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STUDENT'S SPECIAL ISSUE

PROF.CA KISHORE PESHORI
(PRINCIPAL)

Dr. AASHISH S. JANI
(EXECUTIVE-EDITOR)

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FROM THE DESK OF THE EDITOR…!

After Covid-19 the education world has been changing very fast with drastic majorchanges in the research dimensions. UGC and MHRD have launched many virtual platforms with online depositories, e-books and other online teaching/learning materials. Combination of the traditional technologies' with mobile/web technologies to a single platform with depositories would enhance better accessibility and flexibility to education.

The main objectives of NEP 2020 clearly define the pivotal role in catalysing interdisciplinary /multi-disciplinary research culture at UG level.

Students' research at undergraduate and post graduate level is the key to success towards real life education. Implementation of this student centric research requires establishment of the Academic Bank of Credits (ABC), a national level facility which will be a bank for academic purposes with students as academic account holders. A minimum of 20 credits of the 160 credits in four years undergraduate degree programmes will be earned via research activities according to guidelines prepared under NEP 2020.

Further, it will encourage and make it possible for all students to open an academic bank account to commute credits to award any degree/research fellowship/certificates.

The ability to integrate classroom knowledge with practical problems is important to decide research problems of the real world and to provide realistic solutions for the same. Four years Undergraduate bachelor's degree programme objectives are clearly defined in these directions. This calls for developing research experiences in students and developing system of offering real life research projects with keen interest towards pursuing realistic research projects. Here role of research organisations, higher institutions or research centre can support research internships as providers.

Keeping such ideas in mind, I feel humbled to bring out the Third students special Issue of our reputed E-Journal "MMK: ACE", including research papers for the first time from students' community at various undergraduate, post graduate and Doctoral level Programmes of our College. This volume develops the fact finding empirical approach among students community at higher education.

I extend my sincere gratitude to the Management of H.S.N.C. Board and our respected Principal Prof. Dr. CA Kishore Peshori for their constant support and motivation towards a strong Research foundation.

Finally, a big thank you to the Peer-reviewers and Publishing House for helping us in publishing this E-Journal. I invite feedback and suggestions from our Readers, Researchers and Academicians for further improvement in our E-Journal "MMK: ACE".

Dr. Aashish S. Jani
Vice-Principal & Executive Editor

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PRINCIPAL'S MESSAGE…!

Dear Members of the Academia,

It brings me immense joy and pride to witness the continued growth of SMT. M.M.K. College, especially in the realm of research, as evidenced by the expansion of our esteemed Research Centre in Commerce (Business Policy & Administration) and the recent approval in Accountancy.

I extend my heartfelt gratitude to the dynamic editorial team, led by Dr. Aashish Jani, Vice Principal, for their unwavering commitment and dedication to advancing the cause of research at our institution. Their tireless efforts have played a pivotal role in steering our academic community toward the frontiers of knowledge.

In the spirit of our rich cultural heritage, I am pleased to include a Sanskrit shloka in this research endeavour, symbolizing the fusion of tradition and progress in our scholarly pursuits:

"चरैवेतिचरैवेति..."
"Keep Walking, Keep Walking",

The present focus on student-centric research in this Third edition of MMK: ACE is indeed a commendable initiative taken at the opportune moment. It reflects our collective commitment to nurturing the research acumen of our students, a vital aspect of our academic mission.

I express my sincere appreciation to the Research Committee, whose proactive approach has not only fostered the development of new faculty but has also provided a platform for meaningful research at both undergraduate and postgraduate levels. The previous volumes of MMK: ACE have been well-received by the academic community, and I am confident that this edition, emphasizing student research, will further elevate our standing.

Kudos to the editorial team for curating diverse themes that delve into various facets of the Economy and Education sector. I extend my appreciation to the Course Coordinators, specialized students, academicians, research guides, and scholars whose valuable contributions have enriched the content of this journal.

I applaud the continuous efforts of the editorial board in cultivating and promoting a robust Research Culture across all multidisciplinary programs. Your dedication is instrumental in inspiring our faculty and students to embrace the role of researchers and critical thinkers.

As we embark on this intellectual journey through the pages of MMK: ACE, I wish the entire team the very best. May the ideas shared in this volume pave the way for positive outcomes and catalyze many more students and teachers to embark on the rewarding path of research and scholarly exploration.

With warm regards,

Prof. Dr. CA Kishore Peshori
(Principal)

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Rebooting the German Economy through Digitalization

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Abstract:- The present study attempts to determine the overall development of digitalization in the German economy. In particular, this paper highlights the growth of digitalization in different sectors, including health, automobiles, and financial services. The paper also studies the digital readiness of the German Economy. To achieve the objective, the analysis is undertaken for a period of five years from 2016 to 2021 by using data from sources such as OECD, IMF, and World Bank. The study has used a combination of graphical and tabular representations to correlate data and to thoroughly and accurately study the impact of digitalization on the respective sectors. The study also analyses policies adopted by the German government in relation to digitalisation.

Keywords:- *Germany, digitalization, health, automobiles, financial services, government policy.*

I. INTRODUCTIONS

According to the **International Monetary Fund,** "Digitalization encompasses a wide range of new applications of information technology in business models and products that are transforming the economy and social interactions." "Digitalization is both an enabler and a disruptor of businesses".

Digitalization is an essential element in today's era as it is proven to be useful in increasing efficiency, saving costs, allowing data to be evaluated, and reducing human error and operational costs. As the world advances towards modernity and digitalization, the usage of technological systems must be carefully addressed. Eventually, the economy will have to deal with digitalization or else it will collapse. But when digital transformation is done correctly, it takes a country to a whole new level. Adopting new technology is simply one aspect of digital transformation. It impacts entire countries and organisations including the toolset, workflows, customer service, management, way of thinking, etc.

Known for its strict digital laws and strong economy, Germany is one of the most powerful countries in Europe. It is the world's fourth-largest economy by nominal GDP, and the fifth-largest by Purchasing Power Parity (PPP) in 2021. It is also the third-largest exporter and importer of goods globally. Germany is also a global leader in the fields of industry, science, and technology. Since it is a developed country with a high human development index, it offers a universal health care system, environmental protection, and tuition-free university education. The country also has the third-highest number of UNESCO World Heritage Sites. The country is also a member of the United Nations, NATO, the G7, the G20, and the OECD.

Germany has a population of 84,274,119 based on the latest data by the United Nations, making it the most populous country in the European Union and the nineteenth most populous country in the world. The total population is equivalent to 1.07% of the entire world population. In Germany, 76.3% of the population lives in urban areas, and the median age is 45.7 years. German is the only official language, and it is the most widely spoken. Standard German is understood throughout the country. It is estimated that over 99% of those who are 15 and older are capable of reading and writing. In Germany, Christianity is the most predominant religion, accounting for 53.9% of the country's population. There are also smaller religious groups (not more than 1%), such as Judaism, Buddhism, and Hinduism.

Germany has a leading role in spectrum assignment. Germans use the Internet more than average, and their digital skills have improved. German companies and citizens are actively pursuing e-commerce opportunities. In the 2020 Bloomberg Innovation Index, Germany was ranked the most innovative country globally and 9th in the WIPO (World Intellectual Property Organisation) Global Innovation Index for 2019 and 2020.

II. REVIEW OF LITERATURE

In terms of digitalization, Germany is one of the world's leaders. Consequently, a few research articles were reviewed to obtain background knowledge about Germany's digitalization and to explore what research has previously been done.

Llopis-Albert, Rubio & Valero (2020)examined topics like connected and autonomous driving, mobility as a service, digital recommendations in car purchasing, big data, etc. Furthermore, they performed a detailed study on analysing the impacts of digital transformation on the automotive industry from different perspectives of participants, ranging from automobile manufacturers,

service providers, public transportation providers, and to consumers. Their methodology has been successfully applied to a complex case study-based empirical analysis. As a result, it is suggested that it is crucial to invest in digital transformation so that manufacturers will have ample profits, productivity, and competitiveness.

Köcher, Meissner, Schweinsberg, & Poensgen (2021)conducted research and analysed the public confidence in responsible ministers' digital proficiency. For example, 21% of the population trusted Economy Minister Altmaier, who was especially pleased with digitalization; 11% trusted Chancellery Minister Braun, and 10% trusted Education Minister Karliczek. Trust in Chancellor Helge Braun is particularly steep in 2019. Only 4% trusted his capability in digitalization, which is currently 11%.

Meissner, Schweinsberg & Poensgen (2021) stated in the digital riser report by ESCP Business School that the Digital Riser Index indicates that the competitive landscape around digital technologies is moving extremely quickly. It suggests that progress is attainable regardless of a country's digital competitiveness baseline and size. However, the speed of digitalization differs significantly. While this development does not mean that the gain of one is the loss of another, it does demonstrate that governments should emphasize ways of strategically managing their policies in this crucial area for the future.

Zimmermann (2021) has presented an analysis regarding Germany's position in digitalization in international comparison, particularly the country's expenditure on digitalization. Germany's investment in the IT sector lags far behind compared to other countries such as the US, France, and the UK. Germany occupies the 12th rank within the EU28 in digital technologies in business processes. Low IT penetration into the economy is low spending on small and medium-sized enterprises. In 2019, SMEs (Small and Medium-sized Enterprises) spent just under EUR 18 billion on digitizing their operations. However, various hurdles still stand in the way. On the one hand, efforts must continue to raise awareness of the benefits of using digital technologies in business, particularly from a strategic perspective. On the other hand, there is a shortage of qualified specialists, a lack of skills, limited access to finance, and continuing deficits in digital infrastructure. Economic policies must now set the course in the right direction.

Neter (2021) concluded in his research paper that a panel of interested users selected from the general population in Germany was used to study digitalization and health in Germany. He divided the items into four topics to explore, such as 1) general attitudes toward digitization, 2) the COVID-19 pandemic, 3) physical activity, and 4) perceived digital health. Over half (57.10%) reported using digital technologies for health-related purposes. The majority of 88.56% observed that digitization would be necessary for therapy and healthcare in the future. On the other hand, only 25.64% reported interest in smartphone apps for health promotion and prevention, and 42.70% downloaded the COVID contact tracing app.

The European Centre Business School (2021) has studied the digital engagement of leaders from 27 European nations and their interaction with digital subjects. In terms of employment in 5G, it ranks first. Germany ranked second just after Estonia in terms of overall digital engagement. Third in terms of entrepreneurship; fourth in terms of e-government; sixth in terms of engagement with cybersecurity and in terms of engagement in Industry 4.0, Germany ranks 10th. Focusing on Germany's profile, it is found that the then-German Chancellor Angela Merkel was a lot more active when it came to 5G (25%), followed by AI (20.8%) in 2020. She equally gave digital engagement to subjects like digital education, mobility, cyber security, industry 4.0, and entrepreneurship (16.7%). However, she did not focus on robotics like her counterparts.

Professor Anderl, (2016)the Efficient Industrie 4.0 has five use scenarios with corporate industrial partners. These include information carriers such as component parts and industrial materials, paperless quality assurance, digital value stream mapping for real-time production control, status and energy consumption monitoring, and flexible, intelligent machine-operator assistance systems. At TU Darmstadt, a "SME 4.0 Centre of Excellence" was also established to transfer Industrie 4.0 knowledge to industrial practices. In a related vein, "IT security" is a key component of "Efficient value creation processes," "Energy management," and "New business models."

Euractiv (2022) has conducted a study in Germany which affirmed, According to a survey conducted by Bitkom, 66% of all German companies admit they are either behind the curve or have already fallen behind in the transformation to Industrie 4.0. While reports show that more prominent and tier-1 companies are well-positioned for Industrie 4.0, small and medium-sized businesses suffer. They further said that the three major problems suffered were a lack of financial resources (77%), high data protection requirements (61%) and IT security requirements (57%). Therefore, there is an imminent need to provide relief, support, and funding through various sources in the next legislative period, and the same has been echoed by many around Germany. The government has already taken the initiative in the current legislative period, but some flaws still need to be fixed.

III. OBJECTIVES

As per the study, objectives of the research paper are as follows:

- To examine the position of Germany as a digitised economy in Europe,
- To examine and analyse the growth of the German digital infrastructure,
- To assess the growth and adoption of digitalization in different sectors such as automobiles, financial services, and health care,
- To review the German government’s digital policy and understand its stance towards adopting digitalization within the country.

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IV. SCOPES AND METHODOLOGY

The timeline considered for this paper is five years, from 2016 to 2021. This paper studies the overall development of digitalization in Germany. In addition, this paper also examined the overall effect of Germany's different sectors, such as automobiles and financial services, as well as the health sector. For this research paper, secondary data are utilised. The data had been extracted from various research papers published by renowned forums, organisations and institutes. In addition, the statistical data were obtained from websites such as the World Bank, Eurostat, Organisation for Economic and Co-operation Development and the International Monetary Fund, among others.

V. LIMITATIONS

The timeframe for the study is limited to 5 years, that is 2016-2021. Further, the study concentrates on only three sectors of the German economy: the Automobiles, Financial services and Health sector. The other sectors were not included in the study.

VI. COUNTRY PROFILE

A. *Geographic Profile*

- **Location:** German territory extends from the Alps across the North European Plain to the North Sea and Baltic Sea in Central Europe. Its central and southern regions have forested hills and mountains surrounded by the Danube, Main, and Rhine river valleys.
- **Size and Land boundaries:** The German territory covers 3,57,021 square kilometres, including 3,49,223 square kilometres of land and 7,798 square kilometres of water. It has nine bordering countries and a total of 2,389 kilometres of land boundaries: Denmark (140 km) in the north, Poland (467 km) and the Czech Republic (704 km) in the east; Switzerland (348 km) and Austria (801 km) in the south, France (418 km) in the southwest, and Belgium (133 km), Luxembourg (128 km), and the Netherlands (575 km) in the west. Furthermore, Germany shares a maritime border with Sweden in the north and the United Kingdom in the northwest.

B. *Economic Profile*

- **Overview:** In 2022, the German economy is the largest economy in Europe. Germany lies within the heart of Western Europe. It faces significant demographic challenges to sustain long-term growth, like its Western European neighbours. With low fertility rates and declining net immigration, the country's social welfare system is under pressure, necessitating structural reforms.

The government system is a Federal republic, with the president as head of state and the chancellor as head of government. Germany has a mixed economic system, combining a variety of private freedoms along with centralised economic planning and government regulation. Germany is also a member of the European Union.

In 1871, the German Empire, a modern federal state, unified the nation-state now known as Germany. In the first half of the 20th century, Germany was involved in two devastating world wars consequently in 1949, two German states were formed due to the Cold War: the eastern German Democratic Republic (GDR) and the western Federal Republic of Germany (FRG) .

The collapse of the Soviet Union and the fall of Communism enabled Germany's unification in 1990. The unification of the two German states made Germany Europe's most populous nation, thus strengthening its role as a key member of the European Union and the continent's economic, political, and security organisations.

- **Gross Domestic Product (GDP):** Germany has a highly developed social market economy. In 2021, Germany contributed 3.32 % of the global GDP. The service sector generates over 70% of the GDP in Germany, while industry accounts for 29.1% and agriculture for 0.9%.

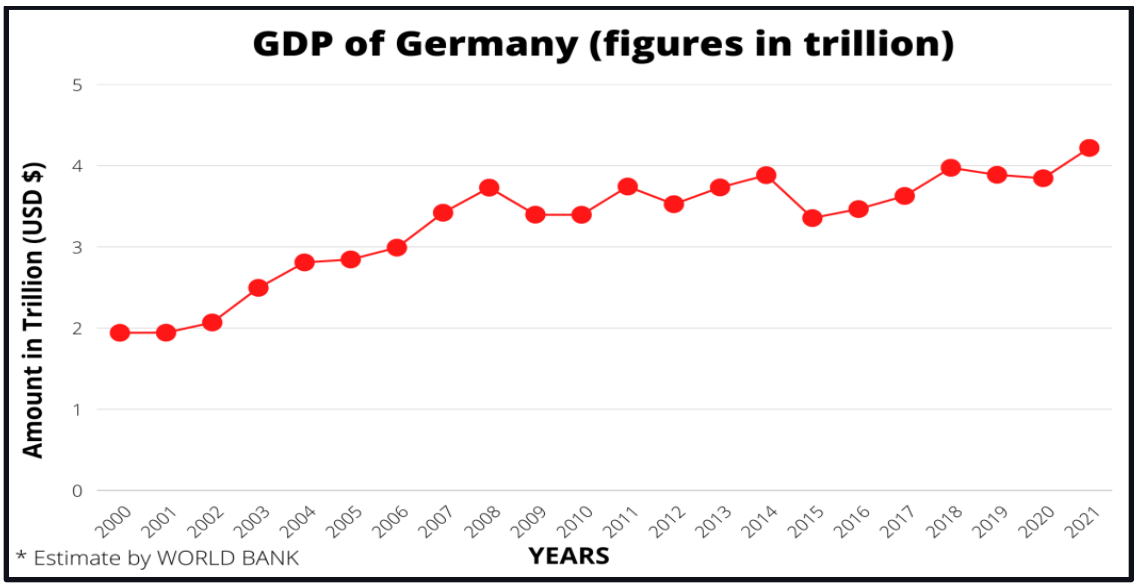

Fig. 1: GDP of Germany (Source: World Bank)

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According to the **World Bank,** as seen in figure 1, Germany's GDP grew by just 2.7% in 2021 due to increased COVID-19 cases, pandemic-related restrictions, and supply chain pressures. Germany's GDP in 2017 was $3.628 trillion due to Germany's exports continuing to improve on an annual basis. Exports of goods and services were up 4.7% on a price-adjusted basis. Imports increased by 5.2%. Consequently, the balance of exports and imports contributed +0.2 percentage points to GDP growth, but it grew to $3.975 trillion in 2018 due to a positive contribution from domestic demand. Both household final consumption expenditure (+1.0%) and government final consumption expenditure (+1.1%) increased over last year. There was a fall in the GDP for 2019: it went down to $3.888 trillion. The main reason for this GDP decline was Germany's exposure to tensions in international trade, and the new figures partly reflect the drop in overseas exports. Still, in the year 2020, Germany's GDP increased to $3.846 trillion in 2020.

- **Inflation:** According to figure 2 in 2021, Germany's consumer price inflation rate was 3.1 %, but in 2020 it was 0.5 %.

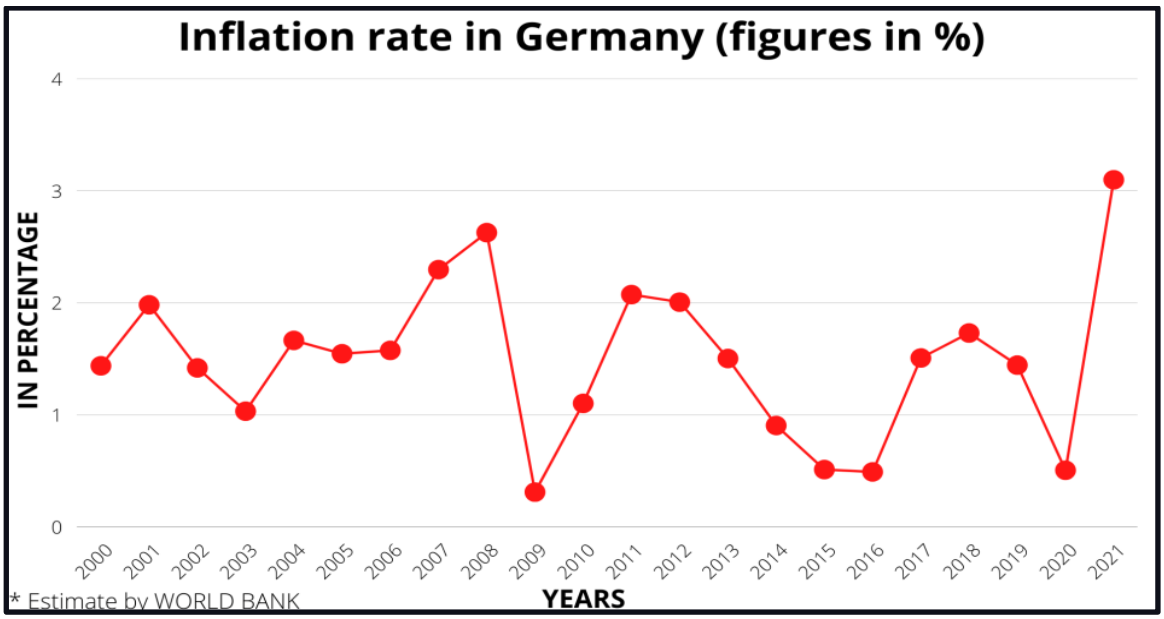

Fig. 2: Inflation rate of Germany (Source: World bank)

Between 2020 and 2021, German inflation soared by 260%. The main reasons were increasing energy prices; delivery bottlenecks caused by supply chain interruptions; heating oil prices rose the highest and doubled compared to last year; fuel prices rose by 43.2 %; and German prices of goods increased in November by 7.9 % above the average, according to Destatis (2021).

- **Employment:** Furthermore in figure 3, Germany, the employment rate for 2021 was 59%, the same as in 2020.

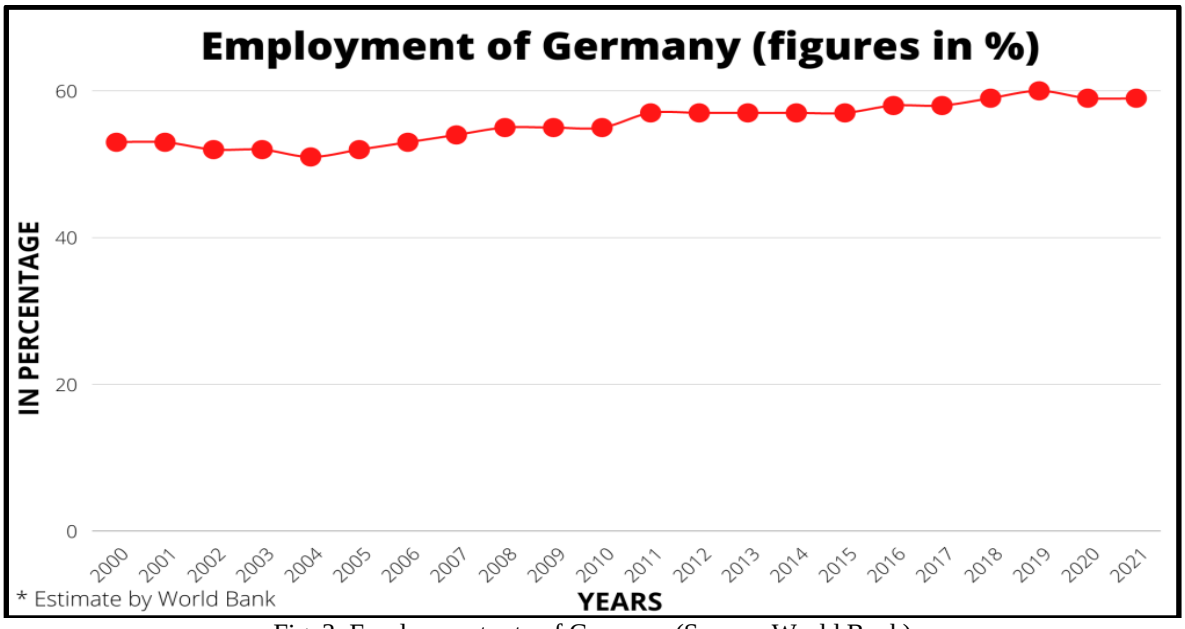

Fig. 3: Employment rate of Germany (Source: World Bank)

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The data shows that in 2020 there were 41.74 million people employed in Germany. According to provisional estimates by the Federal Statistical Office, roughly 45 million people in Germany were employed in February 2022. From March 2021 to January 2022, there was an average monthly increase of 58,000 people (+0.1%), or 0.1%, in employment. In February 2022, there was an increase of 28,000. However, the number of people employed is still below the pre-crisis level. In February 2022, the number of employed individuals fell by just 0.2% or 72,000 people.

- **Export & Import:** Exports dominated national output at 41%. Germany's top exports are cars ($123B), packaged medicines ($60.9B), vehicle parts ($54.6B), blood, antisera, vaccines, toxins, and cultures ($34.1B), and planes, helicopters, and spacecraft ($20.9B), with most going to the United States ($116B), China ($106B), France ($101B), the Netherlands ($84.8B), and the United Kingdom ($74.4B).

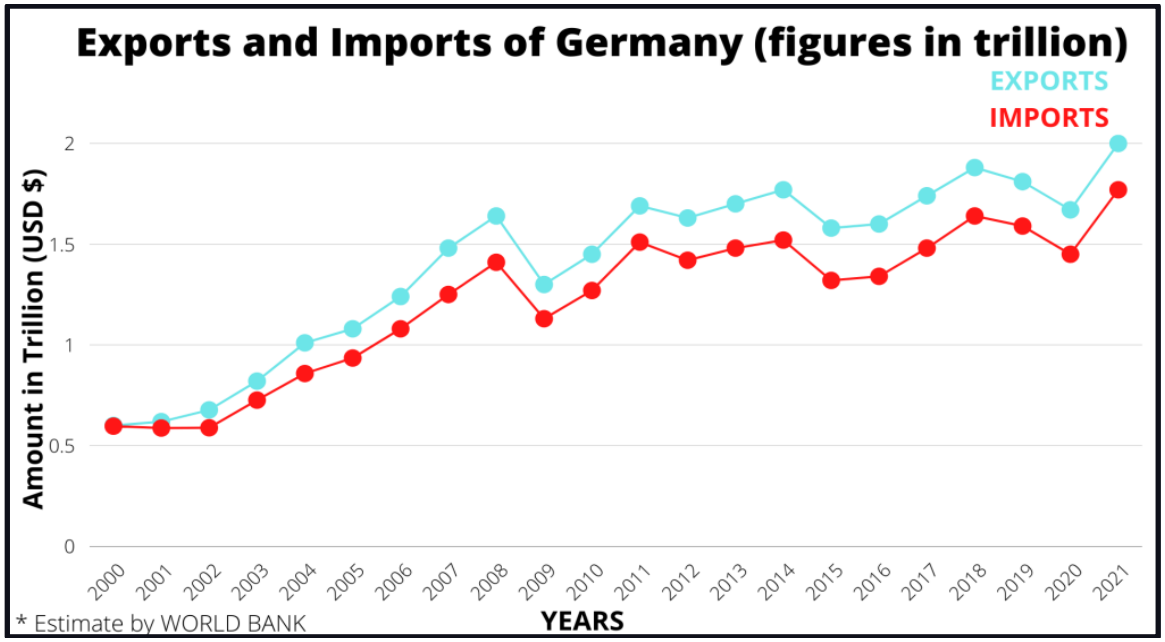

Fig. 4: Imports and Exports of Germany (Source: World Bank)

As per figure 4 in 2016, Germany recorded the largest trade surplus in the world, worth $310 billion. In 2019, the German economy exported $1810.93 billion worth of goods and services, ranking it among the top exporters globally. Economic Complexity Index (ECI) statistics indicate that Germany ranked third in exports and third in imports for 2020. Germany's top imports are cars ($68.9B), vehicle parts ($36B), packaged medicines ($32.2B), broadcasting equipment ($28.7B), and blood, antisera, vaccines, toxins, and cultures ($25.5B), importing mostly from China ($112B), the Netherlands ($105B), Poland ($73.1B), France ($65.2B), and Italy ($62.1B).

VII. UNDERSTANDING DIGITAL GERMANY

Let us now understand digitalization in Germany by examining its digital profile and digital infrastructure.

A. Digital Profile of Germany

- **Digital Economy and Society Index (DESI):** The Digital Economy and Society Index (DESI) measures vital facets of digital transformation, from human capital to connection quality to state and economic integration. Since 2014, the European Commission has monitored Member States' digital progress through the Digital Economy and Society Index (DESI). Members of DESI participate in country profiles to identify areas that require priority action, as well as thematic chapters that provide an overview of key digital areas at a European level, essential for policy development.

A report by DESI 2021 indicates that the EU's digital leaders are Denmark, Finland, Sweden, the Netherlands, and Ireland. Germany ranks 11th, despite its expanding economy and enormous might. While Germany performs relatively well in broadband connectivity, planning and building capacities are lacking, and an urban-rural digital divide persists. The DESI index contains four components, such as human capital, connectivity, integration of digital technology, and digital public services. In terms of human capital, Germany ranks 7th out of 27 EU countries and is therefore above average, and it performed well on most connectivity indicators in 2021, ranking 6th in the overall composite connectivity indicator. In terms of the integration of digital technology into business activities, Germany is ranked 18th, and in digital public services, it is ranked 16th. *(Fig 5).*

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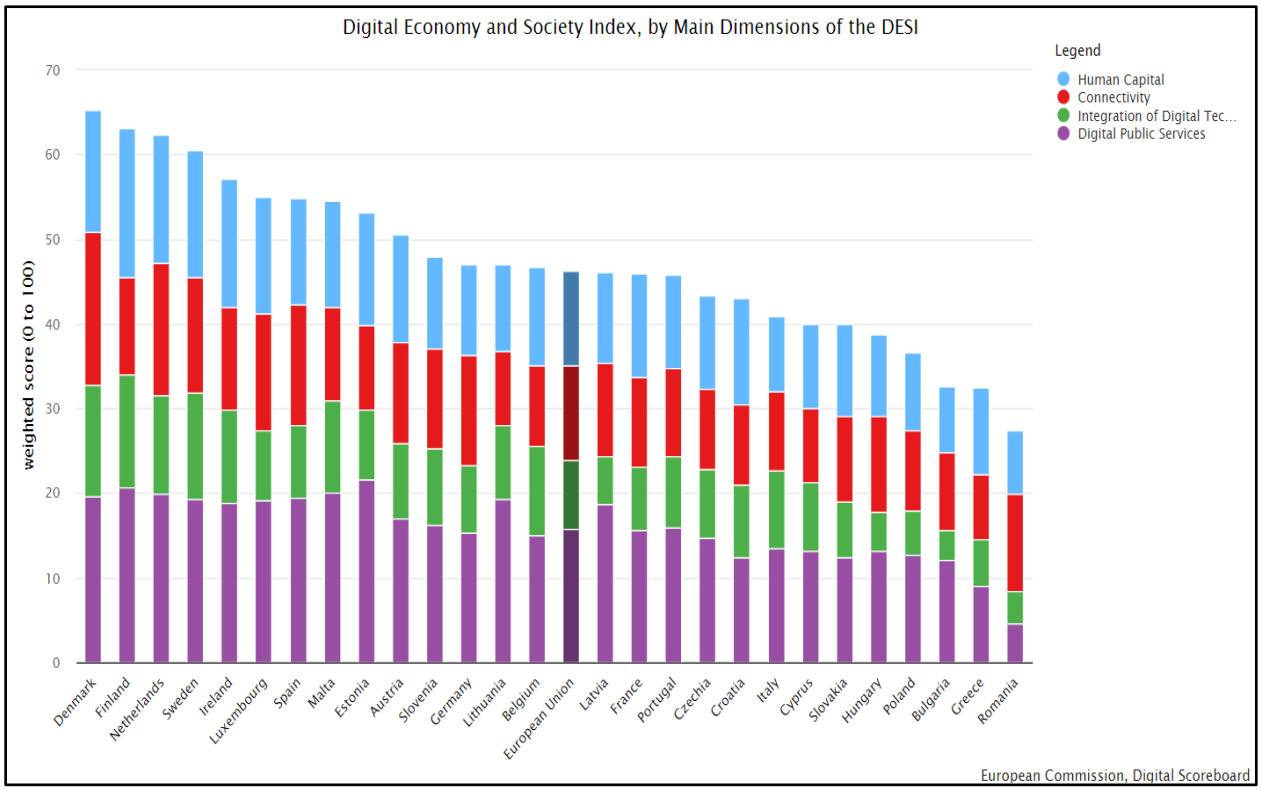

Fig. 5: DESI 2021 rankings (Source: Digital Agenda)

As per *(Fig 6)*, the performance of Germany on the DESI index is far better than that of the European Union in almost every segment. From 2016 to 2021, Germany has shown better performance on the DESI index as compared to the EU.

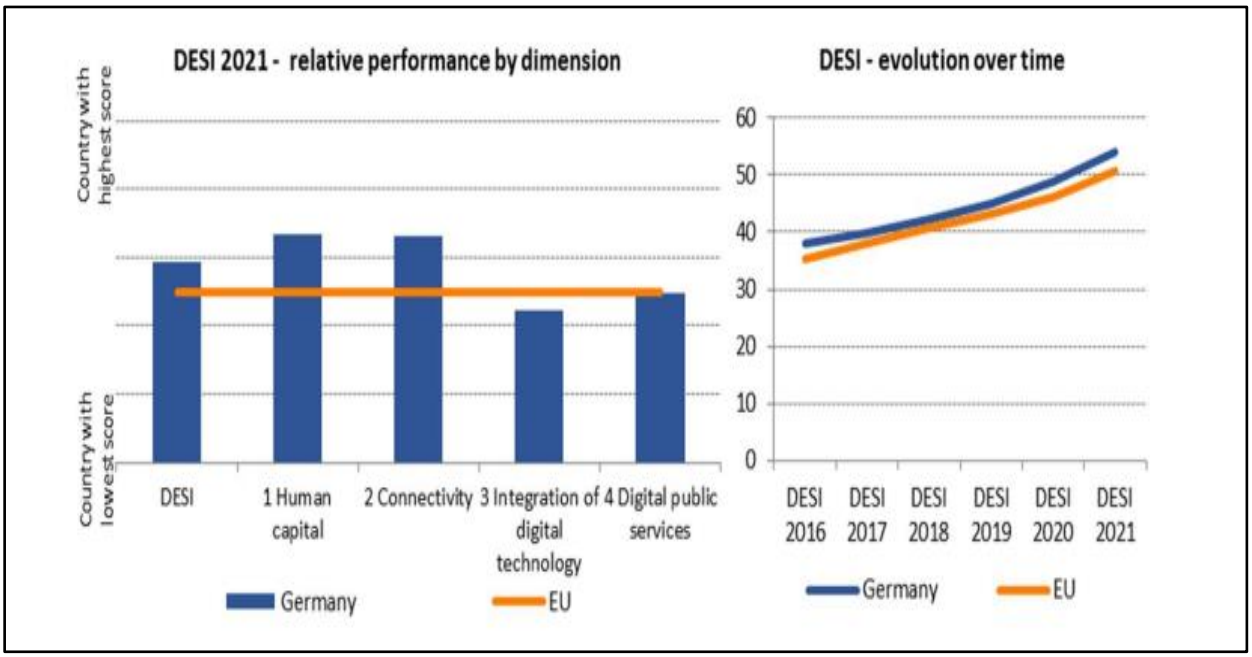

Fig. 6: DESI 2021 comparison with EU (Source: Digital Agenda)

As per the above figure, the performance of Germany in DESI (2016-2021) has improved in comparison to the EU. The German Federal Government adopted the Corona Recovery Plan in June 2020. They are investing EUR 130 billion to deal with the economic effects of the COVID pandemic. Several digitalization initiatives were implemented in areas such as public administration, learning, mobility, artificial intelligence, 5G, smart cities, digital sovereignty, and hospital modernization. With the help of such a plan, the overall development of digitalization is improving in Germany, which is also helping them to rank in a dominant position.

In the digital era, Germany's technology sector is of paramount importance. According to the study done by Deloitte, sales revenues in the German technology sector

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will grow by more than 20% by 2022, up to 280 billion euros. In addition, business-to-business (B2B) sales in the industry will account for more than 60%. While consumer products like consumer electronics or PCs generate narrow profit margins due to intense competition, German technology providers are benefiting particularly from the growing demand in the more profitable business sector. By 2020, Deloitte estimates 750 million Internet of Things endpoints will be operating in Germany, an impressive growth rate. As a result, there is potential for solid growth for German software developers and service providers in all industries. Additionally, advanced vital technologies such as artificial intelligence will allow small and mid-sized companies to benefit from new digital technologies without high startup costs.

B. Digital Infrastructure of Germany:

Deutsche Telekom introduced DSL in 1999, Germany's most common means of connecting to the Internet. Alternatives include cable, FTTH and FTTB, satellite, UMTS/HSDPA (mobile) and LTE. ADSL (Asymmetric Digital Subscriber Line) is the most common type of internet connection in Germany. Internet users in Germany are increasing year on year. In 2013, 86% of the total population used the Internet, but in 2020 the percentage increased to 95% at an all time high *(Fig 7)*. But in the year 2021, the rate came down to 92%. According to the figures for 2021, there were 112.9 million mobile connections in Germany, an increase of 1.6% over the previous year.

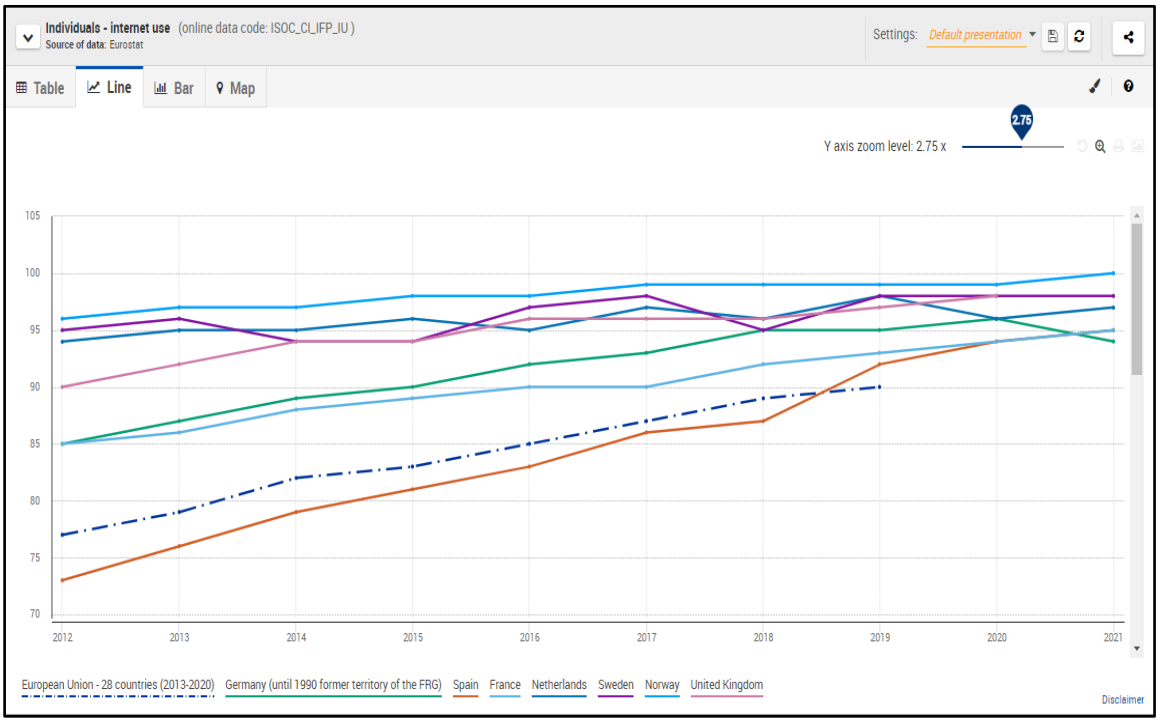

Fig. 7: Internet users of Germany (Source: Eurostat)

In Germany, the average internet speed is 74 Mbps. While in the USA it is 152 Mbps depending on which state you look at. *(Fig. 8)*. In Germany, about 93% of households have DSL connections with download speeds ranging from 2 Mbps to 50 Mbps, mostly in urban areas. Although Germany is lagging in terms of high-tech infrastructure, a regular user can work from home, stream videos, and play video games online every day. Germany ranks 4th in the total number of registrations in their assigned top-level domains, that is (.de), and has a market share of 3.8% worldwide. *(Fig 9)*

COUNTRY	AVERAGE SPEED
US	152 Mbps
France	113 Mbps
Germany	***74 Mbps***
UK	64 Mbps
India	47 Mbps

Fig. 8: Speed of Internet fixed broadband (Source: Ookla)

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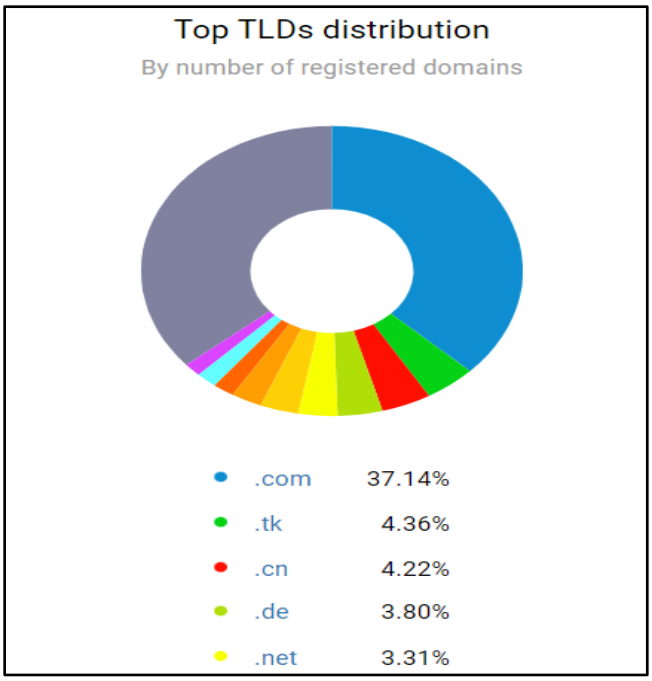

Fig. 9: Top 5 domains (Source: domainnamestat.com)

C. Digitalization Efforts in Key Sectors of Germany

Germany's three main sectors, namely automobiles, financial services, and health care, will be examined in this study.

D. Digitalization in the Automobile Industry, with a Focus on Electric Vehicles.

Digitalization is the process of transferring information, data, and processes from one medium to another. It is a process that has been occurring for a long time, but it is now being accelerated by the emergence of new technologies such as smartphones and digital cameras. As such, electric vehicles are a vital part of our society's digitalization efforts. The rapid growth of electric vehicles (EVs) has created a need for them to be connected to the Internet. This needs to be done in order to facilitate access to information and services such as charging stations, charging infrastructure, and public charging networks.

Electric vehicles have also become a key component in the development of self-driving cars. Self-driving cars are expected to be able to drive themselves when they are equipped with sensors that can sense their surroundings and react accordingly. With this capability, they will be able to drive more safely and autonomously than ever before. This connectivity between electric vehicles and digitalization is an important step forward in the evolution of our society's digitalization efforts.

In terms of production and sales of automobiles, Germany is by far the leading market in Europe. It controls 31.5% of the European market, and the automobile industry generated EUR 410.9 billion in revenue in 2021. On an international scale, it produces the third-highest number of cars and the fourth-highest number of total motor vehicles. Germany is well-known worldwide for its outstanding automotive industry and engineering excellence. The German automotive industry is pivotal in the global transition to electric mobility solutions. The values of innovation, reliability, safety, and design are deeply ingrained in German cars from Asia to America.

The global electric vehicle market will be valued at $1,103.17 billion by 2030, poised to grow at a CAGR of 23.1% from 2021 to 2030, and by 2030, it is expected that the German EV market will grow at a Compound Annual Growth Rate (CAGR) of 35%. EV sales in Germany rose by 207% between 2019 and 2020 and 104% until November 2021, making it the world's second-largest EV market, just behind China. In 2021, the top-selling electric cars were the Tesla Model 3, followed by the Volkswagen E-up and the Volkswagen ID.3.

The country sold 25,052 plug-in hybrid vehicles in 2016, outpacing all-electric vehicles for the first time. A record 54,492 plug-in vehicles were registered in 2017, up 217% from the previous year, including 29,436 plug-in hybrids and 25,056 all-electric vehicles. In 2017 and 2018, the plug-in electric car segment had a market share of 1.8% and 1.9%, respectively. The total number of plug-in electric passenger cars sold in Germany in 2019 were 108,629, including 45,348 plug-in hybrids and 63,321 all-electric vehicles. In 2019, the segment's market share increased to 3.10%. Despite the global decline in car sales caused by the COVID-19 pandemic, new plug-in electric cars registered in Germany from January to September 2020 achieved record registrations with 204,251 units sold, including 105,882 plug-in hybrids and 98,369 all-electric vehicles. A record increase in the market share of 13.6% was achieved in 2020. In Germany, 588,944 plug-in electric vehicles were on the road on January 1, 2021, representing 1.2% of all vehicles, up from 0.5% in the previous year. Plug-in car stock consisted of 309,083 fully electric vehicles and 279,861 plug-in hybrids. (Fig 10).

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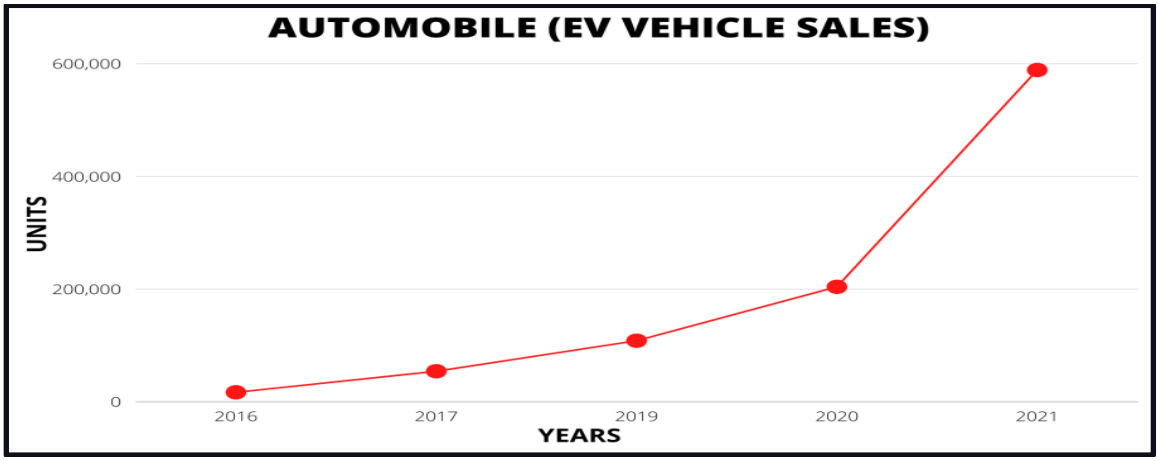

Fig. 10: Automobile sales in Germany from 2016 to 2021 (Ev & Hybrid) (Source: Statista)

The German government is confident that the German automotive industry will maintain and expand its leadership in digital automotive innovation. By 2030, the German government plans to have 15 million purely electric cars on the road, with an aid package worth 2 billion euros ($2.33 billion). For the transport sector, the government set a goal in 2016 to have 7 to 10 million plug-in electric cars on the road by 2030 and 1 million charging points.

➢ *Electric Vehicle Batteries and Electric Vehicle Charging Stations*

- **Electric Vehicle Batteries**

An electric vehicle battery is a type of rechargeable battery that fuels the electric motors of a battery-operated or hybrid electric vehicle. In modern electric vehicles, lithium-ion and lithium-polymer batteries are the most common types of batteries. The world's leading battery manufacturers are from Asian countries. As shown in *Fig. 11*, domestic cell production in the top five countries is based on production capacity. The three Asian countries, China, South Korea, and Japan, produce about 80% of the world's battery cells.

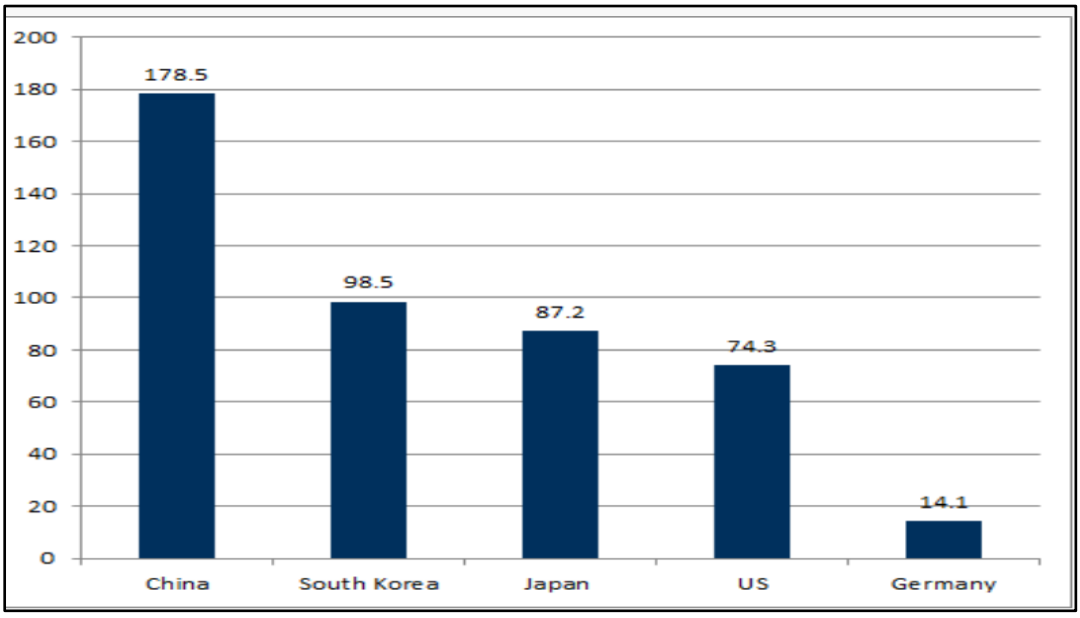

Fig. 11: Worldwide EV battery manufacturers from 2016 to 2021 (Source: Finanzen.net)

The European electric vehicle battery market was valued at $834 million in 2020, and it is estimated that Europe will account for 31.0% of the global EV battery market. It can grow at a CAGR of more than 30% between 2021 and 2026. Germany is also witnessing increased demand for electric vehicles, which in turn is expected to drive the growth of the market under study. Germany is currently leading the EV battery market in Europe as there is a strong demand for electric cars in Germany. The German government is also promoting electric vehicle use. In 2017, the government began installing DC fast chargers around the country, and Tesla has rapidly expanded its supercharger network. In recent years, thousands of new electric-car drivers have now used the nationwide fast-charging network funded by the German government. German companies such as Bosch Corporation and Continental AG focus on electric battery manufacturing.

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- **Electric Vehicle Charging Stations**

An electric vehicle charging station is a device that allows electric cars, neighbourhood electric vehicles, and plug-in hybrids to be charged with electricity. The most advanced charging stations have intelligent metres, cellular capabilities, and network connectivity, while others are more basic. In 2022, the European Automobile Manufacturers' Association (ACEA) estimates that half of all electric car charging points in the European Union are in only two countries: Netherlands (90,000 charging stations) and Germany (60,000 charging stations). According to *(Fig 12)*, the EV charging stations in Germany have seen tremendous growth from 2016–2022. In 2016, there were only 15,479 charging stations in Germany, but by early 2022, the number had nearly quadrupled to 60,000, a nearly fourfold increase.

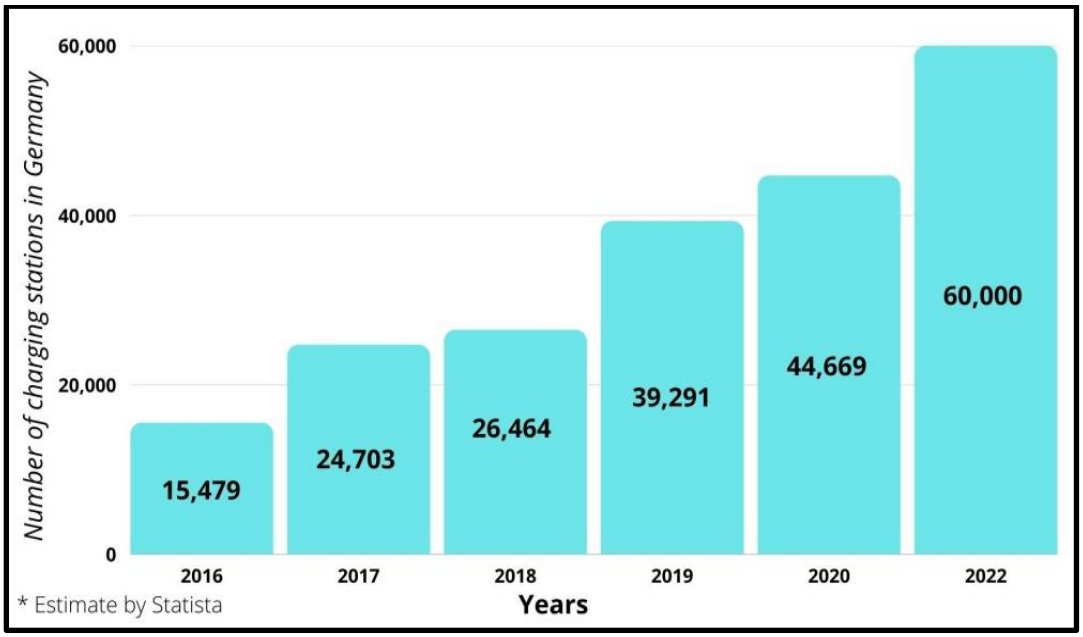

Fig. 12: Number of charging stations in Germany from 2016 to 2022 (Source: Statista)

Germany now has over 33,100 public charging stations, a huge growth of more than fivefold over the previous five years. There have been an additional 5,300 charging stations installed just in the past six months, a 19% increase. The number of electric vehicles has increased tremendously over the years, and as of now, there are 240,000 fully electric cars and 200,000 plug-in hybrids on German roads. The federal government's objectives are still far off despite this robust growth on both sides. The optimum ratio by 2030 is 1:10, with 1 million public charging stations and 10 million electric vehicles. At 1:13, the ratio is presently, and the tendency is upward. In Germany, more than 12% of charging stations are located in Munich, Hamburg, or Berlin. There are over 80% of charging stations in Germany with level 2 charging points, as opposed to only 1.3% of charging stations with level 3 charging points.

According to the German Association of the Automotive Industry (VdA), there should be 3,10,000 more pure electric cars for the current number of charging stations than there are now. According to Volkswagen, in order for the proportion of e-cars to grow significantly, more public charging stations are required to ensure a sufficient power supply.

➢ *Research & Development*

Research and development (R&D) processes involve companies developing and innovating new products and services. In 2019, global R&D spending in the automotive sector was $103.1 billion *(Fig 13)*. In 2018, Europe and Japan accounted for 24% and 27% of global investment in this sector, respectively. The automotive sector is also an essential pillar of the European economy and a leader in R&D and innovation. The German automotive sector creates 60% of R&D growth in Europe. In the world rank of 2500 enterprises with the highest expenditure on R&D in 2016, the automotive sector led: Volkswagen once again came first (EUR 13.67 Billion), GM was 11th (EUR 7.68 Billion), Daimler was 12th (EUR 7.53 Billion), Toyota was 13th (EUR 7.50 Billion) and Ford was 15th (EUR 6.92 Billion).

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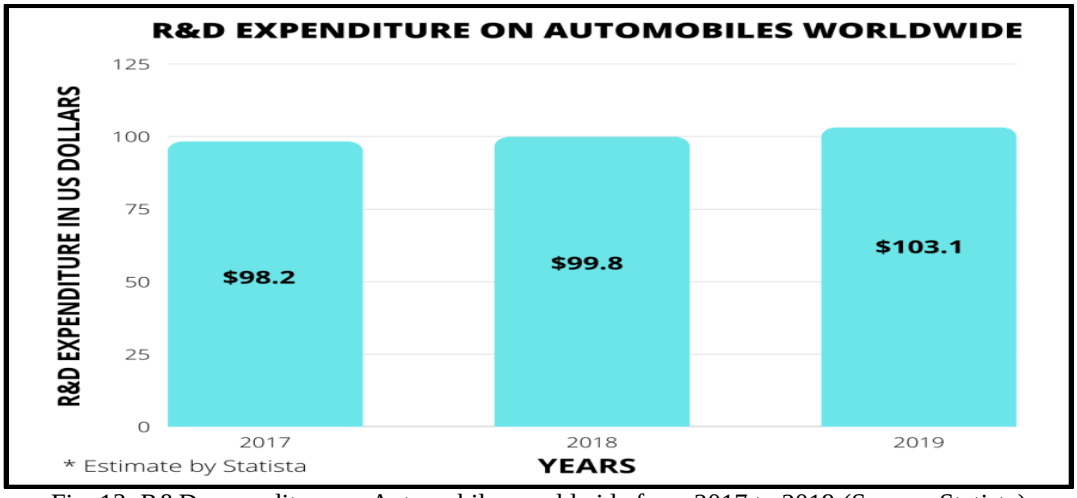

Fig. 13: R&D expenditure on Automobiles worldwide from 2017 to 2019 (Source: Statista)

Furthermore, the country's highly skilled workforce, integrated industry value chain, and outstanding R&D infrastructure make it a world leader in automotive R&D. In 2020, Germany's automotive sector accounted for 34.1% of total German industry R&D expenditures of around EUR 71 billion. During the period 2022–2026, German automotive manufacturers and suppliers are expected to invest more than EUR 220 billion in electric mobility and digitalization.

A strong investment in research and development has been made by German automotive companies in order to maintain the competitiveness of their vehicles. In 2021, German automotive companies spent almost EUR 28.3 billion on internal R&D projects more than any other domestic manufacturing sector. Automotive manufacturers and suppliers spend more than one-third of all R&D dollars in Germany's manufacturing sector, and R&D budgets are anticipated to increase in the future.

The German automotive industry ranks first in international innovation rankings, according to the German Association of the Automotive Industry (VDA). The top three positions are occupied by Volkswagen, BMW, and Daimler, with Bosch, Schaffler, and ZF also ranking highly. In the next few years, the industry plans to invest EUR 150 billion in digitalization, electric mobility and drive systems, hydrogen technology, and transport safety.

- *Artificial Intelligence in Electric Vehicles*

As of 2021, vehicle automation levels are largely at level 2 with a few at level 3. By 2024, the Volkswagen Group hopes to introduce level 4 automated vehicles. By 2030, it is anticipated that many German automakers would have reached level 5 automation or full automation.

Levels	Automation types	Functions
Level 0	**NO AUTOMATION**	Manual control. All driving tasks are carried out by a human (steering, acceleration, braking)
Level 1	**DRIVER ASSISTANCE**	The vehicle features a single automated system (e.g. it monitors speed through cruise control).
Level 2	**PARTIAL AUTOMATION**	ADAS. The vehicle can perform steering and acceleration. The human still monitors all tasks and can take control at any time.
Level 3	**CONDITIONAL AUTOMATION**	Environmental detection capabilities. The majority of driving activities can be completed by the vehicle, although human override is still required.
Level 4	**HIGH AUTOMATION**	All driving duties are carried out by the vehicle in specific situations.. Geofencing is required. Human override is still an option.
Level 5	**FULL AUTOMATION**	The vehicle performs all driving tasks under all conditions. Zero human attention or interaction is required.

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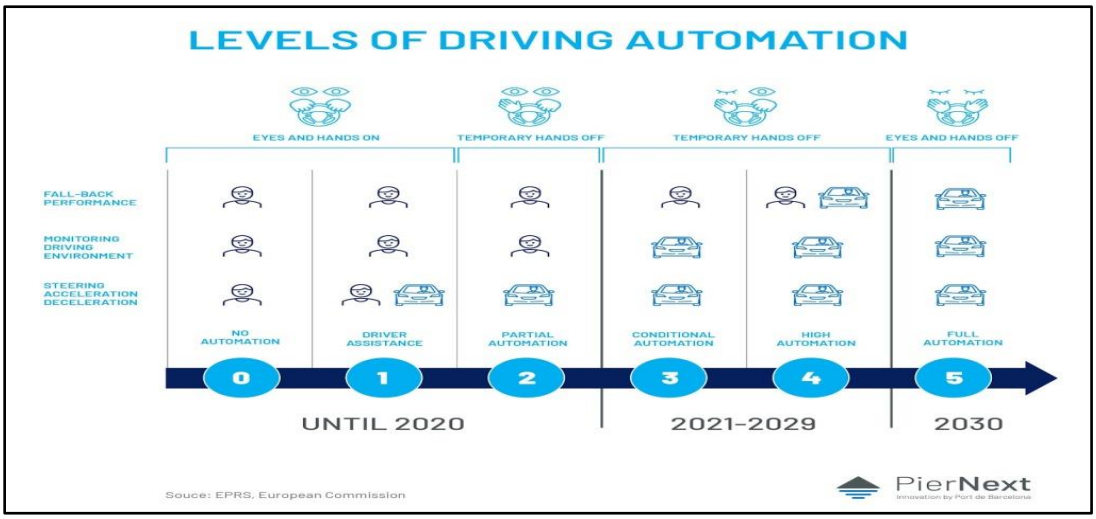

Fig. 14: Levels of automation (Source : Pier next)

- **Implementation of Artificial Intelligence (AI)**
  In 2015, 5–10% of the vehicles had an AI system installed. In the last five years, AI has been deployed for parking assistance, cruise control, and level 1 and 2 autonomous vehicles, resulting in increased technology adoption. While some emerging trends, like fully autonomous vehicles, are expected to become a reality, there may be new revenue streams and opportunities for OEMs (Original Equipment Manufacturer) and other entities in the value chain. (Fig. 15)

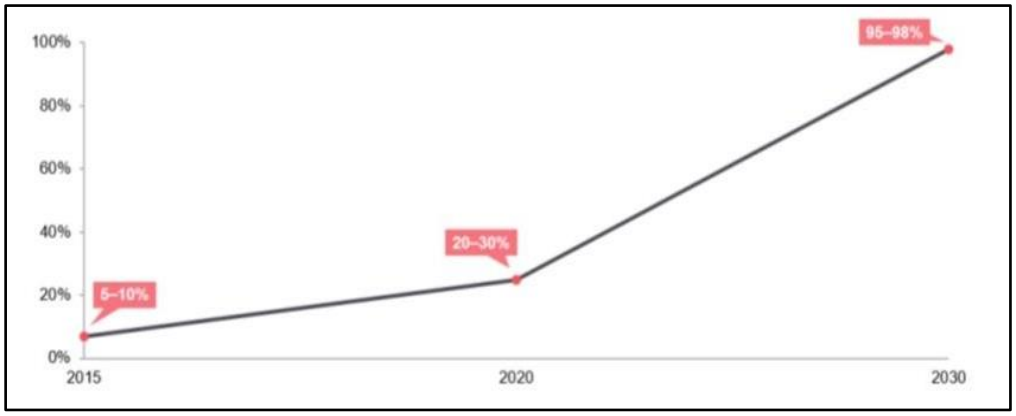

Fig. 15: Penetration of AI in the Automobile sector in Germany
(Source: Future bridge Analysis and insights)

- **Impact of Penetration in the Autonomous Vehicle Market**

In the upcoming 8–10 years, it is anticipated that the demand for autonomous cars will increase as AI becomes more widely used. In 2019, 89% of the autonomous vehicles sold were level 1, and 11% were level 2. Very few vehicles are level 3. However, it is anticipated that AI technology in the automobile sector will mature during the next 10 years. Level 3 vehicles are expected to account for most of the market share, folowed by level 2 and level 4/5 vehicles. (Fig. 16)

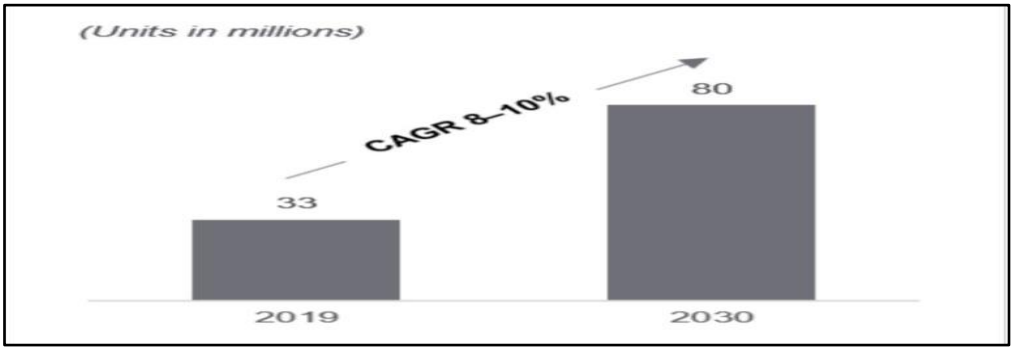

Fig. 16: Growth in CAGR in Germany (Source: Future bridge Analysis and insights)

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E. Digitalization in the Financial services

Germany is home to 1,647 financial institutions, including several private and public banks, capital management companies, and Fintech startups. Additionally, 3% of its workforce is employed in the financial industry, which has risen its GDP by €120 billion just in 2019 alone.

Germany is categorised as a cash economy since the majority of people solely use cash for market purchases. According to a study by the Bundesbank in 2020, cash is the preferred payment method for 60% of Germany's population in retail environments. This is further supported by domestic card usage, which is lower than its European countries. Germany only accounts for 75 card transactions per capita annually, compared to 84, 279, and 401 in Spain, the UK, and Norway respectively as shown in *(Fig. 17)*. The cash consumption of Germany now is equivalent to Sweden in 2003, Italy and Poland in 2015, and all of Europe in 2006.

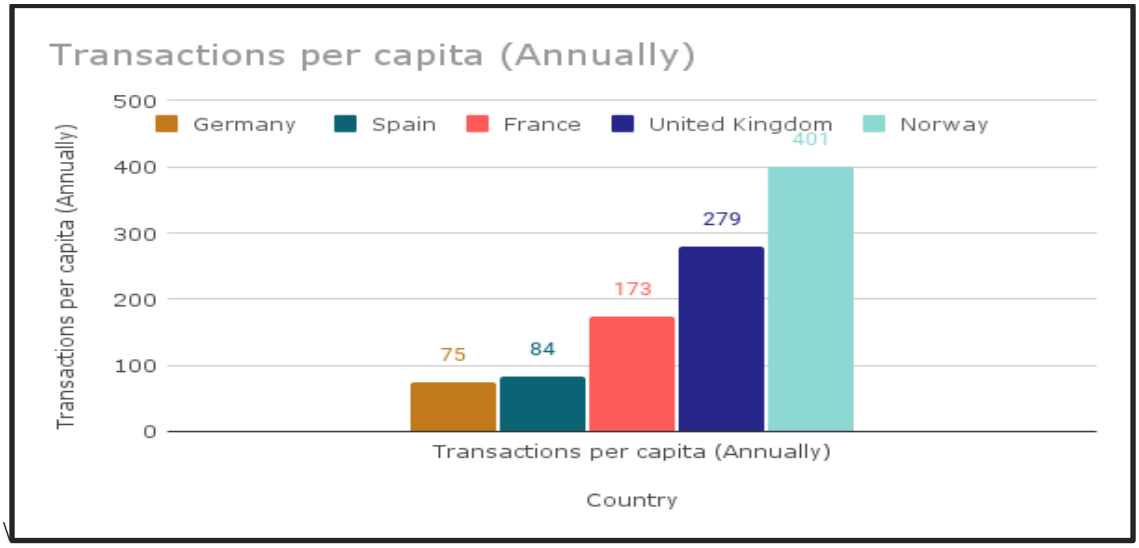

Fig. 17: E-commerce payment method (Source: EHI Retail Institute)

However the e-commerce sector's major payment portal is digital wallets. As per *(Fig 18)* digital wallets have an adoption rate of 26%. In contrast 13% for cards and 8% for bank transfers. Additionally, it is anticipated to expand at a CAGR of 22.5% and take up 28% of the market by 2021. Paypal is the major contributor to this sector, accounting for 20% of transactions. Its continued expansion can be owed to its interoperability with various national banking systems. Because of numerous other Fintech which have flourished in this country, Germany may be seen as a crucial global hub for fintech with the ideal combination of investment and innovation.

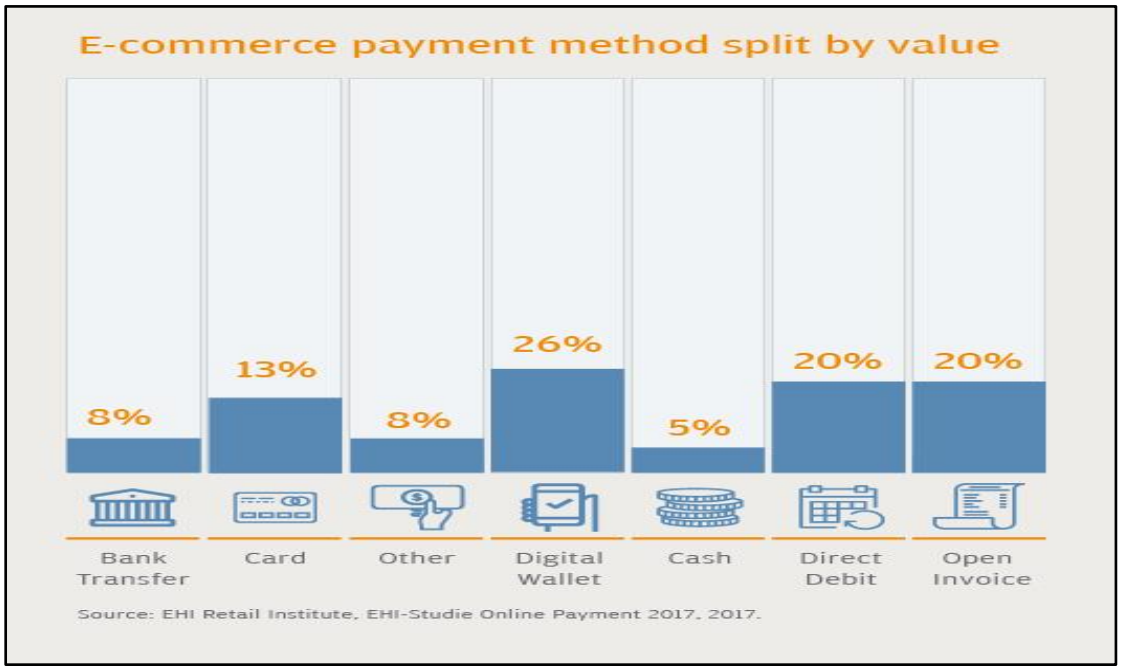

Fig. 18: E-commerce payment method (Source: EHI Retail Institute)

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The market for fintech worldwide, which was estimated at $110.57 billion in 2020, is expected to expand to $698.48 billion by 2030, with a CAGR of 20.3% between 2021 and 2030. The German Fintech market is on an upward trend, perceiving an adoption rate of 64% during 2019 and growing to 71% in 2020. This growth can be realised as a disruptor of the preexisting financial sector.

➢ *The Emerging Fintech Market*

Fintech refers to any financial organisation that uses technology as the foundation of its end-user experience. Germany has the second largest Fintech market in Europe and the fourth largest in the world. Over the previous four years, Fintech expanded tremendously, with an annual average growth rate of 131% between 2015 and 2019. Fintech now accounts for 10% of all new businesses in Germany, making it the second-largest startup activity in the country's startup ecosystem behind ICT. Germany as a whole has a significant role to play in the expansion of the Fintech business. As evidence of the fintech market's steady expansion, the number of businesses climbed from 144 in 2016 to an all-time high of 791 companies and secured $2.2 billion in funding alone in 2019 and 2020. *(Fig. 19).*

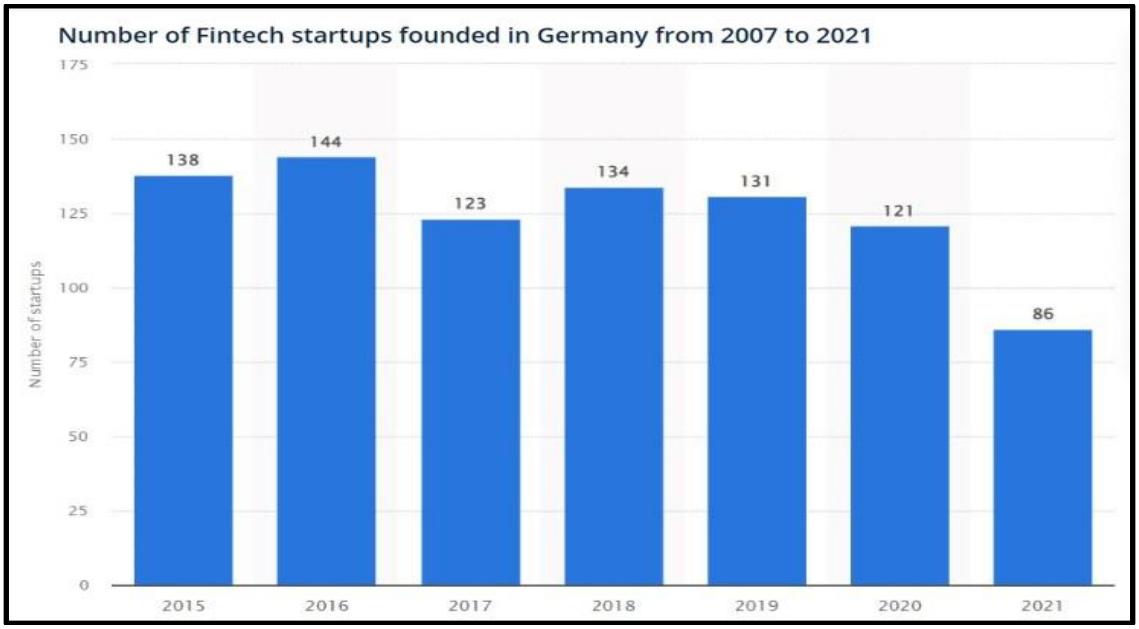

Fig. 19: Number of fintech startups founded in Germany (Source: Statista)

Germany's thriving fintech industry has been unaffected by anything, including the worldwide pandemic, as January 2021 alone witnessed a record 13 investment agreements with a combined value of €275 million. Brexit is also another reason for this quick growth since the upheaval allowed Germany to step up and gain momentum as London, Europe's long-established financial powerhouse, grappled with domestic unrest. However, the fintech sector is not as unified as it may seem. The Pandemic has significantly upset the current quo, and the public banking sector is deteriorating more quickly. It has been noted that upgrading essential financial IT systems would cost twice or three times as much as replacing them. This dilemma is slowing growth and innovation in the traditional German financial system. Fintech businesses were able to fill the hole, significantly enhancing their visibility in the German market.

➢ *Payment Evolution*

Germans are the most open cross-line customers on the planet, with more than half having submitted a request on a global site. Regardless of this eagerness, Germany is one of the most divided markets with regard to payment strategies. Non-Visa payment techniques, for example, SEPA direct charge, SOFORT, and Girocard represent most of online exchanges.

- **Girocard**- The brand "girocard" unites the electronic payment framework "electronic money" and the "Deutsche Geldautomaten-System" (German ATM framework) with 68 million clients. In the radiance of COVID-19, 45% of contactless payments utilised this neighbourhood strategy, with numerous retailers, huge and little, executing card payments to support contactless payments. With in excess of 100 million issued cards, girocard is the most widely recognized debit card in Germany. It permits cardholders to pull out cash at around 60,000 ATMs across the country and to pay cashless at retail location (POS) terminals. Not at all like other charge card payments, girocard payments and money withdrawals are charged straightforwardly from your account. Girocard was launched by the German Banking Industry Committee (GBIC) and in this manner utilises the high security principles of the GBIC.
- **SOFORT** - Germany, Austria, Switzerland, and Belgium are the countries with the highest utilisation of the SOFORT online banking payment method in Europe. SOFORT is a need for every company wishing to conduct business in Europe since 85 million individuals utilise it. It is a solitary use, deferred notice payments strategy that expects clients to confirm their payment. It diverts them to their bank's entrance to validate the instalment, and it commonly requires 2 to 14 days to get notice of accomplishment or failure.

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F. Digitalization in the Health Sector

According to the **World Health Organisation**, Germany's healthcare system in 2013 was 77% publicly funded and 23% privately funded. In 2019, there were 4,94,300 beds in 1,914 hospitals (545 public hospitals, 645 non-profit hospitals, and 724 private hospitals), 1,112 rehabilitation centres, and 18,753 pharmacies. In 2020, Germany spent 12.5% of its GDP on health care. Germany has a strong healthcare system regarding infrastructure, hospital beds, and trained staff. In 2021, Germany's life expectancy was 83.2 years for men and 78.2 years for women, with a meagre infant mortality rate.

According to Research Gate, German hospitals spend between 1-3% of their budget on IT, whereas Dutch hospitals spend between 4-9%. As a result, private hospitals make the most of the opportunity to differentiate themselves from public hospitals. Public hospitals, by contrast, are constrained by their small IT budget, which does not allow them to invest unless it is proven that a digital solution can save money while maintaining or improving quality.

With 5.7 million employees, the healthcare industry is the largest employer in Germany due to its well-established infrastructure. So, according to the **German Federal Ministry** for Economic Affairs, 7.5 million people are employed in the health sector, making up 16.7% of the total labour force. In 2020, Germany had 372,000 doctors, equivalent to a physician's density of 4.5 per 1,000 people, making it the country with the fourth-highest physician density in the **OECD**. There are six jobs in the healthcare sector in Germany, which generates an economic footprint of €678.2 billion, or roughly 12% of Germany's GDP. Of this, €131.2 billion was generated through foreign sales.

Within the health care sector, the medical equipment industry is extremely robust. Germany has a well-established market for medical equipment. The German medical device market is approximately $35.8 billion annually, or 25.6% of the European market. It is the largest importer and exporter of medical devices. The United States maintains a 30% market share in the German medical device import market. Exports of medical products account for 8.3% of total German exports. Despite the COVID-related pressure on the medical device industry, the German medical device market grew by 4% in 2019 and by 3% in 2020. As a result, Fitch Solutions estimates the 2020-2025 CAGR of the German Medical Devices Market at 5.1% in euros and 6.8% in dollars.

The German e-health market was estimated to be worth around three billion euros in 2017, with a CAGR of around 22%. Germany is known for having strict laws and regulations regarding patient data and privacy—probably the most stringent in Europe. German lawmakers passed the Digitale-Versorgung-Gesetz, or DVG, in late 2019—a law designed to catalyse the digital transformation of the German healthcare system, which has historically lagged in that area compared to the rest of the world. The methodology is already leading to meaningful changes and will be a boon to developing and evaluating digital health tools and generating insights into their value. The COVID-19 pandemic has further emphasised the need for safe and effective digital tools to support remote patient monitoring and care delivery globally following the passage of the DVG. By introducing the DVG at the right time, Germany can set an example for other countries by illustrating how to adopt and diffuse digital technologies to improve patient outcomes.

Moreover, the pandemic has boosted collaboration between startups and large corporations. The BioNTech-Pfizer partnership is a prime example of exponentially successful cooperation. An increase in funding is seen in the stock market and capital markets. However, Germany is still very conservative in this area. Due to the fear of losing German industry knowledge and experience and the desire to secure the medical ingredient supply chain, more significant regulatory hurdles have been created. Nevertheless, as investors recognise this sector's strong growth potential, optimism remains high in this sector.

- *Telemedicine*

Germany has steadfastly remained at the forefront of the digital health transformation during the pandemic by continually innovating and adapting legislation accordingly. In 2019, DIGA Fast-Track was created by the Digital Healthcare Act (DVG) and various legislative changes, which meant that apps could be prescribed by doctors and costs were reimbursed through German health insurance.

On October 5, eleven months after the German federal government passed the DVG, two health apps officially became available for prescription.

In addition, telemedicine systems play a significant role in Germany's aspirations to quickly implement digital health services. Earlier in 2021, operators of telemedicine platforms reported a growth rate of over 1,000%, with more than 20,000 medical doctors and psychotherapists offering appointments through video-consultations. Online appointments are covered as long as one of the 20 platforms certified by the Federal Association of Statutory Health Insurance Physicians (KBV) is utilised. *(Fig. 20)*

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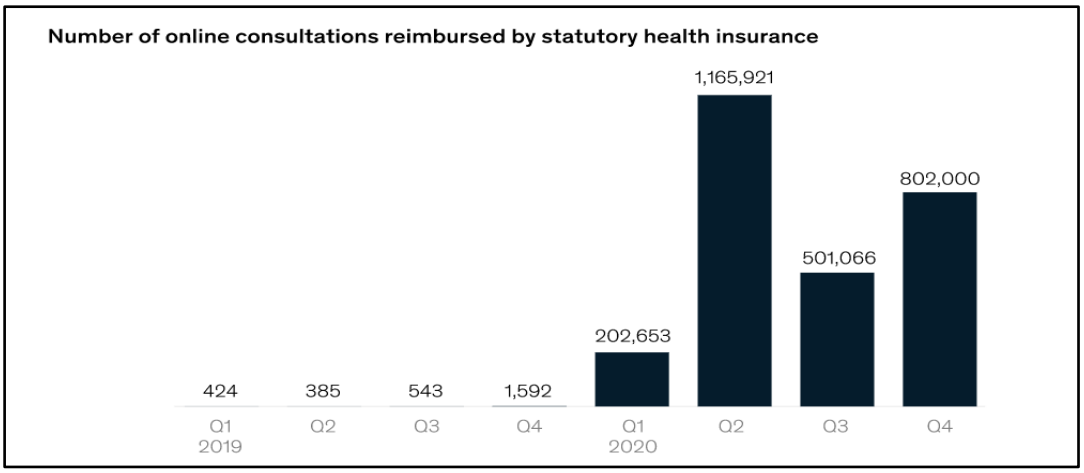

Fig. 20: Number of consultations reimbursed by statutory health insurance (Source: KBV)

However, Germany has not always had such a high level of acceptability for digital health. Healthcare IT News spoke with Dr. Susanne Ozegowski, head of corporate development and digitisation at Techniker Krankenkasse (TK) and member of the HIMSS EMEA advisory board, who stated: "In Germany, until three years ago, digital health didn't play a big role". There were a few fitness and wellness apps but hardly any digital health applications that had a relevant impact when it came to the diagnosis and treatment of diseases."That changed when the minister of health, Jens Spahn, came into office three and a half years ago, who really pushed the issue of digital health overall."

In a Q&A of the *Deutsches Ärzteblatt 2021 April 10*, Professor *Deutsches Ärzteblatt*, head of the Health Innovation Hub of the German Federal Ministry of Health, said: "It is above all digital technologies that keep us together as a society in this situation. This also applies to medicine."

As a consequence, manufacturers of practise software are bolstering investments in integrated solutions for online health consultations. During the pandemic, German CompuGroup Medical (CGM) decided to create its own video-consultation solution called "Click Doc", which is available to all doctors free of charge until further notice. Around 5,000 doctors have enrolled for this KBV-certified video consultation since it launched, According to CGM. The German video-consultation platform, DoctorKonsultation.de, is also one of the providers who have experienced strong growth in demand in the wake of the pandemic. A company spokesperson said, "We are currently experiencing an openness to the video consultation that is new to this extent."

- *Wearable Devices:*

Electronic devices that can be carried or worn on the body are called wearables. These devices can be divided into groups like wearables, bracelets, and smartwatches. The terms "wearable device," "wearables," and "wearable technology" all refer to wearable, self-contained devices with embedded sensors that detect, monitor, and share data about a person's health and performance. Although portable and wearable technology is excellent, it is necessary that manufacturers are aware of necessary requirements that these products must satisfy. In the past three years, the number of connected wearable devices has more than doubled worldwide.

Globally, the number of connected wearable devices increased from 325 million in 2016 to 722 million in 2019, more than double in just three years. By 2022, it would probably be more than one billion devices. *(Fig. 21)*

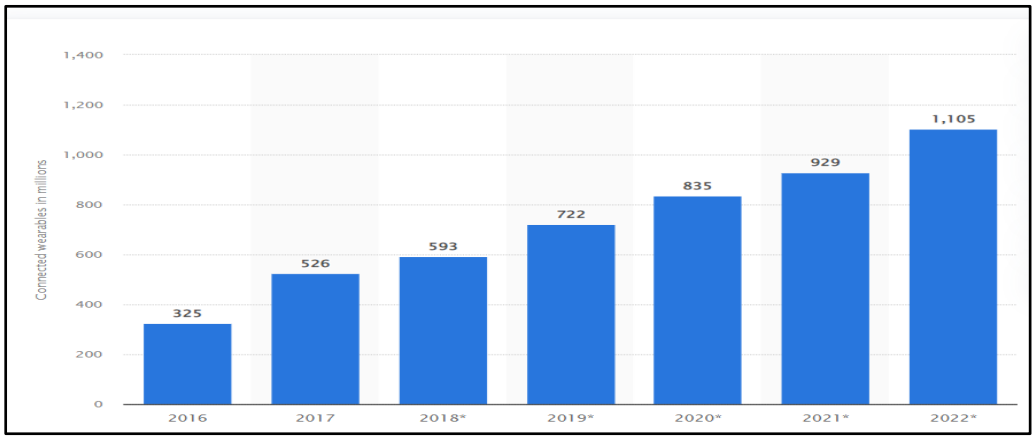

Fig. 21 Sales of connected wearable devices in Germany (Source: Statista)

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Sales of smartwatches are primarily responsible for the growth of the wearable device market. After launching its first smartwatch in 2015, Apple has had a 45% share of the market for smartwatches since 2018. The popularity of wearable technology is another factor driving the growth of the wearable industry. Sales are projected to increase by 24% and the German wearables market to expand by 20%. Comparing the first three quarters of 2019 to the same period in 2018, the wearables market grew by 41%.

Almost 7.4 million wearables were sold in the German market in 2021, a growth of nearly 9%. The sales value increased almost 20%. On average, more than €180 is spent on a device, an increase of nearly 10% compared to the previous year (2020).

The wearable category's growth is impressive: in the past five years, the number of units sold has more than doubled, and the turnover is almost 2.5 times higher than in 2017. The average price has increased by 17% since then. The product segment includes smart watches (no SIM), health and fitness trackers, wrist sport computers, connected watches, and locators. The wearables market has been shown to be very successful throughout Europe. In 2019, market analysts expect sales of 3.3 billion euros (+26%) and around 21.5 billion wearable devices (+26%).

VIII. GOVERNMENT POLICY ON DIGITALIZATION

"The best public policy is made when you are listening to people who are going to be impacted" - **Elizabeth Dole**

➢ *R&D Expenditure By Federal Ministry*

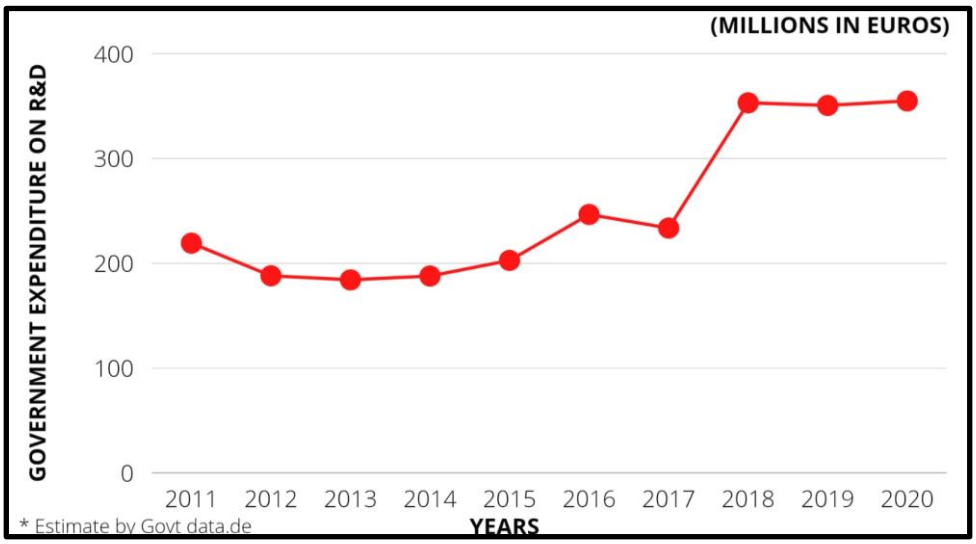

Fig. 22: Federal ministry of transport and digital infrastructure spending on R&D (Source: Govt. de)

Figure 22 shows that the Federal ministry of transport and digital infrastructure spending on R&D has been stagnant from 2011 to 2017, but from 2018 expenditure has shown tremendous growth. According to the ministry, R&D expenditures in 2011 totaled €219.3 million; this figure slightly increased to €233.7 million in 2017. Nevertheless, the figure has jumped to €353.1 million since 2018, and the trend has continued till 2020. The Federal ministry has utilised this fund to improve the digital infrastructure in Germany, providing better connectivity for the development of different sectors and the economy. The hope is that better connectivity can help the country be more competitive and attract more research and development, especially in innovative areas like autonomous driving, blockchain, or artificial intelligence.

➢ *What are the investment plans of the Federal Government?*

Despite the challenging fiscal environment, the Federal Government provides incentives for investment and innovation to strengthen Germany as a business hub. A sum of 50.8 billion euros is available for investments in the year 2021– still significantly higher prior to the pandemic. Substantial funds will be invested into climate protection, digitalization, education, research and infrastructure. In addition to spending on environmental protection and digitalization, the Federal Government is stepping up project funding in microelectronics. Additionally, it plans to start an investment offensive with partners in Europe to assist international technological initiatives. Governments are also devoting more attention to emerging digital technologies such as AI, and 5G infrastructure, which is critical to support enhanced mobile broadband, Internet of Things (IoT) devices and AI applications. The paper examines one of these German government initiatives, known as Industrie 4.0.

A. Industrie 4.0

In 2016, the federal government launched a strategic effort to establish Germany as a lead market and provider of advanced manufacturing solutions. Through this effort, referred to as "Industrie 4.0", they're taking important steps to enable a digital and automation transformation, including defining a legal framework to reinforce data security, connecting the industry with educational providers to assist

develop the talent needed for a digital future, and making it easier for foreign digital talent to return to Germany.

Germany has begun to address its low levels of digitalisation in the public sector by driving digital transformations in the Federal Employment Agency and Federal Office for Migration and Refugees, as well as by implementing e-government services. The goal is to achieve a paperless justice system by implementing an electronic tax declaration system (ELSTER) as well as electronic court files within the justice system.

The Federal Government will continue and expand the successfully launched funding initiative AI Flagship Projects for the Environment, Climate, Nature and Resources (KI-Leuchttürme) and further develop it, focussing on funding AI innovations for climate protection and the resource efficiency of AI applications. As part of this, it will bolster the links between SMEs, start-ups and public-interest actors and research to promote the transfer and application of research findings across the breadth of the economy and society.

In addition, governments are paying more attention to emerging digital technologies such as artificial intelligence (AI), blockchain, and 5G infrastructure, the latter of which is crucial to supporting mobile broadband, Internet of Things (IoT) devices, and AI applications. 60 countries have national AI strategies, and several OECD countries have published national 5G strategies, including Australia, Austria, Colombia, France, Germany, Korea, Spain, the United Kingdom, and the United States. Blockchain and quantum computing are attracting increasing policy attention, as well. The emergence of 5G and the Internet of Things will further fuel the production of data, increasing the urgency of ongoing policy discussions on data governance, privacy, and security. Several countries have issued a blockchain strategy (Australia, China, Germany, India, Switzerland).

Universities and research institutions are also competing internationally for highly trained AI specialists and AI experts. Another strategy is to expand programmes to help companies access foreign human talent that they need to drive the digital economy forward. Internationally, Government talent schemes and programs are specifically targeted towards AI experts.

B. The Digital Strategy of 2025

The digital strategy of 2025 illustrates how the Federal Ministry for Economic Affairs and Energy will set tools for the digital transformation of Germany.

- Broadband real-time communication in the gigabit range is necessary for the Internet of Things, autonomous driving, and Industry 4.0. Establish an extensive optical fibre network in Germany as soon as possible.
- Ensure the informational autonomy of consumers and guarantee an open Internet.
- Avoid creating dependency on online platforms with substantial network effects.
- An investment fund for gigabit networks in rural regions in the future. A fund volume of around €10 billion is expected to lead to additional investments in 2025.

C. Artificial Intelligence Strategy of the Federal Government

There has been a significant increase in federal government commitment to future technologies such as artificial intelligence. By 2025, the Federal Government will invest five billion euros in artificial intelligence as part of the economic stimulus and future package. By using these funds, supercomputer infrastructure will be modernised and computing capabilities will be increased; AI centres of excellence will be sustainably bolstered and will be integrated into regional economies through application hubs; and AI ecosystems of international appeal will be established to lay the foundation for a European AI network and the competitiveness of "Made in Europe".

As part of a Franco-German AI research and innovation network, the federal government will continue to strengthen the networking between German AI centers of excellence and French AI institutes. The objective is to establish a pan-European AI network aligned with the AI strategy of the European Commission, which will decentrally implement the transfer of AI applications from research to practise and promote the systematic further development of expertise in science and research, business and society.

The Federal Government's Observatory for Artificial Intelligence in Work and Society (AI Observatory) is planning to develop certain indicators to record trends and developments in the German, European, and international AI landscape and to then align and evaluate the implementation measures in the AI Strategy accordingly. These currently include indicators on the use of AI in the economy, in higher education and teaching, as well as in work and society.

IX. SUGGESTIONS

A. Suggestions for the Automobile Sector:

➢ *How can blockchain help the automotive industry and how can it be implemented in the automobile industry?*

Blockchains are ideally equipped to address the complicated problems automakers deal with on a daily basis because of their fundamental characteristics, such as their decentralised nature, transparency, and immutability. The ability to track the entire history of a specific car and the introduction of practical channels for communication with after-sale service providers are both aspects of blockchain-based solutions that can bring real advantages for the end customer. Numerous blockchain uses in the auto industry are possible. Let's look at some of the advantages that technology can bring and implement to this industry.

- **Digital passports for vehicles:** By storing the complete history of a vehicle on a blockchain, this issue can be easily resolved. This provides the user with a trustworthy means to check the history of a specific car and to communicate pertinent information about a vehicle to

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other parties. For example, whenever someone is buying second hand cars there are chances that the car might be stolen or the information provided by the dealer would be not appropriate or upto the marks in this scenario blockchain can play a vital role of providing the necessary data within your finger tip. Due to this there are chances that the car robbery case will show a decline in near future.

- **Ride and car sharing app:** Block chain technology, for example, can allow a new sort of ride-sharing business that operates on a peer-to-peer network without the need for a central authority, such as Uber, to act as an intermediary. Drivers will be compensated when riders arrive at their destinations, as transactions between network participants are managed by smart contracts.

B. Suggestions for Financial Services

➢ *Data encryption and authentication to ensure security and privacy:*

One can establish high-level security settings with the help of the Fintech security development company. The settings may consist of the following factors to make it more secure such as: Data encryption to make the data secure and encrypted. Real-time notifications and alerts. Biometric authentication to verify the person who is accessing the data after he or she has provided the required biometric evidence (such as fingerprints, voice confirmation, or by face verification to the authentication mechanism). Two-factor authorization provides additional security to the person's online accounts.

➢ *Using effective and innovative marketing tactics:*

In order to offer good service and products to the consumers, the Fintech companies must make sure that they will have to invest money, resources, and efforts. Moreover, they have to come up with better and innovative marketing strategies and techniques which consist of both - advertising and collaboration. This will not only gain popularity but will also boost the publicity of the brand.

C. Suggestions for the Health Sector:

➢ *Smart integrated wearable:*

EMR (Electronic Medical Records) system improvements have changed how data is retrieved. For instance, during cardiac rehab, check a patient with CHF's (Congestive heart failure) chart to find out what are their typical heart rate and other heart rate characteristics. Connect a wearable device to this data via a smart contract. An alarm is set off when the safe heart rate limits are exceeded. The patient is informed and seeks guidance or emergency treatment. A smart contract can be programmed to notify medical personnel to get in touch with the patient or dispatch an ambulance.

➢ *Health records:*

Smart contracts allow for the storage of data and records on a digital ledger. This means that if a patient needed to transfer from one hospital to another, they could do so quickly and without having to fill out a bunch of paperwork. The patient's preferred physician can then view the records on the blockchain network. A variety of patient information databases are used by hospitals and healthcare organisations. These can, however, be too restrictive to allow for the global dissemination of potentially life-saving insights. Without blockchain and smart contracts, this information could take a long time and be compromised.

➢ *Health Insurance:*

Health insurance can employ smart contracts on a regular basis, which would improve the system's efficiency in many ways. All information about a patient's policy will be securely stored in their patient profile if they purchase their insurance through smart contracts. The blockchain is a secure ledger that is less vulnerable to hackers than a conventional database, and then it is used to store this information. They might also take the stress out of filling out protracted insurance claim forms. The smart contract would automatically activate in the event that an insured person underwent a medical procedure that is covered by the insurance policy. This indicates that the money will be transferred from the insurance company's account directly to the hospital. This automation eliminates all hassles and delays.

D. Suggestions for Government Policy:

➢ *Abnormal vacancies in the Information Technology (IT) sector:*

Even though EU citizens can move in and out of Germany due to freedom of movement for non-EU citizens immigration laws are a bit complex. A worker's skill level is currently determined by their academic qualifications. The Federal government should introduce new laws under which employers would look at vocational qualifications, opening up more opportunities to people without a university degree. The federal government should propose a plan in which non-EU citizens with special skills like programming, data analysis, cloud computing, hardware deployment, machine learning, etc from vocational career paths will be allowed to enter the country and look for a job there, as long as they meet certain requirements, like German language, skills, and age. For example, suppose a foreign student wants to come to Germany to work in an IT company but he doesn't have a degree from a recognised university in IT specialisation but if he has a vocational or a skill certificate in that IT specialisation like programming, security, etc. The federal government should allow such students to enter Germany and look for jobs provided they fulfil the basic requirements, like knowing the German language. In addition to this, the federal government should also stop asking companies to give German citizens priority over foreign workers when looking to fill vacancies. The federal government should enact a policy for companies to set up vocational training programs to impart and improve IT skills amongst domestic as well as foreign employees. The government can also train unskilled workers and inspire part-time women workers to work more.

X. CONCLUSIONS

The findings have revealed that there is much relevance in terms of the growth of digitalization in Germany. The impact is not only restricted to positive outcomes but simultaneously leaves a detrimental effect such as security risk, lagging tech infrastructure etc. The time period taken for the study is over a period of 5 years from 2016 to 2021.

The study provides a thorough understanding of Germany's different business sectors, such as automobiles, financial services and the health sector. It is impossible to deny that digitalization contributes to the growth of the German economy by providing technological innovations and improving services that ripple through the economy.

DESI, or Digital Economy and Society Index, is used to summarise the overall digitalisation process at the European level and to keep track of its progress. Graphical and theoretical representation of DESI has also been added to the research. As per DESI 2021, Germany was performing better as compared to the EU in some of the important segments. The reference figure (Fig. 1.6) shows that Germany is ahead of the EU in terms of human capital and connectivity, and these components have been growing since 2016. However, Germany lacks in the integration of digital technology and digital public services. Hence there is scope for improvement in these components in near future.

There is a growth in the population of Internet users in Germany. According to Eurostat, the percentage will increase from 86% in 2013 to 95% in 2020. As of 2021, the internet penetration rate in Germany was 92%. DSL is the common means of connecting to the Internet in Germany. 93% of households have DSL connections with download speeds ranging from 2 Mbps to 50 Mbps, mostly in urban areas.

It is observed that digitalization has had a profound impact on Germany’s automobile sector. The country has experienced a drastic increase in the sales of electric cars as Germany is the leading market in Europe in terms of production of the automobile sector and will maintain and expand its leadership in digital automotive innovation. It is estimated that by 2030, the German government plans to have 15 million purely electric cars on the road. Germany is witnessing an increase in demand for electric vehicles which in turn will raise the demand for electric batteries and EV power stations and will drive the growth of Germany's automobile sector.

The study investigates how digitalisation also impacts financial services to a greater extent. The paper also studied payment systems and how they are digitised. It was established that fintech businesses could fill the hole, thereby enhancing their visibility in the German market.

Furthermore, there was a big impact of digitalization on the German health sector. Under health services, telemedicine grabbed the eye as it rapidly rolled out digital health services. Moreover, the contribution of wearable devices to the digitization of the health sector is highlighted within the research.

Reflecting on the region-wide benefits to return from the pandemic, Dr Ozegowski explained: "COVID has also helped within the acceptance that we need to do more in healthcare on a European level. Here two things came together: COVID, of course, on the other hand also the fact that Germany had the EU presidency in the second half of 2020. "

The government is focusing more on Artificial Intelligence (AI) to modernise and strengthen AI networking. The objective of establishing a pan-European AI network will promote development in science, business, research and society. The Federal government of Germany has adopted policies to enhance mobile broadband, Internet of Things (IoT) and AI applications. The government is taking steps to enable a digital transformation thereby building a legal structure to improvise data security for the betterment of the digital future and to welcome foreign digital talent to Germany.

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