit a wall due to non-performing assets (NPAs). Quoting the former Chief Economic Advisor, *"To begin with, NPAs still amount to Rs. 9.2 lakh crores, equivalent to 9½ percent of bank assets, the highest ratio of any major economy in the world, by far. At the public sector banks, where the main part of the problem resides, the NPA ratio is even higher, at 12 percent* [9]*."*

Supply chains (SC) are a backbone of economies and society, and largely interact with nature. The interactions in these SC ecosystems are very complex and triggered by mutual interrelations and feedbacks between SCs, nature, society, and the economy. The concept of viability has been extensively developed. The key points are:

- Stability: The ability to return to a pre-disturbance state and ensure a continuity
- Robustness: The ability to withstand a disruption (or a series of disruptions) to maintain the planned performance

- Resilience: The ability to withstand a disruption (or a series of disruptions) and recover the performance.
- Viability: The ability to maintain itself and survive in a changing environment over a long period of time through a redesign of the structures and replanning of economic performance with long-term impacts.

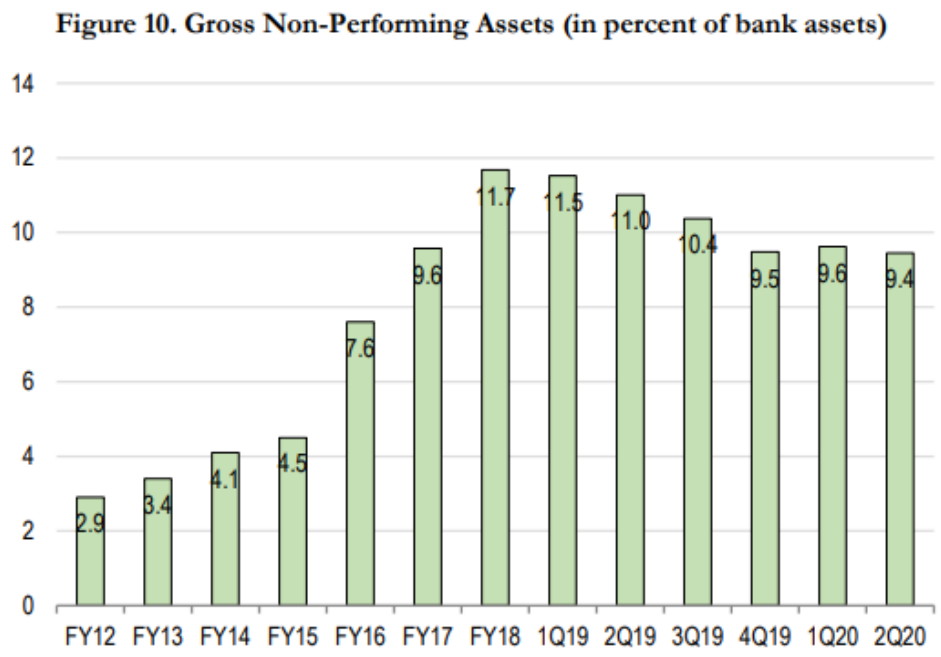


Figure 2.5 Gross NPAs [9]

3. Sector Specific Impact

The COVID-19 pandemic remains a health and humanitarian crisis, but the business impact that it leaves on organizations is profound. Whilst a few have stronger defences, others might struggle to reset to a normal.

Consumer demand patterns have shifted and re-routed the supply chain. Here is an industry specific look on the economic impact and likely recovery period. [10]

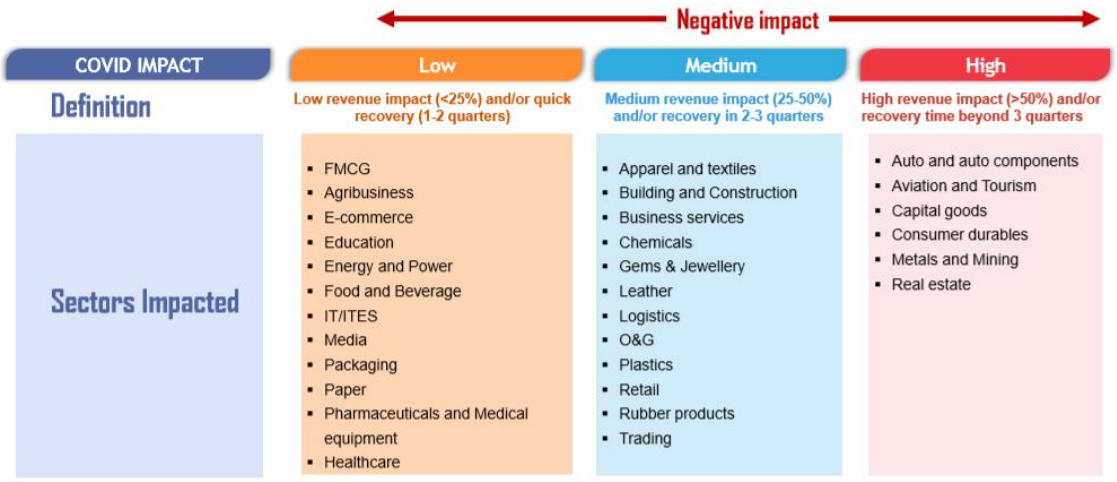


Figure 3.1 Sectorial Impact on revenue [11]

3.1 Healthcare sector

The healthcare sector is at the epicentre of this unprecedented global pandemic challenge. It has resulted with an exponentially increasing demand on health facilities and health-care workers, leaving health systems overstretched and ineffective operation.

The sector is facing a twin-burden:

a) Investing additional manpower, equipment, consumables and other resources to ensure 100 percent preparedness for safety in the hospitals and ongoing treatment of patients.
b) Experiencing a sharp drop in OP footfalls, elective surgeries and international patients. [12]

On the other hand, the private healthcare sector has been witnessing a loss of business and this trend is expected to continue for the foreseeable future (at least 3-6 months) India's medical device industry:

The medical devices industry has also taken a hit. India imports consumables, disposables and capital equipment including orthopaedic implants, gloves, syringes, bandages, computed tomography and magnetic resonance imaging devices from China. Due to the current crisis in China, the medical device manufacturers across India are finding it difficult to source important raw materials and electronic components. [13]

3.2 Fast Moving Consumer Goods (FMCG)

Market research firm, Nielsen, revised its outlook for the growth of the FMCG segment, downgrading it from **9-10% to 6-7%** for this year as a consequence of Covid-19 outbreak. This comes in the backdrop of the industry witnessing early signs of recuperation in January and February, however, a lockdown following the outbreak of the virus towards the end of March, impacted quarterly growth rates as well. [14]

Although, Traditional trade saw a huge surge in demand for essential food items followed by snacks, modern trade saw the highest demand for lifestyle items after staples. The demand for chocolates and confectionery, non-essentials such as cosmetics and gourmet saw a decline.

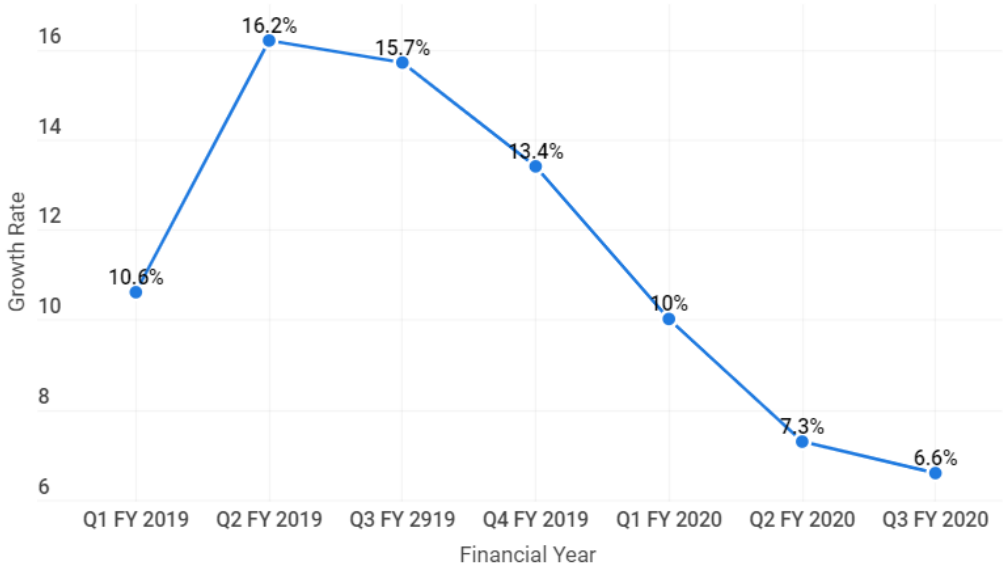


Figure 3.2 Growth rate of Indian FMCG sector (Statista)

FMCG companies have been forced to adapt their strategies for costumer acquisition and retention.

There are 2 set of changes anticipated in the consumer behavior:

- The consumers will try to minimise the number of trips that they make to the shopping complex. Consequently, the average amount an individual spends on each trip will increase.
- Online shopping and E-commerce market will escalate to fill in the boots.

3.3 Oil and gas

Covid-19 has severely dented the consumption of fuel in the country, with the growth in consumption of petroleum products falling to an abysmal 0.21 per cent to 213,686 thousand tonne (TMT) in 2019-20. The growth in India's petroleum demand last fiscal has been the lowest in at least 10 years. In March 2020 alone consumption fell 18 per cent to 16,083 Thousand Tonne (TMT) as compared to the same month a year ago. [15]

3.4 Agriculture

COVID-19 has disrupted myriad activities in agriculture and supply chains. Reports showed that the non-availability of migrant labour has interrupted harvesting activities, particularly in northwest India where wheat and pulses are being harvested. There are disruptions in supply chains because of transportation problems, scantiness of people, restrictions over inter-state travel and other issues. [16] Despite of a decline in the price for wheat, vegetables, and other crops, yet consumers were found paying more. Media reports reflected a depression in dairy sales pertaining to the closure of hotels, restaurants, sweet shops, and tea shops during the lockdown.

4. Approach towards market analysis

We use PEST framework to identify dominant factors for the Post Covid-19 strategies. PEST analysis stands for 'Political, Economic, Social and Technological Analysis' to indicate the external influences. [17]

Political factors (P) : these refer to different forms of government interventions and political activities in an economy. In the Covid-19, scenario, political factors are going to play a significant role.

Economic factors (E) **:** these refer to the macro-economic policies and conditions of the external environment. The entire economy is severally affected by Covid-19. The economic policy and directions are going to decide the thrust given to the various sector.

Social factors (S) **:** these refer to social, cultural, and contextual demographic factors of the external environment. Covid-19 has affected the social structure and it has also the potential of affecting the work culture.

Technological factors (T) **:** these refer to technology related activities, technological infrastructure, technology incentives, and technological paradigms that may affect the external environment. Technology is going to play a vital role in the post-Covid scenario.

4.1 Technological influence

The COVID-19 pandemic shows that digital connectivity is critical to societal resilience and business continuity in times of crisis. For digital infrastructure providers in emerging markets, higher demand for connectivity may be counterbalanced by a series of negative shocks. [17] These could affect broadband operators and smaller companies, leading to less competition, limited availability of open-access broadband infrastructure, and reduced technological innovation. However, the perceived value of digital connectivity is likely to rise, creating opportunities to implement policy reforms to accelerate the rollout of 4G and 5G. Digital infrastructure companies, however, may accelerate their migration toward diversified business models. Against a background of funding withdrawal from emerging markets, financing for smaller or independent companies in the poorest economies may require substantial support from development finance institutions to preserve competition, improve resilience, and promote digital inclusion for the poorest. [18]

	Demand for digital connectivity and services	Supply of digital connectivity and services
Short-term (during lockdown)	**Change in consumer usage patterns,** including new data-intensive applications for individuals (such as video conferencing or streaming) and organizational change from business (including Cloud storage and computing, home-based work)	**Disruption in the digital infrastructure supply chain,** resulting in a higher cost of inputs (such as IT equipment and energy) and delays in investment projects **Organizational changes** stemming from social distancing of workers, resulting in higher costs of operations
Long-term (after lockdown)	**A shift in consumer behavior,** including permanent change in usage patterns for individuals and increased virtualization of business operations—both public and private—to strengthen resilience **Income loss** resulting from unemployment and the exit of private sector businesses	**Exit of critical suppliers and distributors** resulting from financial distress

TABLE 1 Potential Demand and Supply Shocks of COVID-19 on Digital Infrastructure

Source: IFC.

4.2 Political influence

Astonishingly, India has a one-page law with just four bare sections passed in 1897 to deal with such a crisis and is out of date. The 1857 law has no provisions for the private sector, which is an essential stakeholder in dealing with an epidemic of this magnitude.

The way forward is to set up a multi-disciplinary task force with objectives that can be implemented in a time-bound manner. [19]

NITI Aayog will have to make very short-term plans which will be dovetailed into long term plans. It will have to work closely with industry and oversee the execution of these plans. [17]

4.3 What could be the key to post-pandemic Market

COVID-19 is a health and economic crisis that has a sustainable impact on consumer attitudes, behavior and purchasing habits. Companies can adapt to these changes by taking action to respond, reset and renew to be positioned even stronger for the future. [20]

4.3.1 Respond

- Stand up a cross-functional command centre with KPI tracking
- Create an Elastic Digital Workplace task force

- Reshaping the marketing plan around new demand and brand purpose

4.3.2 Reset

- Redefine relationships with consumers, customers and employees and reimagine the organization and ways of working
- Rethink and redefine relationships with ecosystem partners
- Reconsidering the product and service portfolio

4.3.3 Renew

- Accelerate the move to an intelligent data-driven operating model
- Reprioritize enterprise investment plans for post-COVID era
- Scan market for merger and acquisition opportunities

5. Sustainable Business Models and Goals

In the world acclaimed Brundtland Report, SD is defined as "the development that meets the needs of the present without compromising the ability of future generations to meet their own needs. [21] Since then, the concept has evolved to focus on three basic principles, defined as the Triple Integrated Equation (TIE), requiring an understanding of the complex interplay of environmental, economic and social processes.

Our report's main focus is on investigating sustainable technology and business models at the micro level. Sustainable business development (SBD) is underpinned by sustainable technology and innovation, while managing technological change has a direct impact on the sustainable competitiveness of business operations. [22]

Technology and business innovation drive the economy towards achieving the sustainable development goals set. The technology we use in performing business operations impacts the environment, society and economy, and, consequently, technology and business enterprises are perpetrators of potential damage and cause unwanted effects on economy, society and the environment. Hence, where sustainable business strategy is approached through a sustainable

business, technology and innovation model, the emphasis is placed on technology and business innovation. [22]

Figure 1. Sustainable development relations: input (environment), process (economy and output (social and environmental objectives).

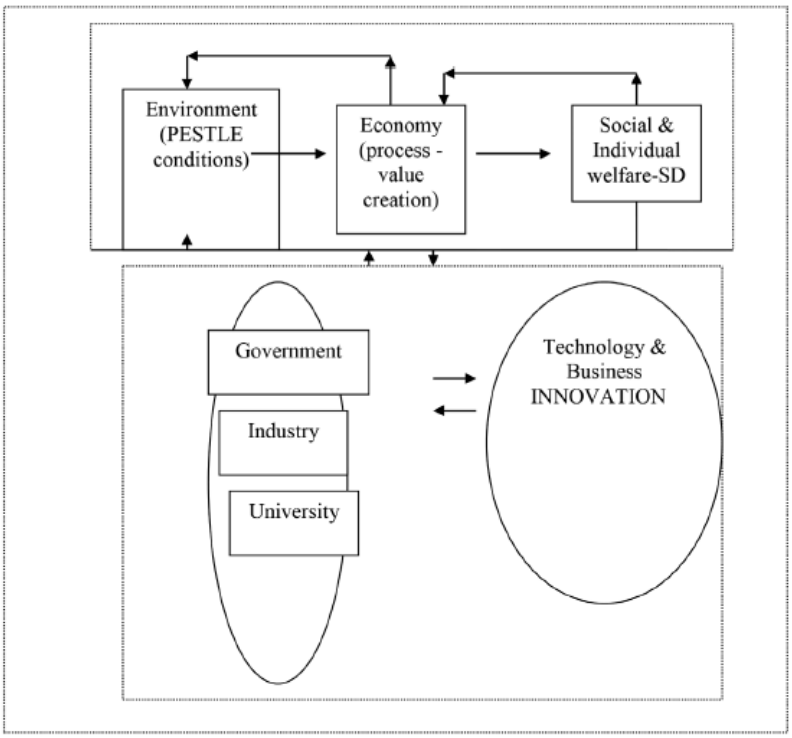
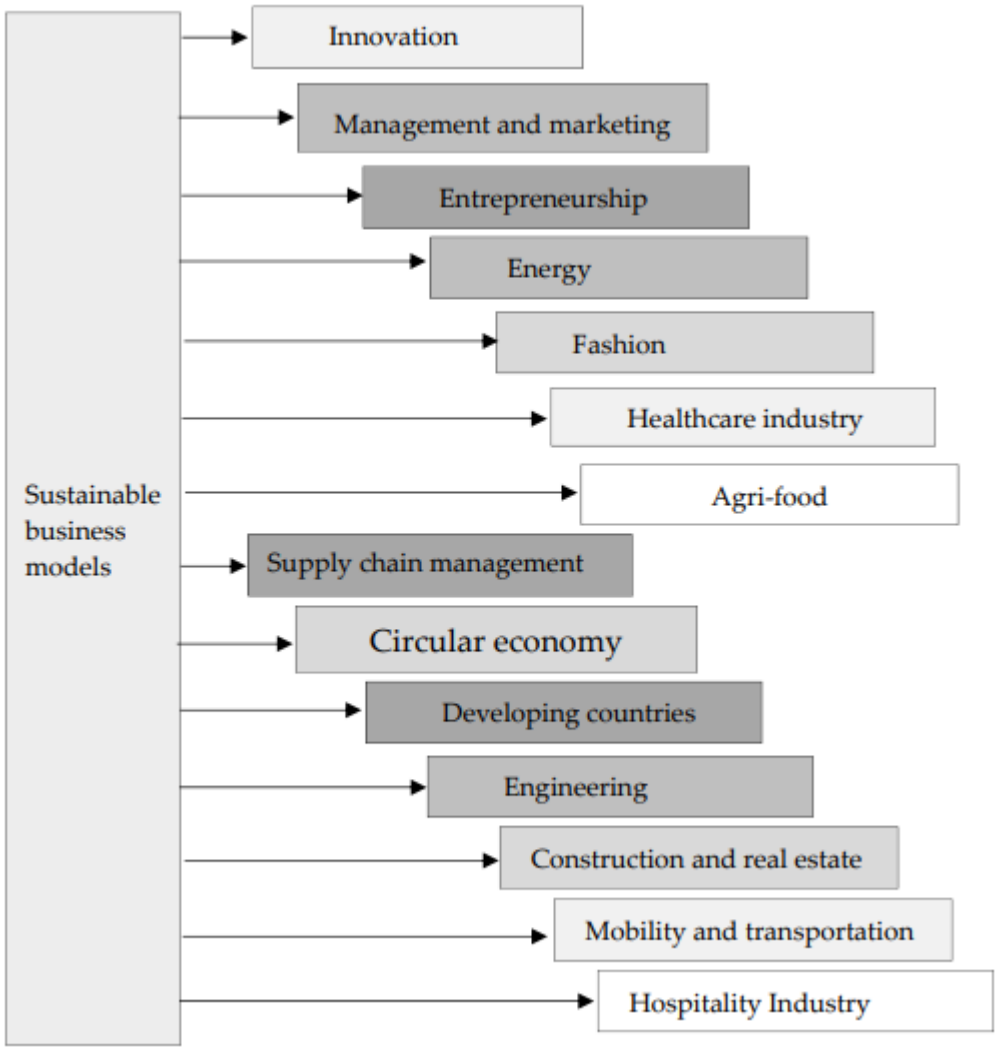


Figure 5.1 Sustainable business Model of Different sectors

We assess different sectors of industry through their "sustainable business model" to see any setbacks that can affect their business during pandemic.



Note that many large enterprises are however having more turnover than the last fiscal year due to their diversified business model and stability in the current market.

5.1 Sector Wise infrastructural Gaps during COVID-19 period

We have noticed that the business of these main industries among a very large set may been affected by covid-19. And we further pondered around the fact that why these infrastructural gaps were created in the first place. But firstly, what were the main gaps that were created, again there are only a handful reasons to show among a very large set, but these are important ones,

Cold storage: it indicates the lack of basic logistics. Which means that lack of refrigerated trucks, personnel problem, and custom made vehicle carrying capacity and all. Also there is a scarcity of specific cold-chain `logistics provider. Food not reaching many distribution centers. People at the mercy of civil societies.

Transportation: services that can deliver goods to distribution centre with sufficient speed and reliability. The problem which stands during this crisis is that the food is not reaching many distribution centres and often they are at the mercy of civil societies.

Unemployment: there is no central unemployment insurance scheme in India and US has unemployment insurance and UK is paying companies to put a hold on layoffs so as to not disrupt existing economic linkages.

5.2 Why infrastructural Gaps Were Created

Economies, especially developing economies, were already facing significant infrastructure gaps, amounting to $15 trillion globally, according to the Global Infrastructure Hub for the period 2016 to 2040. Governments now face a dilemma whether to increase infrastructure spending as a means to stimulate their economies or, ironically, to cut committed infrastructure spending to save.

We've seen technologies such as fiber and IoT (Internet of Things) step up during the pandemic, but the infrastructure sector is relatively underinvested in technology compared to other capital-intensive industries. Pressure from reductions in capacity arising from social distancing, people's reticence to commute, and demand for carbon reduction will likely spur planners to de-prioritize some infrastructure like airport and road expansions and focus on digital infrastructure and smart mobility. Technology adoption, obsolescence, and resilience will become critical factors when investing scarce resources. [23]

Infrastructure supporting economic activities and supply chains will have to be more resilient. With the COVID-19 outbreak, businesses are naturally looking to strengthen the resilience of their supply chains against such outbreaks and natural disasters in general. This could mean diversifying their production, supplies and markets. [24] This could also mean employing ICT technology to better monitor the various aspects of supply chains, making more use of

automation, online commerce, etc., to ensure that production and trade can continue despite disruption.

The demand for segments such as data centers is expected to increase in order to maintain safe and secure digital infrastructure as more customers move their daily operations online and employees' transition to remote work environments.

Telecom and the associated digital infrastructure is key to any nation's progress. With 1.5 million kilometres of fibre laid, and less than a fourth of the cell towers connected on fibre, there is a long way to go to 'fiberise' the backhaul infrastructure. Currently, most of the network connectivity in India is microwave-based, which accounts for about 75-80 per cent of cell sites. For the network to be robust and available with low latency, the need for 100 per cent fiberisation has been felt the most at this critical stage

Development of infrastructure for a comprehensive and robust cyber security and data storage capacities is required.

One of the major causes of high inventory costs is inventory loss. While all supply chains suffer loss to some extent due to theft, damage and obsolescence, the issue of loss is particularly important in supply chains for perishable goods such as fresh foods or temperature sensitive medications. Avoiding losses in these types of supply chains not only brings economic benefits, but also helps to meet the basic needs of Indian citizens, particularly rural residents, for nutrition and healthcare. Currently, loss rates in perishable supply chains are high, up to 40% for agricultural goods. [25]

A key reason for this situation is the lack of effective refrigerated supply chains, known as cold chains. Cold chains are a collection of refrigerated trucks, warehouses, and processing facilities which quickly move perishable items from point of origin to point of sale.

India faces various challenges in the cold chain market—lack of reefer vehicles and cold chain logistics providers, non-standardized vehicle boxes, scarcity of skilled operators and drivers of the reefer vehicles [26] and high industry fragmentation, with more than 3500 unorganized players. [27] Some other pressing issues are:

- No real-time visibility into inventory holdings and the inability to rapidly and automatically share that information up the supply chain.

- Digital capabilities to track inventory drawdown in real time and also the digital links up and down the supply chain to rapidly transmit that information to distribution centers and suppliers to keep a dynamic inbound replenishment supply.

One key approach to dealing with variance in consumer demand is to better understand the root causes of variance and anticipate it, known as demand forecasting. However, in India's highly fragmented and relatively immature distribution system, that point of sale visibility is often impossible to create and many of the smaller less advanced suppliers would not be in a position to effectively use that visibility, both of which pose a major barrier to buffer stock reductions.

One important remaining barrier is the ability of firms to obtain transportation services that deliver goods to a large DC (Distribution Center) footprint with sufficient speed and reliability.

Three major barriers stand in the way of a possible solution, i.e., modal shift:

5.2.1 There is insufficient infrastructure capacity:

Capacity must be thought of not only as a physical metric, but also an operational metric which varies by the type of commodity being moved. Here, operational metric is a key factor to allow us to see what's going on in the business in real-time

5.2.2 Incomplete infrastructure connectivity:

Newly designated industrial zones are not well integrated with the rail network, as well as with destination points. Many Indian container ports are also not effectively integrated with the mainline rail network. And the port cities are heavily relying on their sea-network which may cause overload.

5.2.3 Insufficient cost advantage for efficient modes.

With data analysis and new technologies in operation research efficient modes are present. But sometimes these methods do not fall under cost-efficient.

5.3 Role of Technology in Sustainable Business Models

Digitization is the backbone and technology is the key enabler of efficient supply chain. A digitized platform to integrate supply chain, right from demand forecasting to load consolidation and truck routing and dispatch scheduling, can reduce the delivery time and costs.

While existing logistics systems in India have inefficiencies in inventory management, modal split, truck productivity and final mile solutions, they can be addressed by a set of whole system solutions targeting technological, digital, infrastructure, policy and regulatory components. Inventory cost can be brought down by improving the quality and siting of warehouses, accurate forecasting, digitized inspection systems and digitized warehouse processes. Worsening mode share can be addressed by improving connectivity and capacity of rail and waterway networks, and building out heavy haul as well as intermodal corridors. Truck productivity can be enhanced by truck standardization, efficient loading and unloading practices and digitization of routing and dispatch. Urban deliveries can be optimized using intelligent transportation systems, efficient routing and scheduling practices and improvement in infrastructure like consolidation centers, loading bays etc.

India Cooling Action Plan (ICAP) emphasises the cold chain infrastructure and discusses the gaps and opportunities country can leverage from providing the cold chain facilities at the rural level as far as food security, improving farmer income and healthcare services are concerned.

The action plan reports that India has a large inventory of cold storages or refrigerated warehouses, but on the other hand, the remaining elements of cold chain infrastructure–pack houses, reefer transport, and ripening chambers—are largely missing.

The outreach of cold chain infrastructure to farmers in India should be the target to ensure food security and healthcare in the country. This ambition of outreach can have multiple benefits for all including the direct benefit to farmers, optimised supply chain, reduced wastage & loss of food and medicine, reduced greenhouse gas emissions from the food waste, and food security for all in the country.

Cold-chain Component	Requirement	Created	Gap
Pack-house (MT)	11,21,274	3,984	97 %
Cold storage (Bulk) (MT)	3,41,64,411	3,18,23,700	9 %
Cold storage (Hub) (MT)	9,36,251		
Reefer transport (MT)	4,94,608	72,000	85 %
Ripening chamber (MT)	91,306	8,120	91%

Table 5.1 Storage capacity [28]

Table 5.1 [28] shows that there is sufficient cold storage capacity but there is scope for addition of other critical cold-chain links which include pack-houses, reefer transport, and ripening chambers. The holding capacity reflects the volumetric size and the actual throughput will be in multiples of the operational or holding cycles. For example, an average weekly turnaround of reefer transport units will translate the 72,000 tons holding capacity into 3.7 million tons in throughput capacity.

The hurdles are as following:

5.3.1 Regulatory framework roadblocks impede innovative entrepreneurial spirit in the cold chain sector.

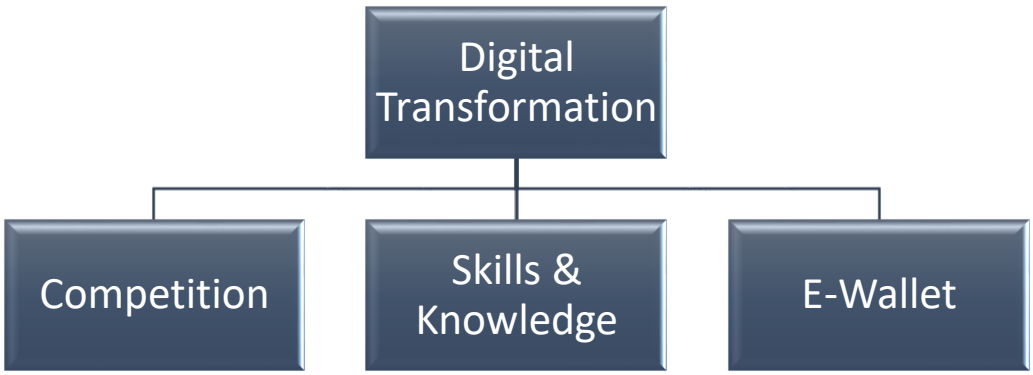
5.3.2 Absence of a business model for cold chain industry in India that can be applied at the local level and that can ensure the involvement of the farmers.

5.3.3 Industry not stepping up with cost-effective solutions for temperature-controlled storage spaces and transportation is discouraging as the initial investment required in the cold chain sector is huge.

The optimisation of the supply chain of perishables can ensure the reduction in food wastage and better utilisation of food stock.

Having a robust cold chain infrastructure with effective policy support and implementation strategy can go a long way in unprecedented times such as now.

Now to address on how technology can mitigate these needs of SMEs during the pandemic we can comment on:



5.4 Digital transformation (DT)

5.4.1 Using social media to promote products or businesses.

5.4.2 Using online software can help in making billing and payment documents easily.

5.4.3 Monitoring business transactions virtually, where business owners can automatically reconcile banks on all cash and bank accounts.

5.4.4 Real time monitoring of inventories that aim to find out average buying and selling prices of their products.

5.4.5 As citizens are to engage in practices while maintaining social distancing, DT plays an important role

5.5 Artificial Intelligence and Blockchain Technology

5.5.1 AI is considered a technological solution to improve the efficiency and the productivity of the sector, and its key role is recognized in its adoption to contribute to reaching SDGs.

5.5.2 Value of Blockchain has become apparent as COVID-19 reveals the risks associated with our dependence on long, complicated, and often opaque value chains.

5.5.3 Computerized transparency tools can give us a much better ability to identify critical nodes that might be prone to failure, thus enabling the industry to adapt more easily if supply chain becomes disrupted.

6. Case Study (AI)

The pandemic has also compelled citizens to engage in practices while maintaining social distancing, now widely recognised as one of the key parameters to break the chain of transmission. Thus, to ensure good health of all players in the agri-food system, AI can truly represent an important aid at all levels, both for agriculture and the food industry and for large-scale distribution. [29] In agriculture, for example, mobile apps “enhanced” by AI supplied to

agronomists are able to immediately identify what the problem is of the framed plant. [30] Sustainable development (SD) needs to be achieved to harmonize the profit, social protection, and environmental respect. For companies, SDGs (Sustainable Development Goals) establish the new sustainable development strategies.

- Although AI is considered a technological solution to improve the efficiency and the productivity of the sector, and its key role is recognized in its adoption to contribute to reaching SDGs, the analysis on involvement of stakeholders and their importance in this process is still missing.
- Secondly, if the AI issues (and more in general, the new technologies), on the one hand, lead the way to consider the agri-food sector as an ecosystem, allowing public and private organizations to coexist in the same area, on the other hand, all stakeholders involved in the supply chain (i.e., farmers, processors, investors, and so on) are considered as actors of business models founded on sustainability and responsibility themes. [31]

The agri-food sector requires evolutionary rather than revolutionary changes to reshape institutions. The limits of these AI considerations are related above all to the difficulty of making accurate predictions in such a recent state of emergency, but also to the concrete intention of the various actors to make important investments, which are able to develop new technologies in efficient and effective mode, linked to the actual needs of the moment.

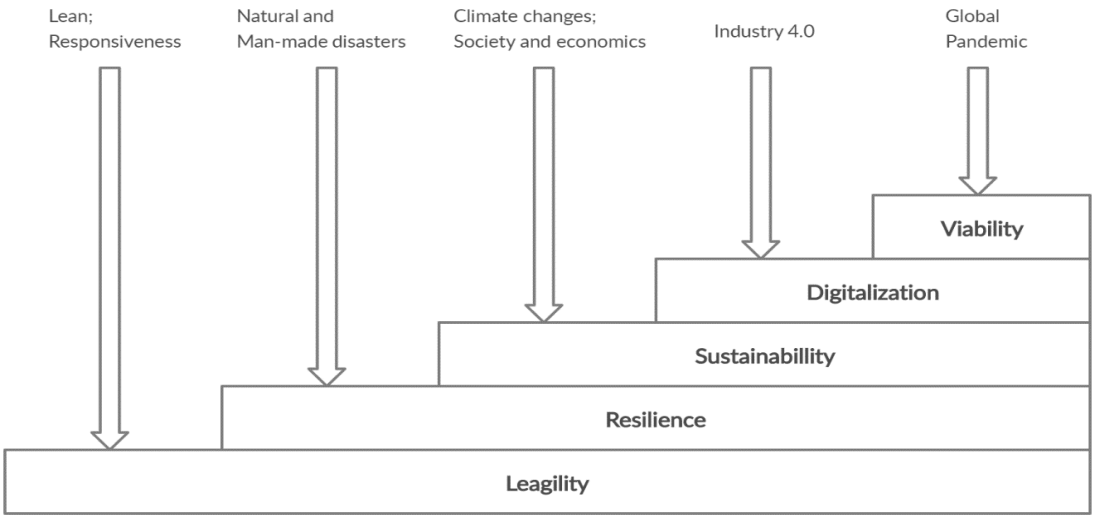
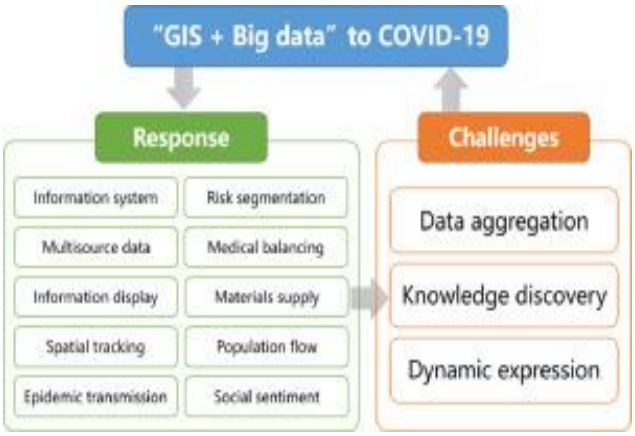


Figure 6.1 Transformation of major SC management research angles over time

6.1 Automation

6.1.1 Automation, the Internet of Things, and robotics that help reduce the labor required by different industry sectors.

6.1.2 Social distancing has translated into much slower productivity, Technologies to reduce labor and automated operations would help reduce these kinds of vulnerabilities.



7. Why Nudges

In their seminal work "Nudge: Improving Decisions on Health, Wealth, and Happiness," Professors Richard Thaler (Nobel Laureate) and Cass Sunstein postulated that these human traits systematically affect individual decisions and market outcomes. It's instructive to explore how these factors might be influencing individual decisions:

- Limited rationality: People focus on the narrow impact of individual decisions rather than the overall effect.
- Social preferences: People have a social preference for equitable outcomes.
- Lack of self-control: People tend to give in to short-term temptation rather than stick to a long-term plan.

Empirical evidence tells that certain human actions result in better social outcomes, and digital technology enables to reliably predict those outcomes based on observed behaviors.

Thaler and Sunstein (2008) defined a nudge as:

"Any aspect of the choice architecture that alters people's behavior, in a predictable way, without forbidding any options, or significantly changing their economic consequences."

Gregor & Lee-Archer (2016) defined a digital nudge as:

"Individually targeted processes, facilitated by information technology, to achieve social policy outcomes".

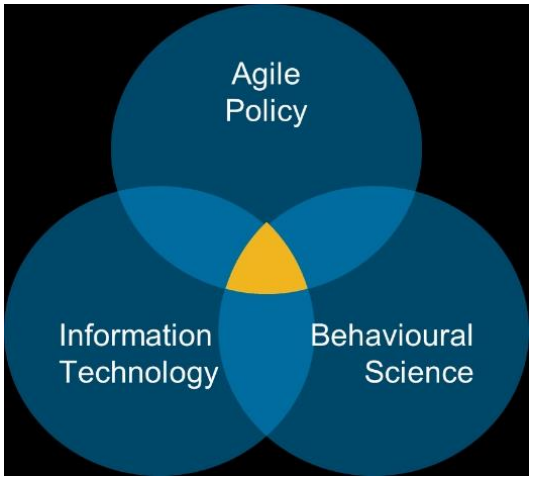


Figure 7.1. At the intersection of agile policy, information technology and behavioral science is the digital nudge. [37]

Predictive analytics and contextualization capabilities can improve the effectiveness of traditional nudging by enabling the shift from reactive to proactive interventions and by making nudges more targeted to individual circumstances.

- Predictive analytics is a specific field of data mining in which large stores of data are analysed to detect patterns and to predict future outcomes and trends. While predictive algorithms have been used for many years, they have typically been restricted to operating on pre-existing data. Real-time computing platforms have changed this by allowing data to be analysed as it's created. This means that analytical discoveries can be applied to adjust government action dynamically, thereby influencing trends as they emerge.

- Contextualization is the next evolution of personalization: blending together information about past interactions and anticipated behaviors with present motivations and intent. Where personalization attempts to anticipate future behaviors based on past activities, it lacks the in-the-moment context of the citizen's current circumstance. This is important because it's precisely that current context that's most relevant and useful for predicting future behavior.

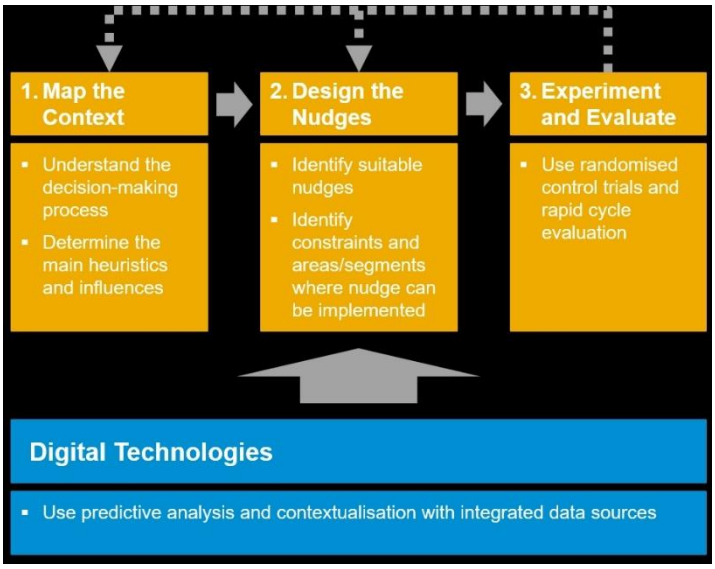


Figure 7.2. A framework for the design and application of digital nudges [37]

- Experience management brings together operational data (O-data) about what is happening, with experience data (X-data) that tells "why it's happening." This fusing of X+O data can enable governments to better understand citizen sentiments and motivations, and thereby take effective action. Importantly, since sentiments and motivations are constantly changing, governments need to embed feedback and analysis throughout their business processes and at every point of citizen interaction.

A study (by Ramit Debnath, Ronita Bardhan) investigated how government formed reactive policies to fight coronavirus across its policy sectors. They collected the primary data from the Press Information Bureau (PIB) in the form press releases of government plans, policies, programme initiatives and achievements. A text corpus of 260,852 words was created from 396 documents from the PIB. They employed an unsupervised machine-based topic modelling using Latent Dirichlet Allocation (LDA) algorithm on the text corpus to extract high probability topics in the policy sectors. The interpretation of the extracted topics was

made through a nudge theoretic lens to derive the critical policy heuristics of the government. Results showed that most interventions were targeted to generate endogenous nudge by using external triggers.

The examples below provide a brief idea of how nudges were brought into play:

- The nudges from electronics and IT related policies were aggressive on tackling fake news in social media and keeping people indoors during the lockdown. The repeated telecast of popular ‘80s and ‘90s TV shows were one of the distinct public policy nudges. It used nostalgia as a nudge to make the people conform to stay at home norm and practice social distancing measures. [32] These TV-shows ranged from family entertainer to religious and were broadcasted in the national channel called Doordarshan. 'Fake News' was treated as a concern of national security.

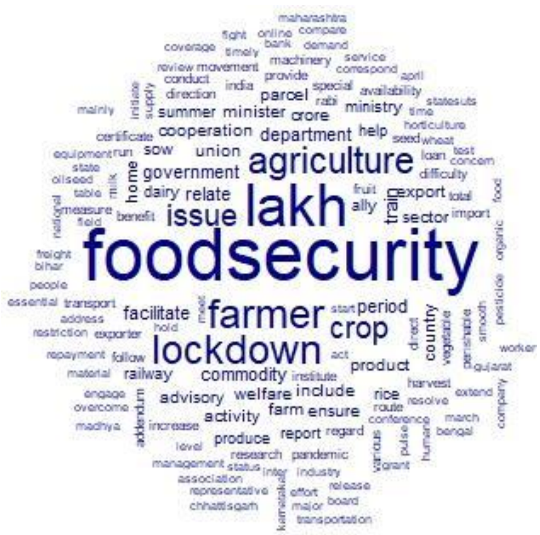


Figure 7.3 High-frequency words in the official media release of Agriculture and Food Ministry of the Government of India in the wake of COVID-19.

- Railways nudged public by issuing 100% refund on cancellation of tickets to discourage travel in the wake of COVID-19 pandemic. In addition, they removed all senior citizen benefits and concessions to discourage ticket sales. Similarly, the policies on agriculture and farmer’s welfare focussed on ensuring food security and undisrupted supply chain during the nationwide lockdown phase. February to April is the harvesting time for winter crops in India that is crucial for food security in the country. In the wake of coronavirus and strict lockdown measures, the Government of India allowed farmers to harvest.

Besides, policy emphasis was laid on providing fiscal packages to the distressed farmers who were affected by national lockdown and supply chain disruption. The policy nudges were focussed on the continuity of harvest and rerouting of the critical food supply chain.

8. Nudges for addressing consumer demand and Producer Supply

8.1 GST reduction and restructuring

The government needs to put money in the hands of people to nudge them into spending to keep the economy alive. GST rates on FMCGs (an already slowed down sector) and other good must be lowered or removed thus effectively leaving people with more money to spend. This might even be a good time to re-structure GST into two slabs to avoid complications such as the council having to decide if rotis and parathas should be taxed at the same rate or not [33]

8.2 UPI and digital transactions

Even if money is put in the hands of the people, due to the lockdown and general apprehension around going out, it is difficult for them to spend this money. UPI transactions have been at an all-time high in June [34]. More steps taken in this direction such as cashbacks or other such offers will incentivize consumers to spend in an easier manner thus helping the economy.

8.3 Fuel Prices

Excise duty on petrol and diesel form a significant part of the government's revenue. There has been a significant government shortfall in the tax revenue. The government hoped to earn ₹ 21.63 lakh crore during the course of 2019-20. However, till December 2019, it had only earned ₹ 13.83 lakh crore (63.9%) of the total [35]. The crude prices have fallen to a historical low. Still, the cost of fuel remains high because the tax revenue on fuel forms a major chunk of the government's income and at a time when other sources have dried up, fuel price hikes seem like a lucrative option. However, in such times government should become "spender of the last resort" and decrease fuel prices because fuel prices directly affect prices of various commodities and increase in prices of the commodities disincentives spending.

8.4 Opt-out Moratoriums

Even though government has forces banks to offer moratoriums to borrowers, many financial institutions, mostly private banks have taken advantage of a behavioral economics aspect called status-quo bias (or conformity) in order to protect their own interests [36]. Essentially, the instalment amount is automatically deducted unless the borrower asks to defer payments. This puts the onus of opting out on the borrowers. Some players make it deliberately harder to opt out. In case further moratoriums are offered, the government must force all financial institutions to comply with opt-out moratoriums.

9. Conclusion

Developing a cogent supply chain response to the coronavirus outbreak is extremely challenging, given the scale of the crisis and the rate at which it is evolving. The best response, of course, is to be ready before such a crisis hits, since options become more limited when a disruption is in full swing. However, in this report we have identified the proper nudges that can overcome various economic. Political and technological factors. There are measures that can be taken now even if you're not fully prepared. And although its long-term consequences have yet to fully play out, the coronavirus outbreak already provides some lessons about how you can better prepare your addressing needs of producer supply and consumer demand to deal with future large-scale crises.

These are gross simplifications of many sustainable models that the government can take to reduce risk and ensure response capacity. A more detailed analysis and assessment includes use of behavioural economics, and draw out a pattern between pre-crisis and, supposedly, post crisis situation and moreover what can be done to bridge the infrastructural gaps and to properly identify nudges based on that. Obviously, in selecting a SBM, we have made sure the above said points fulfils that and this report, based on the SBM, have successfully identified the changes that needs to be done. Government have to weigh the costs of each and how it will affect their ability to serve their people and compete against other countries. It's impossible to anticipate the

arrival of global crisis such as the coronavirus outbreak, but government can mitigate their impacts by taking supply chain preparedness to a higher level.

Bibliography

[1] IMF, “World Economic Outlook,” International Monetary Fund, Washington DC, October 2019.

[2] T. C. W. Lin, “A Behavioral Framework for Securities Risk,” *Seattle University Law Review,* no. 34, p. 324, 2011.

[3] T. Simon, “Feeding the behavioral revolution: Contributions of behavior analysis to nudging and vice versa,” *Journal of Behavioral Economics for Policy,* vol. 1, pp. 91-97, 2018.

[4] F. Lüdeke-Freund, “Towards a Conceptual Framework of 'Business Models for Sustainability',” *KNOWLEDGE COLLABORATION & LEARNING FOR SUSTAINABLE INNOVATION, R. Wever, J. Quist, A. Tukker, J. Woudstra, F. Boons, N. Beute, eds., Delft, 2010,* 2010.

[5] L. Leatherby and K. Greifeld, “What the Yield Curve Says About When the Next Recession Could Happen,” August 2019.

[6] S. N. Sharma, “Severe slowdown: When will the Indian economy recover and how?,” December 2019.

[7] V. Kaul, “Budget 2020: Can the Indian government spend its way out of the slowdown?,” January 2020. [Online]. Available: https://www.newslaundry.com/2020/01/21/budget-2020-can-the-indian-government-spend-its-way-out-of-the-slowdown.

[8] S. Malviya and S. Mirchandani, “Worst FMCG show likely in 15 years: Credit Suisse,” September 2019. [Online]. Available: https://economictimes.indiatimes.com/industry/cons-products/fmcg/worst-fmcg-show-likely-in-15-years-credit-suisse/articleshow/71193810.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst.

[9] A. Subramanian and J. Felman, “India's Great Slowdown: What Happened? What's the Way Out?,” Center for International Development, Harvard Univerisity , Cambridge , December 2019.

[10] Accenture, “Coronavirus (Covid-19) Industry Impact,” Accenture, 2020.

[11] Avalon, “The Avalon Pandemic Test – Impact of COVID-19 on Indian Inc. – An Asia focused strategy and management consulting firm,” Avalon, April 2020.

[12] The Economic Times, “Economic times,” 2020. [Online]. Available: https://economictimes.indiatimes.com/markets/stocks/news/coronavirus-impact-on-healthcare-sector/articleshow/75136714.cms?from=mdr. [Accessed 30/05/2020 May 2020].

[13] Y. Egan, “How Covid-19 will impact the financial outlook for the health care industry,” Advisory Board, may 2020. [Online]. Available: https://www.advisory.com/research/health-care-advisory-board/expert-insights/2020/covid-19-financial-impact. [Accessed 30/05/2020 May 2020].

[14] S. Anand, “Nielsen slashes FMCG growth forecast by half to 6-7% for 2020,” The Economic Times, April 2020. [Online]. Available: https://economictimes.indiatimes.com/industry/cons-products/fmcg/nielsen-slashes-fmcg-growth-forecast-by-half-to-5-6-for-2020/articleshow/75472275.cms. [Accessed 30/05/2020 May 2020].

[15] B. Abdi, “India petroleum demand: Covid-19 impact: India's petroleum consumption falls to 10-year low, Energy News, ET EnergyWorld,” The Economic Times, April 2020. [Online]. Available:

https://energy.economictimes.indiatimes.com/news/oil-and-gas/covid-19-impact-indias-petroleum-consumption-falls-to-10-year-low/75064474. [Accessed 30/05/2020 May 2020].

[16] S. M. Dev, "Addressinh Covid-19 impacts on agriculture, food security, and livelihoods in India," International Food Policy Research Institute, April 2020.

[17] A. H. S.G. Deshmukh, "Framework for manufacturing in Post-Covid-19 World Order: An Indian Perspective," p. May, 2020.

[18] D. S. a. G. V. Houngbonon, "www.ifc.org," May 2020. [Online]. Available: https://www.ifc.org/wps/wcm/connect/8f9237d2-eceb-433f-a2d0-300907808722/EMCompass_Note_83-for+web.pdf?MOD=AJPERES&CVID=n7M5wS.}},. [Accessed 29/05/2020 May 2020].

[19] S. Datta`, "India must bridge huge gaps to tackle Covid-19," March 2020. [Online]. Available: https://www.deccanchronicle.com/opinion/columnists/200320/india-must-bridgehuge-gaps-to-tackle-covid-19.html. [Accessed 29/06/2020 June 2020].

[20] Accenture, "Covid-19: Impact on Consumer Behaviour Trends," April, 2020.

[21] C. H., "Business model innovation: Opportunities and barriers," *United Nations World Report, 1987,* p. June, 2010.

[22] C. H., "Business model innovation: Opportunities and barriers," *Harvard Business School,* vol. 80, p. June, 2000.

[23] R. Abadie, "COVID - 19 and infrastructure: A very tricky opportunity," World bank, 15 May 2020. [Online]. Available: https://blogs.worldbank.org/ppps/covid-19-and-infrastructure-very-tricky-opportunity. [Accessed 29 June 2020].

[24] Asian infrastructure investment bank (AIIB), "Background impact of Covid-19 and implications on Infrastructure priorities," AIIB, 2020.

[25] KPMG, "Impact of Covid - 19 on Indian economy," KPMG, 2020.

[26] Ernst & Young, National Center for Cold Chain Development, "Refrigerated transportation: bottlenecks and solutions," 2020.

[27] Ernst & Young, "Cold Storage Market in India 2015-2020," July 2015.

[28] ICAP, "India Cooling Action Plan," ozone cell, 2020.

[29] A. D. Vaio, F. Boccia, L. Landriani and R. Palladino, "Artificial Intelligence in the Agri-Food System: Rethinking Sustainable Bausiness Models in the COVID-19 Scenario," *Sustainability,* vol. 12, 2020.

[30] B. Boshkoska, S. Liu, G. Zhao, A. Fernandez, S. Gamboa, M. Del Pino, P. Zarate, J. Hernandez and H. Chen, *Comput. Ind.*, no. 110, pp. 64-80, 2019.

[31] D. Perales, M.-J. Verdecho and F. Alarcón-Valero, "Enhancing the Sustainability Performance of Agri-Food Supply Chains by Implementing Industry 4.0.," in *Springer Science and Business Media,* Berlin/Heidelberg, Germany, 2019.

[32] B. E., "Coronavirus Lockdown Creates Captive Audience for '80s Show," *The Wall Street Journal ,* 2020.

[33] PTI, "Ready-to-eat frozen parotas to attract 18 pc GST; 5 pc for plain parotas served in restaurants," June 2020. [Online]. Available: https://economictimes.indiatimes.com/industry/cons-products/food/parotas-are-not-rotis-and-will-attract-18-gst-says-authority/articleshow/76334210.cms?from=mdr.

[34] PTI, "UPI payments hit all-time high of 1.34 bn transactions in June," July 2020. [Online]. Available: https://www.thehindu.com/business/upi-payments-hit-all-time-high-of-134-bn-transactions-in-june/article31968685.ece.

[35] V. Kaul, “Budget 2020: If calculated the right way, government’s fiscal deficit is Rs 10 lakh crore,” February 2020. [Online]. Available: https://www.newslaundry.com/2020/02/01/budget-2020-if-calculated-the-right-way-governments-fiscal-deficit-is-rs-10-lakh-crore.

[36] R. H. Thaler and C. R. Sunstein, Nudge: Improving Decisions about Health, Wealth, and Happiness, New Haven and London: Yale University Press, April 2008.

[37] Digital Economy, “Dealing with disruption: A Digital Nudge,” Hyperconnectivity, March 2020.