

R1/A2: DESK RESEARCH - GOOD PRACTICES IN EU OF COMPANIES TACKLING CURRENT CHALLENGES





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About JoinMe

JoInME project supports higher education teachers in delivering quality education and training to higher education students (18-25 years old), no matter their gender or social background, amid and post COVID-19 sanitary crisis on the topic of entrepreneurship. This will be achieved by offering an up-to-date joint intercultural and multidisciplinary training program on entrepreneurship in the field of AI for Industry 5.0.

About the country report

This document is a guide to help bring together and compare research from each of the project's partner countries: Cyprus, Greece, France, Lithuania, The Netherlands and Ukraine. All countries collected examples and good practices all over Europe that can be an inspiration for teachers as well as students. It might even be an opportunity for students to broaden their network. This desk research was made by each partner to identify the winning practices from startups or companies from countries topping the Industry 4.0/5.0 in terms of use of Al.

The report is divided in 3 main sections: the first chapter "The current trends and state of Industry 4.0/5.0 aims to summarize the current situation of the industry in each abovementioned country. The second chapter aims to discover how the businesses reacted to the challenges that they needed to face during and after the COVID19 pandemic and how this worldwide event changed their strategic and operational thinking. In the third part we are looking for best practices and updates on how AI related solutions can make businesses more successful and resilient. 2021-1-FR01-KA220-HED-000032254



I. The current trends and state of Industry 4.0./5.0

Cyprus

The national context of Industry 4.0/5.0

After the difficult period of the economic crisis in 2013, the Republic of Cyprus has been impressive in the way it is preparing the future. A characteristic example is the field of innovation. The Republic of Cyprus has turned its attention to the fourth industrial revolution and strives to create the right environment, at the level of enterprises, companies, services and investments, by adopting innovative practices and processes.

On the initiative of the President of the House of Representatives, Mr. Dimitris Syllouris and through a systematic effort of three years, Cyprus has already developed a National Strategy for Blockchain Technologies and Distributed Ledger Technology (DLT) while the corresponding National Strategy for the Development of Artificial Intelligence is already at the stage of completion. With a clear vision, strategic goals, priorities and a precise roadmap that includes pilot projects and the necessary legislative reforms the Republic of Cyprus is claiming a position among the pioneering EU states and a coordinating role at a regional level.

The medium-term goal of the government is the establishment of a Network of Understanding and Cooperation among all interested parties for the implementation of the National Strategy of the Republic of Cyprus for the fourth industrial revolution. Academic institutions, research centers, the business world, startup ecosystems and funds will be invited to participate in this network and to cooperate in order to make Cyprus a benchmark for industry 4.0.

In this context, significant opportunities of cooperation between Greece, Cyprus and States of the wider region are created to develop public blockchain services infrastructure and to engage companies in the provision of value added services in sectors such as supply chain, real estate, transportation, fintech, retail, intelligent agriculture, food safety & traceability and many more. These cooperations could be the catalyst for the overall upgrade of the two countries' economy.

It is worth mentioning that, according to a recent report of the World Economic Forum, blockchain could lead to 1.5% global GDP growth in the next decade. With this expectation a global race to develop such infrastructure and services has begun. The recent "Worldwide Semiannual Blockchain Spending Guide" report of International Data Corporation (IDC) forecasts that spending on developing blockchain solutions in 2019 will increase by 80% comparing to 2018 and will reach 15.9 billion USD in 2023.

The position of Greece and Cyprus in this scene is reinforced by the fact that the fourth industrial revolution is of high priority for the EU. The European Commission has a holistic approach to blockchain technologies and DLT, which aims at positioning Europe at the forefront of blockchain innovation and uptake. In this context, the EU aims through a series of initiatives to reinforce cooperation on the development of blockchain/DLT based

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applications, support international standard setting and facilitate dialogue between industry stakeholders and regulators, notably for a regulatory framework, that builds on the EU acquis.

An important initiative that is involved in the above context is the European Blockchain Partnership for the establishment of a European Blockchain Services Infrastructure that will support the delivery of cross-border digital public services, with the highest standards of security and privacy. Both Greece and Cyprus are members of EBP. At the same time the EU, in order to encourage cooperation between public and private sector, has launched the International Association for Trusted Blockchain Applications, which brings together industry, startups and SMEs, policy makers, international organizations, regulators, civil society and standard setting bodies to support blockchain/DLT to be mainstreamed and scaled-up across multiple sectors. The EU context of initiatives is complemented with appropriate funding. Already 180 M€ of EU funding has been spent to support research and innovation in blockchain/DLT while a new investment fund, "The blockchain and AI fund", is being created. In 2020, 100 M€ will be allocated to the European Investment Fund (EIF) for being invested in Venture Capital funds, who will then invest a total of 300 to 400 M€ in AI and blockchain startups.

This favorable framework, which appears to be in place, is an important opportunity for growth for the economies of Cyprus and Greece.

Undoubtedly, the successful implementation of Industry 4.0 in Cyprus entails several challenges that they will need to overcome, but despite these challenges, these practices will bring enormous benefits for their businesses. To identify possible investment priorities and develop an Industry 4.0 strategy, companies will need to consider the below:

• Customer – Providing an experience where customers view the organization as their digital partner using their preferred channels of interaction to control their connected future on and offline.

• Strategy – Focuses on how the business transforms or operates to increase its competitive advantage through digital initiatives; it is embedded within the overall business strategy.

•Technology: Underpins the successof digital strategy by helping to create, process, store, secure and exchange data to meet the needs of customers at low cost and low overheads.

• Operations – Executing and evolving processes and tasks by utilizing digital technologies to drive strategic management and enhance business efficiency and effectiveness.

• Culture, People, and Organization– Defining and developing an organizational culture with governance and talent processes to support progress along the digital maturity curve and the flexibility to achieve its growth and innovation objectives.

The effect of COVID19 on national companies in terms of shifting to Industry 4.0/5.0.

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Although Cyprus' new long-term vision for the sector is full of promise, there is no doubt the coronavirus pandemic has taken its toll on the industry both in Cyprus and globally. The considerable repercussions of the crisis on normally top-performing sectors like tourism, where revenues have plummeted in 2020, has had a significant knock-on effect on other sectors such as manufacturing and industry. The manufacturing sector marked a decline of 19.6% in May 2020 compared to May 2019 and compared to an annual reduction of 32.6% in April. The contribution to GDP from manufacturing in Cyprus decreased to €223.85 million in the second quarter of 2020 from €240.43 million in the first quarter of 2020. The contribution to GDP from manufacturing in Cyprus averaged €243.65 million from 1995 until 2020. Cyprus' Industrial Turnover Index fell by almost 20% in May 2020 compared to May 2019, affected by measures to curb the spread of the pandemic. However, the index marked a steady improvement as containment measures were gradually lifted.

The COVID-19 pandemic in addition to the upheaval it caused to peoples' lives, families and communities and its continued health threat, it also has a significant impact on businesses and the economy. As businesses are working on their scenario planning it's important to have a sense of the potential economic impact. The Cyprus specific results of PwC recent survey revealed that company leaders are greatly concerned about the effects of COVID-19 on their operations. Around 83% of Cypriot CEOs expect their revenues to decrease and at the same time 52% of Cyprus CFOs believe their company could get back to "business as usual" within 3 months if COVID-19 were to end today.

The sectors that were hit the hardest by the pandemic in Cyprus:



Due to fiscal restrictions companies, especially in the tourism sector weren't focusing on the development of their processes and implementation of new methods toward Industry 4.0., but they rather tried to survive this period. Tourism was possibly the worst hit industry, with Cyprus facing the added drawback of being accessible primarily by air and, less so, by sea. Tourism predominantly affects the Hotels and Restaurants sectors with a smaller impact on Transportation and Storage and Wholesale and Retail sectors as well. There are of course significant indirect spill-over effects to other sectors of the economy such as





Food Manufacturing, Financial Services, Professional Services etc that are accounted for in the sector specific GVA.

Greece

The national context of Industry 4.0/5.0

Greece hasn't proceeded yet in adapting practices of digital transformation, although the challenges that occur for Greek industry are continuously growing. Technological maturity of the companies is still low, and most technologies applied are focused on internal operational issues and not on Industry 4.0/5.0 solutions that connect networks and partners. The main problem is that companies haven't strategically planned the entry of new technologies and the Industry 4.0/5.0 practices are used less than expected.

The current trends regarding Industry 4.0 include in general the use of smart sensors, cameras and state of the art robotics, combined with prediction analytics and creation of User-friendly Interfaces. Newly founded companies, many of them start-ups, are offering Hardware and Software Integrated solutions for optimization of processes.

More specific, some of the fields that draw attention currently in Greece are:

- 1. Yield optimization by mixing quality assurance, artificial intelligence, and big data analytics
- 2. Early defect detection and production of zero-defect products
- 3. Real time production monitoring and big data analytics
- 4. Asset tracking and management, reduction of operational and maintenance costs
- 5. Quality and Safety in Industry
- 6. Process Automation and risk modeling
- 7. Energy and Circular economy
- 8. Material recovery and remanufacturing
- 9. Human core and movements observation
- 10. Location intelligence
- 11. Consumers movements and buyers' data (e.g., in department stores)
- 12. Planning and organizing orders and supply chain
- 13. Planning and organizing activities with the use of notifications and ready reports
- 14. Image and video analysis in general
- 15. 3D designs ready for production
- 16. Air quality observations

With the above technologies being developed every day, some industries are already using AI Technology and Industry 4.0/5.0 practices. Some of them are: aluminum and marble factories, retail chains, food factories and supply chains and manufacturing sites etc.

Greece has the 21st place in EU regarding adopting new technologies which is seemingly low. The problem is not only quantitative, but also qualitative. This is due to the fact that individual investments are quite extensive compared to the Gross Domestic Product –

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GDP of Greece (11th place in EU), but those investments usually focus on previous generation systems. Local companies don't leave their tested practices for new ones, or they don't have the technical knowledge to do so.

As a result, technological maturity remains low (24th place in EU) according to data provided by SEV, Hellenic Federation of Enterprises. A relatively high percentage of 40% of enterprises in advanced countries is utilizing AI and IoT systems but for Greece approximately that percentage is 20%.

Greek organizations of entrepreneurs are making the most decisive moves towards implementing new technologies in industry, following the European movement, and trying to draw attention towards those five sectors of Industry 4.0 that need further development in Greece:

- 1. Creation of coordination mechanisms between public and private domain
- 2. Increasing and empowerment of technology investments
- 3. Enhancing investments in research projects with industrial applications
- 4. Decreasing the gap between digital and technological skills

5. Creation of Innovation Hubs for bringing together researchers and entrepreneurs So far, 19 countries of EU-28 are utilizing complete strategies to combine public domain, research, and Industry through Innovation Hubs, which help with the designing and the organization of the new practices. In Greece, very little of these practices have been developed and an additional delay was noticed due to the economic crisis. An absence on national plan for handling the new technologies and including them in actual industry processes is expected to become more and more noticeable in the future, thus forcing initiatives from independent sources

The effect of COVID19 on national companies in terms of shifting to Industry 4.0/5.0.

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Transition process has accelerated due to covid-19 pandemic, with caused an increase of the online services in general. More specifically, the enhancing of the Public domain's online possibilities was forced due to the need for quick and direct services to handle citizens obligations. Digital exchanges have increased, thus forcing the digital transformation of the state systems.

As mentioned above, in Greece those kinds of services were in need of development and modernization and every step towards that goal is important for the overall adoption of Industry 4.0 technologies. Moreover, many companies and enterprises have increased their digital transactions and invoicing, following the state mechanisms. This fact is forcing the creation and adoption of automatization solutions which take under consideration accounting parameters such as taxes. On behalf of the Public Domain, online services and the technology used for developing them are expected to rise even more.

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In particular, according to elements of the General Secretariat for Information Systems (GSIS), digital transactions between the state and the citizens have increased, reaching 490 million in 2021. This number is 55 times larger than the year 2018, where it was approximately 8.8 million.

France

The national context of Industry 4.0/5.0

France is lagging behind: the modernization of the productive apparatus is an essential prerequisite to support the competitiveness of industry French. Indeed, a vicious circle has been set in motion for at least ten years: company margins are too low to support investment, the aging of production tools is accelerating, the ability to innovate is reduced... From 2010, the final report of the Estates General of Industry warned of France's investment deficit, of the order of 100 billion euros, vis-à-vis its main competitors. While the French industry had only 32,233 robots in 2014, there were 59,823 in Italy and 175,768 in Germany. If we reason in terms of "density", i.e. when we relate the stock of robots in service to the number of employees, in 2013 France had 125 machines for 10,000 employees compared to 282 for Germany, far from the 437 of the leader of this ranking: South Korea (see Graphs 2 and 3). [1]

Graphique 2 - Stock de robots industriels multi-tâches (2014)



Source: International Federation of Robotics

Graphique 3 - Nombre de robots pour 10 000 salariés (2013)



Source: International Federation of Robotics

As the economist Robin Rivaton observes, "French industry tends to adopt a conservative attitude" in terms of investment [2]. Companies seek to delay the replacement of their machines as much as possible: only 65% of them downgraded equipment in 2014,





compared to 80% in 2000. And this is above all because of wear or aging manufacturers choose to part with them (60% in 2014, i.e. 15 points more than in 2000), less than a third of machines being scrapped to be replaced by more efficient equipment (see Graph 4).[1]



Graphique 4 - Évolution des motivations pour les déclassements d'équipements

In addition to the low performance in terms of robotization, there is a delay in the digitization of the production tool. The consulting firm Roland Berger [3] reveals that French companies are lagging behind, both when compared to consumer usage and to that of their foreign counterparts.

Their use of digital is often limited to a basic base (emails, showcase website, etc.) and the most advanced uses are the prerogative of a limited number of companies, including many large groups. This finding is confirmed by the main digital maturity indicators published by the World Economic Forum or by the International Telecommunication Union.

Graph 5 shows [1] that French manufacturers are much less advanced in their use of digital tools than their German neighbors. They even rank below the European average on most aspects. The spread of digital technology has so far favored the integration of

Sources: Insee

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internal processes, thanks to planning software (ERP), which gives the impression that these companies remain essentially "digital dungeons" to use Roland Berger's [4] expression. Manufacturing companies have indeed neglected customer relationship management or the more advanced uses enabled by the cloud and the Internet of Things, for example. Finally, it is worth highlighting the glaring gaps in terms of the development of key skills:

French companies were 17% to have employed an ICT specialist and 20% to have organized training in this field in 2014, i.e. respectively 7 and 14 points less than in Germany.



Graphique 5 - Pourcentage des entreprises manufacturières...

Données 2009, 2011 ou 2014

de la relation commerciale Champ : Industrie manufacturière (entreprises de plus de 10 salariés)

Source: Eurostat / Traitement: La Fabrique de l'industrie

Public authorities mobilized

The public authorities seem to have taken the measure of the risks of such a shortfall in productive investment. The various measures decided by the government since 2012 (CICE, Responsibility Pact) have enabled companies to restore their margins and regain

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investment capacity. Through its "Industry of the future" program (see text 1), it is even more directly involved in supporting the modernization of aircraft productive and the digital transition of companies. While public aid for the integration of technologies of the industry of the future is almost absent on the German side, many schemes have emerged in France. Direct financial support of around 2.2 billion euros is provided through Bpifrance, in order to help SMEs and ETIs in financing their investments in digital technology, robotics, energy efficiency, etc. Added to this is a measure exceptional 2.5 billion euros in tax benefits for companies investing in their production tool. The "Robot Start PME" program launched in October 2013 aims to encourage smaller companies to equip themselves with a first robot. It was renewed until 2017 as part of the "Industry of the future" plan, after having exhausted its initial budget in March 2015. Eventually, 250 companies will benefit from this system deployed by Symop, the Cetim and the CEA List.

Text 1 - The "Industry of the future " program in France The French initiative in favor of the industry of the future is part of the "New industrial France. Launched on September 12, 2013 by the President of the Republic and the Minister of Productive Recovery Arnaud Montebourg, this project is the result year-long preparatory work carried out by the National Industry Council (CNI). The determination of priorities was entrusted to the Directorate General for Competitiveness, Industry and Services (DGCIS) and McKinsey, in association with the competitiveness clusters and the strategic sector committees within which the heads companies, the social partners, the administrations concerned and the federations professionals are represented. Since May 2015, New Industrial France has entered its second phase in order to make the project more readable and to bring it more in line with the great challenges for the future. Concretely, this resulted in a reorganization of the 34 plans initial into nine "solutions" and a transversal program entitled "Industry of the future". The ambition of the latter has been broadened: in addition to the modernization of the production tool, its objective today is to support the digital transformation of companies. The piloting of the program has been entrusted to various representatives of the economic world, who are responsible for defining the roadmap. Alongside the Fives and Dassault groups Systems, the two co-pilots of the former "Factory of the Future" plan, we find today members of the CNI, representatives of public authorities, industrialists and as representatives of the Industry of the Future Alliance. Chaired by Philippe Darmayan, Chairman of ArcelorMittal France and of the Group of Industrial Federations, the latter has the mission of implementing and coordinating the actions defined by the sheet of road. It brings together many players from the industrial and digital world (FIM, UIMM, UIC, Syntec Numérique, etc.), the world of research and training (CEA, Cetim, Ensam, Institut Mines-Télécom, etc.) and is open to all trade unions and professional federations wishing to get involved in the project.

No future for the industry without upgrading

The modernization of the productive apparatus is a prerequisite for the improvement of industrial competitiveness and the extent of the mobilization of public and institutional

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actors is a first reason for satisfaction. However, the debate should not be focused on the technological issue alone, as the "Factory of the Future" plan did. Before May 2015, the sole objective of this fund was to finance business modernization projects and to bring out a national technology offer. However, the integration of new production technologies, automation and digitization of processes must be part of an upmarket approach, without which any strategy of industrial reconquest would be futile.

This observation is not new. Many studies and reports have indeed highlighted, particularly since 2008, the problem of positioning the range of French industry and the need to develop a differentiated, high-quality offer, able to impose itself on world markets or to implement more efficient production processes. Two objectives are therefore targeted: to offer differentiated or personalized products that the customer is ready to pay more for than commodities or, thanks to excellent control of manufacturing processes, to control production costs despite the higher cost of labor. These objectives can also be complementary. It must therefore be borne in mind that the model of the industry of the future is based not only on modern, digitized factories capable of manufacturing personalized products, but also on new organizations which improve working conditions by eliminating the tasks the most difficult, which release the creativity of employees and put it at the service of innovation and continuous improvement. The modernization of the production tool must therefore be done in favor of improving "cost" and "non-cost" competitiveness. This must be conceived in the broad sense: it can be based on technology, but also on design, marketing, etc. Several companies still established in France provide excellent examples of this type of positioning. By focusing on the development of innovative products with a high technological content, companies such as Thuasne in technical textiles or Axon' Cable, Eolane or Actia in electronic systems, managed to resist the collapse of sectors subject to price competition from emerging countries. On another level, even if they are few in number, the recent cases of relocations operated in Europe or in the United States show how the proximity with the end markets can be one of the mainsprings of industrial upscaling. In the case of Motorola, for example, the relocation of part of the group's activities to the United States resulted from the choice to expand the brand's product range while offering numerous customization possibilities. In a configuration where the products are sometimes made to measure, at the request of the customer, the direct link with the consumer is essential. because it allows you to better understand your needs, adapt products to your desires, develop associated services, etc. Coordination problems with a distant manufacturer, already sensitive for standardized productions, become almost insurmountable when the degree of customization increases. But, as Stéphan Bourcieu, general manager of the ESC Dijon Bourgogne group, says, "such a strategy of moving upmarket cannot be decreed".

It is a significant enterprise-wide challenge and can only be done over time, because it requires the mobilization of significant financial resources and calls into question many other dimensions: innovation, quality, services, organization of production, level of qualification of employees, etc. The challenge is therefore daunting. The industry of the future represents a unique opportunity to unite all players around this issue. Rather than insisting on the delay or the handicaps of France, we have chosen, in the following part,





to focus on the strengths that our country has and on which we can capitalize to make this transition a success under the best conditions.

France's strengths in the transition to the industry of the future

Identify technological assets

To be mobilizing, the technological vision of Industry 4.0 undoubtedly has a forwardlooking aspect, even in the eyes of the major German industrial groups that participated in forging it. This vision has installed in the collective discourse the image of factories automated and digitized to the extreme, where the production lines would be made flexible thanks to high-end connected machine tools... obviously produced by the champions of the German mechanical industry. French suppliers may give the impression of being behind these leaders and of having missed the turning point of 4.0 technologies. If they are indeed behind in the fields of industrial robotics or automation, they have on the other hand many advantages to assert on advanced technologies such as embedded systems, augmented reality, etc. who will invest massively in factories and businesses. This is why the work of identifying French assets that is essential. It was initiated within the Industry of the Future Alliance; a report by the Academy of Technologies to be published in the fall of 2016 will also present certain key technologies in which France has an advantageous position or must make special efforts.

Cybersecurity is an example of the many areas in which the French offer excels and whose prospects growth are promising. The distribution of network-controlled machine tools and connected objects or the integration of the value chain thanks to digital tools increase the volumes but also the number of data exchange channels, and therefore the possibilities. to break into the systems. The Stuxnet virus, designed in 2008 with the aim of damaging Iranian nuclear facilities, is the best-known example. computer attack having targeted an industrial site, but it is far from being the only one. In 2014, the Norwegian oil industry in turn suffered a massive attack: more than fifty companies had their drilling and prospecting data hacked. In 2016, the public affairs director of Airbus Group reported 300 attacks per day for his company alone.

The energy sector is a prime target for hackers, but the National Information Systems Security Agency (Anssi) has already warned all manufacturers of the resurgence of these cyberattacks, which in some cases could cases have consequences for the very survival of the company.[6]

Major French groups such as Airbus or Thales are now defending their leading position in the cybersecurity market. The challenge for them is to transpose their cutting-edge technologies, developed for military or sensitive applications, to a much wider market. At their side, companies services such as Atos or Orange also offer this type of service in global support offers for the digital business transformation. Finally, there are many SMEs and ETI specialists in publishing and integration cutting-edge cybersecurity solutions, some of which came together in 2013 within the HexaTrust association.

More broadly, in recent years, France has been able to develop a pool of start-ups and SMEs specializing in digital technology: the Internet of Things, big data, etc. The liveliness of this new ecosystem can be found in the results of the barometer established by Capgemini Consulting and eCap Partner. It listed more than 405 fundraisers for digital

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start-ups in 2015, compared to 300 the previous year. The cumulative amount of these fundraisings exceeded one billion euros, an increase of 140% in one year. Among the French nuggets, we can mention Sigfox which, at the beginning of 2015, succeeded in raising 100 million euros from European investors, American and Asian in order to accelerate its international development. This Toulouse start-up deploys a low-speed network dedicated to the Internet of Things ("Ultra narrow band") which allows to cover very large areas with an economy of infrastructure.

The central issue for these digital technologies – and for the technologies of the industry of the future in general – is the standardization of standards allowing the interoperability of systems. On the one hand, this raises the question of the structuring of these sectors made up of very different actors, also developing technologies that are sometimes only in their infancy.

The relations between large groups and start-ups still remain ambiguous, alternating between mutual fascination and mistrust. Mentalities and practices tend to evolve and the proliferation of incubators within large groups is a sign of this desire to take advantage of the advantages and qualities of each: the economic and commercial power of large groups on the one hand, the agility and capacity innovation specific to small structures on the other hand. The success of this cooperation will largely depend on France's ability to impose its products and standards, in the face of competitors. Americans who have already put themselves in battle order. AT&T, Cisco, General Electric, IBM, and Intel, for example, created the Industrial Internet Consortium (IIC) in March 2014. More than 200 actors from Internet of Things have joined forces with these five telecommunications and digital giants to accelerate the development and adoption of their products and therefore their standards.

On the other hand, it highlights the importance of Franco-German and more broadly European cooperation for weigh in the negotiations of this future standardization. The IIC and the Plattform Industrie 4.0 announced their merger in March 2016, recognizing the complementary nature of their work and in particular their architectural models, respectively called IIRA (Industrial Internet Reference Architecture) and RAMI 4.0 (Reference Architecture Model for Industry 4.0). For their part, France and Germany presented a joint action plan in April 2016, which notably provides for the establishment of a unified reference framework, derived from RAMI 4.0.

Capitalize on the quality of public research to support innovation and upscaling

France benefits from good public research thanks to quality laboratories (CNRS, Inria, etc.). The CEA award as the most innovative public research organization in the world by the 2016 edition of the Reuters ranking is a sign of this. Overall, however, it remains a "follower" country in terms of innovation and is struggling to transform the results of its research into marketable, wealth-creating applications. Admittedly, this observation is made in many countries, including in some that we consider to be rather efficient in this area (Sweden, United States, etc.), but we must recognize that it is particularly acute in France. The example of additive manufacturing is symptomatic. In 1984, two patents describing the stereolithography technique were filed by French people and then a few

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weeks later by an American academic, Charles Hull. The latter will create less than two years later a start-up which will quickly become the world leader in this central technology of the industry of the future, while the French patent will never be exploited. The Alcatel subsidiary that owned it did not consider it relevant to maintain it, although a CNRS laboratory demonstrated the viability of the process.

Many reforms have sought to improve the interface between research organizations and companies, in particular the creation of Cifre agreements in the early 1980s, the so-called "Allègre" law on research and innovation of 1999 (which example for a researcher to create or advise a company to promote his work), the extension and lifting of the research tax credit, benefiting companies undertaking research and even more so when they entrust it to public laboratories, the status of "Young innovative company", competitiveness clusters since 2005, Carnot institutes, technological research institutes (IRT), technology transfer acceleration companies (SATT), etc.

This policy has had positive effects. While public expenditure on research and development, expressed in points of GDP, has remained stable, the research effort of companies has risen markedly from the low point observed in mid-2000s (see Graph 6).[1]



Graphique 6 - Dépenses intérieures de R&D des entreprises et des administrations (en % du PIB)

Source: MENESR-SIES Recherche et Insee

Efforts must be continued because France remains below the average for OECD countries in terms of overall effort (2.24% against 2.36% of GDP in 2013). After ten years of creating new systems and institutions, the time must first be for the evaluation and consistency of an architecture that has become complex. The first work of the National Commission for the Evaluation of Innovation Policies, set up in June 2014 following the recommendations of the Beylat-Tambourin report, warns of the risks of scattering and the windfall effects that the proliferation of devices entails. They reveal that between 2000 and 2015, the





number national innovation support schemes increased from 30 to 62 and that over the same period, the allocations per scheme were divided by three.

The technology transfer strategy must then be conceived according to a more global approach. This is what Suzanne Berger recommends in her report submitted to the government in January 2016. Successive reforms have so far favored the creation of institutions to bridge the gap between public research organizations and businesses; today, according to her, it is necessary to rely on much denser direct connections and much more numerous and diverse interactions between public research and companies (research contract, advice, co-supervision of internships and theses, exchanges of all nature, individual mobility, etc.).

Furthermore, the spin-off structures of certain organizations have proven their effectiveness (INRA, CEA). The National Institute for Research in Computer Science and Automation (Inria) is one of the pioneers in this field. For thirty years, he has participated in the creation and the development of more than 120 innovative technology companies, offering products and services in sectors as diverse as defence, transport, energy, education, etc. This support consists not only in providing financial assistance to facilitate the start-up, but also in advising researchers on the definition and formalization of their entrepreneurial project. This support system makes it possible to make the link between the know-how of researchers and the needs of the market and contributes to making them acquire an entrepreneurial culture necessary in this type of approach.

Mobilize engineering schools

Engineers will play a pivotal role in successfully transitioning companies to the industry of the future. Indeed, the various technologies concerned are often available and even, for some, already present within the businesses. The real challenge for manufacturers is to find the skills that will enable them to combine them in an effective and relevant way. Likewise, these profiles are essential to support the upscaling of the industry. As such, the quality of engineering training in France is a valuable asset. According to Laurent Champaney, Deputy Director General of the Ecole Nationale Supérieure des Arts et Métiers (Ensam) in charge of training, "a significant deficit is to be expected among production engineers and engineers in industrial organization because they are at the forefront of modernization and digitization of businesses. In addition, the in-depth transformation of tertiary functions such as marketing, logistics or commercial management through digital will require many specialists in IT development, big data but also system architects capable of implementing network computer equipment, websites, machines and connected objects. These profiles already concentrate the greatest tensions on the job market at master's level, because the needs have not always been correctly anticipated and the training courses are sometimes only at the design phase. In

As a result, between six and eight out of ten recruitment projects are considered difficult for IT project managers or maintenance specialists. More generally, the difficulties in recruiting engineering positions are partly attributable to a lack of attractiveness in the industrial sector. To make matters worse, the typical profile of the engineer the industry needs looks more like in addition to the rare pearl. Companies expect them to combine their technical expertise with skills managerial, that they have a global vision of all aspects of the business, the skills to work internationally, the qualities to integrate into ever-

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changing structures and working methods, etc. As summarized by Laurent Champaney, "engineering professions are becoming more complex and require the mastery of an everwider range of skills, in particular due to the spread of digital technology. These demanding disciplines, where error is not allowed, can put off some students. The tensions in recruitment are also a sign of the competition between employers to attract the best profiles. [7]

They highlight in particular the problem of the stranglehold of large groups (industrial or not), consulting firms or service companies on the recruitment of students leaving the most prestigious schools. Ultimately, the small businesses suffer the most from this shortage.

Christian Lerminiaux, former president of the Conference of Directors of French Engineering Schools (CDEFI), confirms that "it is especially innovative SMEs that lack engineers. Placed in technological niches, they need gray matter to develop, and their difficulty in attracting graduates limits their growth. In the face of these difficulties, it is therefore urgent that engineering schools and SMEs strengthen their links.[8] The "Engineer, think SME" program, launched in 2013 by three engineering schools located between Aix-en-Provence and Marseille, consists for example of organizing site visits, conferences and meetings between students and SMEs in the region. These events allow companies to insist on the higher responsibilities and the greater autonomy in the work that they can offer to their employees. In three years, the share of students in these schools having completed their internship in an SME rose from 5% to 20%. Some large groups are also beginning to seize on this problem of access to skills and play the card of inter-company cooperation with SMEs in their sector. The "Shared learning paths" were thus created in 2012 at the initiative of the aeronautics sector. This device allows a young person carrying out his apprenticeship in a large group, to complete part of his career with one of its suppliers, generally an SME. If his contract does not lead to permanent employment in the group, the apprentice can then go to the SME.

The effect of COVID19 on national companies in terms of shifting to Industry 4.0/5.0.

For many industries, the pandemic accelerated progress with producing results from digitization strategies. This was not the case in manufacturing, where only 15% of executives say they are producing results. However, digitization remains a top priority as consumer pressures increase. It's been a daunting year for manufacturers, yet they continue to move ahead toward a digital future.

Despite slow progress in producing results from their digitization strategies, manufacturers felt increasing customer pressure due to the pandemic's impacts on their business models. Optimizing operations to save costs remains top of mind; however, a heightened focus on becoming digital to satisfy customer expectations and collaborate across traditional silos for growth will accelerate their digitization journey. More executives

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recognize the benefits of prioritizing IT modernization, cloud enablement and IT/OT security. They also view environmental sustainability as core to creating future value.

Lithuania

The national context of Industry 4.0/5.0

The effect of COVID19 on national companies in terms of shifting to Industry 4.0/5.0.

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The Netherlands

The national context of Industry 4.0/5.0

Digitalization and the progress of Al-driven technologies improve production systems through flexibility and efficiency (FME-CWM et al., 2014). To achieve this, host countries are required to implement strategic initiatives, as the key success factor is to accommodate and promote coordination and cross-sectoral approaches (Xu et al., 2021, p.530). In the case of the Netherlands, this is feasible via a constantly evolving and coordinated action plan.

In 2018, the Dutch government launched the Smart Industry Implementation Agenda with the scope "to have the most flexible and the best digitally connected production network in Europe by 2021" (NFIA, 2021). The agenda contains five lines of action that ensure that the acceleration is realized: 1. Establishing an assessment programme and expertise center to enable companies to start working with Smart Industry in a more focused way; 2. Strengthening the cooperation between Fieldlabs in the same region with Smart Industry Hubs; 3. Developing new knowledge by means of a new Smart Industry roadmap; 4. Developing skills labs to facilitate lifelong learning; 5. Start of the data sharing programme, in which the programmes cybersecurity and data value center will be implemented (Smart Industry, 2020).

Thanks to this agenda, the Dutch continuously embrace innovation: they have created nearly 40 Fieldlabs "to develop, test and implement Smart Industry solutions, and train people to apply them" thus enabling more than 300 companies, various knowledge institutions (e.g. TU Delft, TU Eindhoven, Utrecht University, applied research institute TNO, etc.) and government institutions in experimenting together in Smart Industry Hubs (NFIA, 2021). The Dutch drive towards Smart Industry also increases the country's engineering expertise (robotics, aeronautics, sustainable design and development, etc.) and ensures optimal production processes in manufacturing (NFIA, 2021). To transcend the traditional manufacturing boundaries, the Netherlands has created Pilot Plants, where companies and knowledge institutions can research, develop, and test innovative





technologies before introducing them to the market. This enables the transition towards Smart Industry, as it is a more time-efficient and less risky approach for companies and knowledge institutions alike.

As a result, stakeholders in the Netherlands are highly motivated to shift towards Industry 4.0/5.0, as they can easily experiment with new technology in Smart Industry Hubs, as well as apply and share data collected through such processes, in a country that has the digital infrastructure to support Smart Industry (RVO, 2021).

The effect of COVID19 on national companies in terms of shifting to Industry 4.0/5.0.

The COVID-19 pandemic has presented several challenges in the world, thus exposing vulnerabilities in various domains, and forcing industries to reinvent themselves. This was the case, for instance, with the supply chains of the manufacturing industry, which revealed the need for higher levels of digitization and greener practices (Praat, 2021).

In the Netherlands, the constantly changing trends combined with high levels of unpredictability due to the pandemic have highlighted the importance of creating shared spaces where digitalization and automation processes could be optimized in faster and cheaper ways. Accelerating innovation is feasible in the post-pandemic era via industry networks like the TopDutch Region of Smart factories, where smart factory solution providers can *support and speed up production facility start-up* (Praat, 2021).

The pandemic and the resulting disruptions, in general, have challenged European smalland medium-sized enterprises (SMEs) in the manufacturing sector more than they did so on large firms, as SMEs have more limited resources and cannot easily bounce back into a pre-crisis mode. However, SMEs can be more flexible and adaptable during crises, thanks to their small size, ownership status, and hierarchical structures compared to their large counterparts (Juergensen et al., 2020, p.500).

The COVID-19 crisis has also brought about implications on policy issues; immediate effects or long-term implications regarding, for instance logistics, demand disruptions, and the implication of the entire value-chain across different firms and industries, have called for policy shifts towards *more structural and longer-term approaches* that would promote the renewal and growth of the challenged stakeholders "through innovation, internationalization and networking" (Juergensen et al., 2020, p.499). At the same time, the shifting landscape put forth the need for more *human-centric, sustainable, and resilient* approaches in industrial activity (Mecalux, 2021). Consequently, industries are pushed towards *changing their ways for good* and, in the case of the Netherlands, they have both the infrastructure and the motivation to do so (Praat, 2021).

Ukraine

The national context of Industry 4.0/5.0





Systemic work on the Industry 4.0 strategy creation and implementation in Ukraine has begun after the launch of the pro-governmental program Digital Agenda for Ukraine in autumn 2016. A special section of the program was reserved for numerous initiatives emerging in Ukraine to force the development of Industry 4.0.

The National strategy for Industry 4.0^[1] appeared in Ukraine in December 2018 initiated by the Association of Industrial Automation of Ukraine (APPAU). APPAU is the key body engaged in the development of Industry 4.0 uniting more than 50 (as of 2022) top Ukrainian industrial actors, among them industrial vendors (manufacturers – suppliers of equipment and software in the industrial automation system), HEIs, research centers, system integrators, OEMs, IT developers, engineering companies, and industrial enterprises. Since 2016, the Association of Industrial Automation of Ukraine (APPAU) has implemented more than 10 projects of different scale and area, such as, the development of strategies and individual provisions of Industry 4.0 and industrial development, development of Centers 4.0, standardization, cluster development, smart specialization, improving international cooperation and more.

Together with the partners (the Council of Entrepreneurs at the Cabinet of Ministers, the Institute for Economic Research and Policy Consulting, the Chamber of Commerce and Industry of Ukraine, the Office of Reforms at the Cabinet of Ministers of Ukraine, the European Innovation Agency, and the Ukrpromzovneshekspertiza), APPAU founded National movement Industry4Ukraine (https://land4developers.com/). The mission of the movement is to develop industrial hi-tech segments in Ukraine to make Ukrainian economy stronger and in line with Industry 4.0 trends. By the 2022 the movement incudes more than 200 members coming mainly from IT and Industrial Control System markets.

The National Strategy includes 13 projects and a set of tasks of policy synchronization with the Government (see Fig.1).







Fig.1 - 13 projects of the National Strategy 4.0 divided into 5 directions

Main objectives of the Strategy are:

- growth of manufacturing 10% per year that gives growth in GDP from 12% (2017) to 20 % (2022).
- Faster growth of industrial engineering sectors, 10- 20% per year.
- Capital attraction into local 4.0 capacities: production, Center R&D, incubators and SMBs.

In order to achieve those development had to move in thee following directions in 2019-22:

- synchronization with Industrial and Innovation Strategies at the State level.
- Creation of innovative ecosystem for industrial engineering sectors.
- Speed-up of clustersation processes in 4.0 at regional as well at the national levels.
- Full-scale digitization of key sectors in manufacturing, energy and Utilities sectors.
- Integration of technologies 4.0 into Defense strategies.
- Launch of export programs for industrial engineering.
- Integration into EU and WW environment of 4.0.

In 2018-2019 Industry4Ukraine established a network of Industrial Centers 4.0 (research hubs based on universities and science parks), developed roadmaps for digital





transformation of the state railway system and the food industry, aligned Ukrainian standards with the EU regulations, and held several important surveys.

In 2018 the concept of innovation clusters EAM (Engineering - Automation - Mechanical Engineering) was introduced as a mechanism for boosting innovation potential of Industrial high-tech sectors. Thus, the National Cluster Development Program officially started in 2020. Clusters` mission is to encourage innovation and enhance collaboration of various important players in the sectors of engineering, automation and machinery in 5 regions of Ukraine.

The first attempts to determine how the Ukrainian landscape of innovators 4.0 looks like were made in 2018 and the first raw image of the Industry 4.0 landscape in 2017 was obtained (see Fig.2). It comprised around 65 manufacturers offering services and products 4.0 in Ukraine[1]. There are almost 50 Ukrainian brands among them, the other 15 are Western well-known brands, suppliers of equipment and software, which are present in Ukraine.







Fig.2 – Version 1.0 of the Ukrainian Industry 4.0 landscape (2017)

Though various organizations and companies of Ukraine mostly support the necessity of applying the approaches of Industry 4.0 (more than 79% as for 2019) (Nikitin et. al., 2019), still very few really use them. For instance, in regards with the assets performance management according to the report by the Ukrainian experts from APPAU it is still no more than 1% of companies which systematically applied 4.0 technologies in 2021 (Fig.3). The overwhelming majority of enterprises are still located at 1.0-2.0 levels: data capture, integration, visualization and analytics are still not widely used to improve the reliability and availability of physical assets.

Fig.3 – Technological development of Ukrainian companies in regards with the assets performance management

Among strong integrators and developers who are already performing 4.0 assets management are **IT-Enterprise** (https://it-enterprise.com/), **Waites** (https://waites.net/), **Indusoft** (https://indusoft.com.ua/), **a-Gnostic** (https://a-gnostics.com/).

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In 2019 version 2.0 of the Ukrainian Industry 4.0 Landscape was prepared, this time the emphasis was on companies of Ukrainian origin. The use of 4.0 technologies for Industry 4.0 was the main criterion for filtering existing innovators. This version of the Landscape included around 80 local innovators spreading through 16 technology sub-segments (see Fig.4).

Companies in AI / Big data segment are dominant, but other segments, such as, Additive manufacturing and Industrial Internet of things (IIoT), are also showing the fast growth. The second place is given for the segment of IoT-devices (27 companies), the third place – AR / VR (11 companies). Companies developing 3D and cyber-security are also present.

This Landscape 4.0 shows the strong potential of Industry 4.0 in Ukraine, considering that real number of Industry 4.0 companies should be multiplied at least by 2. 70% of the companies of the Landscape work in Ukraine; 50% are product companies, 20% are system integrators and just 30% company work for abroad customers according to the outsourcing model.

- According to Alexandre Yurchak, CEO of APPAU and the coordinator of the Industry4Ukraine platform, in 2022 it is already more than 100 innovators with competitive products and solutions in Advanced manufacturing that are shaping Industry 4.0 Landscape in Ukraine (Yurchak, 2022). Among them[1]:
- Infocom Ltd (https://ia.ua) is a Ukrainian developer in the UGV (unmanned Ground Vehicle) segment. They create unmanned vehicles, robotic platforms for security, fire and military purposes, other military unmanned aerial vehicles, high-tech products for solar energy and for electric transport infrastructure.
- Smart Factory (https://www.softelegance.com/) is a Ukrainian MES/APS development that is required by industrial enterprises as they go to the integration of manufacturing lines and machines in workshops. IT-Enterprise also has a number of other advanced products and is increasingly featured in the Landscape 4.0.
- Molfar Technology (https://molfar.tech/) is a young firm that has develops AI / Drones / Machine vision solutions.
- Drone.ua (https://drone.ua) is a well-know drones manufacturer with applications in Agro-industry, but also in Energy and Infrastructure.
- SoftEngi (https://softengi.com/) create digital twins with the extensive use of XR technology.

Sectors which generate today the biggest part of GDP are Food, Metallurgy, and Energy, while potential drivers of economic development are Engineering, Aerospace, Defense, Biopharma, and Machinery).

In recent years, Ukraine has developed a reputation as an international information technology (IT) hub. The IT Association in Ukraine reported around 116.000 software engineers working in the market in 2018, and more than 250.000 at the beginning of 2022. While there is still a lack of data scientists, DevOps engineers, Machine Learning engineers and other AI experts, they are, often, much easier to find and hire in Ukraine than in Western Europe, and their number is keep growing.

Ukraine has a rich history when it comes to scientific innovation, from physics to life sciences, education, alternative energy, chemistry and engineering. According to Gali

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Halevi, Director at the Institute for Scientific Information, the country makes significant contributions to the global scientific effort, not in the least due to the tremendous growth in domestic and foreign investments in research and development (Halevi G., 2022).

Such investment has enabled the development of the infrastructure needed for sustainable, efficient technologies and processes before the Russian invasion of Ukraine in 2022. With over 2000 startups, Ukraine had also a fast-developing startup ecosystem. Ukraine was in the top 30 startup countries globally according to Startup Ecosystem Rankings 2020 by StartupBlink which ranks the startup ecosystems of 100 countries and 1000 cities (Ukrainet, 2020). Kyiv, the capital, made it to a respectable 32nd place globally and 8th place in Europe. The startups that were founded by Ukrainians include some world-known ones, such as, for example, Grammarly (https://www.grammarly.com/) and Looksery (http://www.looksery.com/).

Now due to the Russian aggression Ukraine shows a negative momentum in the startup ecosystem (StartupBlink, 2022). However, according to the Ukrainian government's assessments, more than 70% of Ukrainian start-ups are continuing to operate despite the war. In order to help businesses continue operations and move closer to the EU tech sector the European Innovation Council (EIC) has set up €20 million fund for Ukrainian start-ups. They believe Ukraine has a vibrant deep tech community and strong potential for creating breakthrough innovations which can become a key economic driver for rebuilding the Ukrainian economy and infrastructure after the war (Naujokaitytė G., 2022).

The effect of COVID19 on national companies in terms of shifting to Industry 4.0/5.0.

Ukraine had been undergoing an historical digital transformation before the upheavals of 2020.

In 2018 the government set a five-year digitization course in the "National Industry Strategy 4.0", according to which the key factors of the development were selected: consolidation of major 4.0 stakeholders and government agencies, active involvement of the IT sector in the transfer of experience of globalization and best business practices enterprises, creation of an innovative ecosystem of industrial high-tech segments, integration into European and world chains values, accelerated development of industrial segments in Ukraine.

In September 2019, Ukraine established the Ministry of Digital Transformation based on its predecessor state agency aimed at the creation of the e-government – "the state in the smartphone" which had to improve public administration and service delivery in Ukraine by 2024, increasing the performance and efficiency of state institutions, and reducing opportunities for administrative corruption due to digitization and virtualization of various processes. Since then, Ukraine has become the first country in the world to introduce e-passports, the fourth European nation to offer digital driver's licenses. It boosted the world's fastest online business registration process via the governmental Diia portal and correspondent mobile services. Ukraine has also leaded the world in the number of online public services for children and newborn via the eMalyatko platform.





In 2019, the government launched the National Startup Fund of Ukraine (USF) endowed with USD 20m of available funding, a public initiative to support innovative projects. The fund's resources amounted to about \$ 14 million to distribute grants from \$25,000 to \$75,000 among promising Ukrainian startups and up to \$10,000 grants for acceleration programmes. Originally set up to promote the development of the local startup ecosystem and internationalisation, USF today is the largest local angel investor with over 100 funded startups and the most extensive database for startups and stakeholders (over 3,000 applications).

In the United Nation's 2020 e-Government Survey, released on July 10, Ukraine placed 69th in the world, with an E-Governance Develop Index, or EGDI, of 0.7119, which is a big leap from the rank 82 with an EGDI of 0.6165 two years before ().

High-profile founders like WhatsApp's Jan Koum, Revolut Ltd.'s Vlad Yatsenko and the country's roughly 250,000 technology professionals gave Ukraine an outsized reputation among coders, with tech workers clustered in offices in Kyiv and other hubs around the country.

The COVID-19 pandemic and quarantine restrictions nudged Ukraine towards even more rapid digital transformation (Bogoyavlenska et al., 2021).

Accelerated digitization due to COVID

Boost of digital innovations in the private business and public sectors in Ukraine was essentially facilitated by governmental initiatives aimed at tackling the outbreak of the COVID-19 disease in Ukraine and making life easier for citizens and businesses:

- A series of new governmentally promoted mobile applications and services was introduced for Ukrainian citizens, a.o., mobile application Vdoma enabling convenient self-isolation monitoring (Fedorov M., 2021).
- A national competition #HackCorona was launched by the Ministry of Digital Transformation, in partnership with the United Nations Development Programme in Ukraine, to find new IT projects and innovative ideas that could fight the pandemic.
- A national programme for the development of a system for comprehensive support of ICT innovation and digitalisation of SMEs, providing access to knowledge, markets, infrastructure and sources of funding through a network of 24 EU|BICs (Certified Business Innovation Centres) was included into the Government Priority Action Plan of Economic Recovery 2020-2022 (Denys Shmyhal, 2020).
- The National Startup Fund of Ukraine started looking for new innovative projects to fight the pandemic and its consequences.
- A concept of Diia City (Digital Country), a new legal framework for IT industry developed by the Ministry of Digital Transformation of Ukraine. The aim is to create a virtual country with virtual services for IT sphere and a place for unlimited investments.

The increased demand for more flexible business and social processes maximized the need for non-trivial solutions and "think out of the box" ingenuity. Businesses have been forced to adopt new internal working practices and routines and felt a strong pressure to

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emphasize online remote work (Gryvnyak, 2020), moreover, they have started offering their products or services through various digital channels.

Demand for the social impact of the transition process

An important consequence of the pandemics was the newly acquired understanding that the world requires not only effective digitally enabled solutions, but a much higher level of process resilience, production sustainability, and decision-making quality (European Commission, 2021). The human role in digital transition was thoroughly reconsidered: social impact of the innovations has become a key factor for their success and wide adoption. This explains the growing popularity of the Industry 5.0 concept, which (unlike Industry 4.0) is supposed to bring humans back into the loop of the industrial processes, and citizen-oriented digitalization products.

Cybersecurity as a priority

It became clearer that the solutions developed or supported by various initiatives, pilots and technical assistance projects should be compatible, secure and adequately certified for personal and sensitive data protection.

The main lessons learnt

COVID-19 outbreak helped revealing two big problems of the Ukrainian digital transformation:

Impaired digital literacy: It has become apparent that there is a need to enhance citizens` digital skills and abilities. According to a nationwide study on digital literacy (Ministry of Digital Transformation of Ukraine, 2019), some 38 percent of Ukrainians have digital literacy skills lower than average, while 15 percent of the population may be dubbed digitally illiterate. Throughout 2019, 34 percent of the Ukrainian citizens aged 18-70 became victims of internet scams, and only 14 percent know how to protect their data online.

Digitalization without proper attention to filling the digital divides between citizen groups (defined by sex, age, skills, disabilities and economic status), while eliminating old inequalities, has the potential to cause new ones – especially in middle-income countries such as Ukraine (Gercheva, 2020; Fouani, 2021).

To address these problems, the national program for promoting digital literacy: "Diia. Digital Education" was launched during the pandemic. The "Diia. Digital Education" platform was created in the form of edutainment, where free series are combined with experts and celebrities to explain how to use websites, the possible applications of smartphones and laptops, basic Internet safety rules, use of online services and courses on how to find jobs and how to acquire new skills to combat rising unemployment. The audience on the platform rose from 36,000 people to 200,000 (in June 2020) (Gryvnyak, 2020).

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II. Resilience of business processes during and after COVID19

Cyprus

Main strategic and operational challenges of companies and startups

According to the common belief, the stability of companies really shows up when they have to deal with some unexpected, fundamental factor influencing their operations. In the time of COVID-19, a high degree of flexibility was needed from all actors in the industry, and the models that have proven themselves so far need to be adjusted due to a worldwide pandemic. In terms of operating model, only those actors who have adequate financial reserves were able to survive in times of crisis. The existence of these financial reserves can also be an advantage in the advertising market, as the vast majority of companies can allocate significantly less money to marketing expenses, so that active advertisers can expect to reach more consumers.

The successful key factors of adjusting these challenges were the following:

- Creating and regulating the new organizational lifestyle, "home office"
- Applying agile methods when organizing the cooperation between employees and departments
- Financial re- planning
- Extra budget for advertising
- Satisfying local market needs, not focusing on the global scale
- Create an easy supply chain
- Opening web shop if it was possible
- Converting B2B to B2C (reaching out directly to the clients. e-commerce, food delivery)

Best practices on how to tackle challenges that came with the pandemic

Each country has faced challenges with inflation, limited movement of supplies, and financial burdens at all levels of society, yet Cyprus maintains promising growth indicators. Furthermore, governmental attitudes on policy have shifted from economic support and relief towards economic growth initiatives. One of the major reasons for continued growth despite financial pandemic impacts is the development of many key industries of the country.

Cyprus business during Covid-19 was halted temporarily like any other global business hub, but the diversity and modernization of the marketplace allowed for efficient adaptations to a changing global climate. Outsourcing capabilities, business support mechanisms, and a highly technological and educated workforce allowed Cyprus





businesses to maintain certain levels of function and flexibility in navigating the crisis. While major industries such as shipping and tourism were greatly impacted by the pandemic, other areas such as real estate, investment, and financial services were able to carry on and promote healthy growth indicators for the country.

Also, broken into three major areas of financial assistance, the Cypriot government released three measures to boost economic support for businesses and individuals, utilizing an individualized support scheme, an economic support scheme, and a tax relief support scheme. A few measures to aid Cyprus business in Covid-19 relief include:

- Program for Financial Support: reduced taxation for relief measures
- Small Business Support Scheme: 70% subsidy for employee salaries of start-ups as well as electricity price reduction
- Nine-month freeze on public and performing business loans
- State guarantee on loss from loans for businesses and self-employed individuals
- Emergency Measures by Financial Institutions and Supervisory Authorities Decree of 2020: suspension of loan installment collection for 2020
- Self-Employed Special Benefit: support for the self-employed
- Child Care Special Leave: allowance support scheme for working parents who could not meet current models of working, such as teleworking, due to childcare-taking responsibilities

COVID19 utterly changed the perspective of companies and startups in Cyprus. Some of the experts claim that the pandemic just speed up some process that was sooner or later would be implemented when developing to Industry 4.0. The 3 main trends that were accelerated in the Cypriot ecosystem leading towards the Industry 4.0/5.0:

- Productivity redefined: automation and technological displacement accelerate, and labor is no longer the most important factor of production. A potential conundrum for ESG-aligned companies, as well as governments seeking to boost productivity in a post-COVID-19 world.
- 2. Market economics redefined: protect your own is the new policy catch. Expect more nativist regulation (particularly in strategic sectors), market concentration and potentially nationalization in the case of bail-outs, and heightened tax scrutiny as governments look to pay back their debt or fund programs to respond to social discontent. Meaning a more local and regional model in terms of supply chains and business models to match the shift from efficient to resilient.
- 3. The purpose of a company redefined: the corporate safety net rises in prominence, as governments prioritize local constituents today over what could happen tomorrow (think climate, public debt). Employees and the public look to companies to fill the gap. Companies that adopt a 'do-it-yourself' attitude come out ahead like adopting a 'man and machine' business model and prioritizing investment in reskilling local, domestic workforces.

Greece





Main strategic and operational challenges of companies and startups

Covid-19 pandemic has affected the economy worldwide in many different and unpredictable ways. Strategic decisions for investment and companies became hard under these continuously changing circumstances. Companies who manage their production demands according to years of experience, were suddenly in front of a situation.

Best practices on how to tackle challenges that came with the pandemic

In Greece, companies that presented flexibility and adapted to the new pandemic data not only weren't affected by the economic situation but also, they increased their income by 12%.

According to PwC Greece, 41 companies of the survey sample have managed to increase their income and their productivity especially during the first 6 months of the pandemic. A great majority of them belong in Industry and produce or move products of high demand during the pandemic, such as sanitary and personal hygiene materials, medicine, food, technology products and logistics.

Increased incomes were noticed in companies trading office furniture probably due to the remote working and expansion of office space, which was common practice for most companies.

Moreover, the first problems in industrial production were noticed because of the isolation policies and the forced distance between workers and technical personnel. In order to overcome their financial issues, many factories and employees were suspended for periods of time. The trading activities and the raw material supply were continuing in order to serve the clients demands.

The benefits of digital transformation were clear during the pandemic, because companies that had already encountered digital technology practices were at a better place compared to others who had to develop solutions in short notice.

France

Main strategic and operational challenges of companies and startups

Major systemic changes to the manufacturing industry were well underway to converging the physical and digital prior to the widespread disruptions of 2020. And the disruptions aren't finished. Trends arising from the effects of Brexit, new waves of COVID-19, and the rolling impact of all-digital living and working promise to keep shifting the ground under manufacturing in 2021.





After an overall fall in investments of 13% in 2020, the industry is experiencing a dynamic recovery with a strong rebound despite still some disparities depending on the industrial sectors. According to an INSEE survey, business leaders in the manufacturing industry in France expect a 10% increase in investment in value. However, 2021 will not be without its share of challenges. Long before the pandemic, manufacturers were already struggling to maintain cost-efficiency while adopting — or planning to adopt — Industry 4.0 digital transformation initiatives. In 2021, the industrial sector will continue to face economic upheaval, but also changes in consumer behavior as well as the evolution of international models of commerce.

The merging of the real world and the digital world and the collaboration between man and machine are now essential to meet the sustainability objectives of the industrial sector, whether it is automation, creating a supply chain ready all eventualities, or to improve the skills of the work force. Many opinion leaders see this convergence as an existential challenge that companies must imperatively meet. While it presents certain risks, this challenge is also an opportunity for the industry sector to reinvent itself.

In France, the government has mobilized substantial resources to support strategic sectors of industry as part of the France Relance plan aimed at restoring the French economy. In total over the 2020-2022 period, the recovery plan plans to mobilize nearly 35 billion euros in favor of industry for systems that support the pillars of recovery, which are ecology, where decarbonization comes first. priorities, competitiveness with massive investment in the technologies of the future, and cohesion with safeguarding and creating jobs.

Best practices on how to tackle challenges that came with the pandemic

Becoming digital to meet customer expectations remains the top trend, and executives report growing consumer pressure on their digital strategies. Cybersecurity rises as a focus and sustainability is core to value creation. Budget constraints and internal processes emerge as new top challenges.

- Progress is slow in achieving digitization results: only 15% of executives say they are producing results from their digital strategies, up from 13% last year and 11% in 2018. The manufacturing industry ranks lowest among industries in this category, along with the government sector (15%)
- Consumer pressure on digital strategies is rising: 54% of executives say external pressures from consumers impacted their approach to digitization to a high degree, rising significantly from 40% in 2020, after more than a year of pandemic impacts. Conversely, the pressure felt from new non-traditional competitors fell to 27% from 37% last year.
- Budget constraints and internal processes emerge as top challenges: For the first time, executives say budget constraints and internal processes are having the most significant impact on achieving their business priorities, increasing considerably since the pandemic began. Challenges with cultural change, lack of

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collaboration across silos and restraints from legacy systems continue to hinder their progress.

- Existing IT supply chains are complex and not agile enough: 39% of executives say the complexity of their IT supply chain poses a challenge to implementing their IT priorities. Furthermore, only 19% rate the agility of their organizations' IT supply chain as very high. This is among the lowest rates compared to all other industries
- Manufacturers foresee greater reliance on fully managed services: 27% of executives say they plan to rely on fully managed IT application services in three years, compared to 13% now
- Manufacturers care about sustainability: 71% of executives view environmental sustainability as highly core to their organization's ability to continue creating value for customers in the future, compared to 51% across all industries. This focus resonates more strongly with European executives (73%) compared to their North American (58%) counterparts, and with natural resources executives (87%) compared to commercial and industrial sector executives (67%).
- Data and predictive analytics remain the top innovation investment: As in 2020, executives rank data and predictive analytics as their top area of innovation investment this year. Business executives rank data and predictive analytics higher than their IT counterparts do.
- Cybersecurity is a top focus, while employee training and awareness are key to success: IT/OT security is a top IT spending trend for 90% of manufacturing executives this year. In addition, 79% believe employee training and awareness are core cybersecurity elements, followed by programs to test organizational response capabilities.
- The use of AI and automation intensifies: 74% of executives say the use of advanced artificial intelligence technologies is the top spend trend impacting IT budgets this year. In terms of progress, robotic process automation implementations, in particular, rose to 36% from 29% in 2020.
- More application modernization and cloud migration are in the cards: 62% of executives say they plan to modernize at least 21% of their organization's applications portfolio in the next 2 years, while 59% plan to migrate at least 21% of their applications to the cloud.
- Digital manufacturing and integration across internal and external networks are top digitization initiatives: With digitization a priority, top initiatives include digitally executed manufacturing (e.g. smart manufacturing) and integration across internal and external networks to enable digital continuity end-to-end.[9]

Lithuania

Main strategic and operational challenges of companies and startups

Best practices on how to tackle challenges that came with the pandemic

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The Netherlands

Main strategic and operational challenges of companies and startups

The COVID-19 pandemic has caused various disruptions globally and has challenged business continuity in multiple sectors and industries. In the supply chain, for instance, the disruption of transportations and labor shortages have created logistical issues of unprecedented magnitude; on the demand side, lockdown measures and uncertainty lowered consumer confidence and affected various industries.

In this context, SMEs -in particular- have experienced *immediate effects* on their *upstream* and downstream activities, because of such issues as reduced capacity utilization, incapacity to produce, decreased demand, subsequent financial concerns/ liquidity issues, etc. (Juergensen et al., 2020, p.502). Furthermore, government restrictions have imposed additional operational adjustments, often calling for further financial investment to ensure social distancing. In sum, the pandemic has highlighted the importance of *investing in* digital technologies to increase efficiency and productivity, by means of providing new/additional opportunities and accelerating resilience in times of crisis (ibid., p.504).

The strategic and operational challenges that come with preparing a more digitized and innovative landscape are linked to the occasional difficulties in implementing digital changes and in training staff accordingly. They can also be linked to the emerging new trends and the difficulty that certain businesses may face in adopting said trends to stay competitive (ibid., p.504).

Examples:

- Manufacturing SMEs are now required to operate in environmentally responsible ways and promote sustainability.
- Global Value Chains (GVCs) are changing and need to become resilient via supply chain diversification, reshoring, stock management, and embracing proximity.

With the scope to ensure efficiency, profitability, and survival, businesses have turned to digital technologies to improve their strategic and operational models. The greatest challenges during this process were linked, during the pandemic, with *identifying and managing risks*, as well as with quickly responding to disruptions in ways that would ensure business continuity through appropriate mechanisms and support systems -both technical and social (Papadopoulos et al., 2020, p.2). This required strategic adjustments and organizational changes that would be efficient for interoperability and that would help people and societies dealing with challenges thrive (ibid., p.3). In this context, Industries 4.0. and 5.0 were eased into prevalence as the strongest facilitators of change, business revitalisation, and business continuity.

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Best practices on how to tackle challenges that came with the pandemic

Cooperation between Technologies Added and Rockwell Automation https://www.technologiesadded.com/ , https://www.rockwellautomation.com/

Technologies Added is the world's first shared smart factory in Emmen. It was created as a new concept for the manufacturing industry with the support of NOM (Northern Netherlands Development and Investment Company), and a development grant from the Province of Drenthe, the municipality of Emmen and the Dutch Ministry of Economic Affairs and Climate Policy.

Technologies Added cooperates with renowned Solution Providers to ensure high-tech manufacturing, efficient distribution and logistics for their site via a specific Smart Factory Logistics concept, applied integrated IT, and *smart capabilities* in general (e.g. 'flexible assembly' capabilities, etc.). This happens in shared facilities where combined companies create a base for advanced Industry 4.0 solutions. This keeps production near the market and reduces its ecological footprint.

The COVID-19 pandemic heightened discussions around global sourcing and highlighted the need for rapid innovation. As a result, a shared smart factory has helped many businesses and start-ups survive by making use of available technologies and know-how at minimum risk. One of the Solution Providers that eased innovation for many companies during disrupted supply chains and other crises was Rockwell Automation (RA).

RA helps companies scale up production and adapt their manufacturing practices in rapidly evolving environments by providing them with the digital capabilities of a large facility that would otherwise be out of their reach. RA basically comes up with the digital tools that can improve manufacturing processes and systems and, hence, scale up production volumes via a great variety of solutions. Even during global disruptions, RA provides a technology platform that is adaptable and constantly evolving, thus helping companies digitally transform, accelerate their impact on the world, and achieve their sustainable goals through smart solutions.

SMITZH

https://www.smitzh.nl/

SMITZH is a smart industry hub of the greater Rotterdam-The Hague area. Its aim is to help manufacturing companies and technology suppliers increase their production rates in cheaper and more sustainable ways. SMITZH puts its clients in touch with relevant field labs and consults per various tools, training courses, and subsidies that can facilitate the transition toward smart manufacturing.

During the pandemic challenges and the global sourcing disruptions, SMITZH succeeded in matching supply with demand locally, by promoting the practical application of smart




technologies that speed up cost effective and efficient production (from robotics to 3D printing and sensors, etc.). SMITZH services include helping companies with:

- implementing smart technology,
- developing and/or testing manufacturing technology,
- and achieving international cooperation.

Furthermore, SMITZH helps with upskilling. This is feasible via:

- Lifelong learning consultation for businesses interested to include their staff in their digital transformation through specific education or training courses, plus consulting for funding options.
- 2. A user-friendly learning environment, *oZone*, which is a platform for following or developing teaching/training materials.
- 3. Participation in skills labs where modular and flexible training programmes are available.

Ukraine

Main strategic and operational challenges of companies and startups

During the period from the 20th April to the 8th May 2020, the Resource Efficient and Cleaner Production Centre (RECPC) carried out a special survey in the industrial sector aiming to search for answers to how COVID-19 had affected manufacturing enterprises in Ukraine and what needs and challenges it had triggered (Vorfolomeiev, 2020). Total 58% of companies reported significant changes in operation caused by COVID-19. They declared that the industrial sector had been strongly affected by (i) the need to close or stop industrial facilities due to governmental regulations, (ii) the reduced economic activity, the decreased demand for raw materials produced and exported by Ukraine, and (ii) disruptions in logistics and transportation. It led to lower prices of Ukrainian products on world commodity markets and reduced investment due to significant uncertainty (Lebedeva et al., 2021). The findings showed that the coronavirus crisis hit the industrial sectors mainly in April 2020, leading to a 16.1% decline in industrial production in Ukraine and an 18.6% decline in the EU. Such industries as automobile manufacturing, light industry, furniture manufacturing, coal mining, oil and gas extraction were hit the hardest. The decline in production, the closure of markets and borders, the cancellation of orders led also to serious logistical problems in the agricultural sector, one of the two main sources of foreign exchange earnings in the country (up to 40%) due to agricultural export. Insurance industry also experienced an acceleration of the digital transformation.





By June 2020 29% of Ukrainian companies have stopped functioning and 6% have fully closed down their businesses. More than 277,000 private entrepreneurs/ small businesses have closed down due to the quarantine.

The new normal required business leaders to react extremely quickly and think critically due to fast changes in the business environment. They found themselves in the situation when the existing business models didn't work, thus they had to be essentially changed and new working formats had to be established (Gryvnyak, 2020). Many of the businesses in Ukraine reported the need to modify their operational and strategic decision making, in particular, to introduce new digital technologies and tools.

Experience of Ukrainian companies confirms the overall conclusion that digitally native organizations that were "insight-driven by default" showed much higher resilience, allowing them to manage the crisis more smoothly, and were able to tighten their dominant market positions, even growing share value while stock markets tumble (Bakker et al., 2021). E.g., Vodafone Ukraine, working in telecom industry, that had initiated digital transformation of their business before COVID outbreak, adapted their business processes to the new realities more quickly than other companies, since it was easier for them to switch to out-of-office work (Ustinova, 2020). Even such conservative industries, as the insurance industry, provides similar cases: insurers that were well advanced with digital transformation responded to the pandemic with greater speed and agility than their more cautious competitors. Thus, even during the "quarantine" first half of 2020, the life insurance sector grew by 10% and the market leader MetLife was largely a growth driver: as in the previous pre-crisis year, its premiums grew by 24% (Shevchuk, 2020).

COVID-19 also opened new opportunities for some important industrial sectors (e.g., the agricultural sector): accelerating and expanding the process of digitalization, and giving new opportunities for the expansion of the market. Until 2020, agriculture focused on digitalization of production processes by use of robotics, drones and satellites, artificial intelligence, the Internet of Things. However, during the pandemic, the digitalization of the sales process became an urgent issue, since traditional access to the consumers was problematic due to the closed markets. Management was actively digitalized during the pandemic. (Kaminskyi, 2021).

Best practices on how to tackle challenges that came with the pandemic

The pandemic had a huge immediate impact on everyday approaches to everything – from school education, household chore division or the social life to the way people dealt with banks, paid bills or interacted with the health system. It made people think faster and seek new solutions, oftentimes of a digital nature.

Highlighting cyber-consciousness and social responsibility

Health and lives of employees are the priority for all businesses and organizations. Combating the pandemic extends beyond medical and clinical approaches: corporate social responsibility or, in other words, shared responsibility of companies for societal well-being, is believed to be an effective tool available for many stakeholders, including enterprises (García-Sánchez et al., 2020).

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Understanding the importance of the (i) monitoring of the coronavirus spread; (ii) research and development of diagnostics, treatments and vaccines, (iii) wide outreach of the important and truthful information about the virus and willing to give back to society, Ukrainian IT companies actively contributed to the development of modern digital tools automating these processes.

SoftServe (<u>https://www.softserveinc.com</u>), a technology company specializing in consultancy services and software development, for instance, developed e-tools:

- The STOP COVID-19 online platform and chatbots providing the latest information about the pandemic in Ukraine;
- FightCovid19, to help systematizing the actual demands of hospitals linking them to relevant donors and investors.

Cyber-consciousness has become another important component of the corporate culture in COVID times. Businesses needed to adapt to the new practices to increase profits, so they increased their usage of e-signatures, online tools for business operations, online consulting and ordering and digital payment systems. Therefore, they also needed to increase the working capabilities of employees by digital retraining and upskilling, supporting them in exploration of new digital tools and social media:

- SoftServe took part in the development and sharing of technological expertise at various levels: regional and national. They offered educational services for local institutions, state authorities and public bodies.
- The pandemic was the main reason for Ferrexpo Poltava Mining (<u>https://www.ferrexpo.com/</u>), the world's third largest exporter of iron ore pellets, to launch a virtual reality simulator "Ferrexpo Digital Training", a unique cross-platform complex solution based on VR / AR technologies. The need to train their employee dismantling various piece of equipment was as high as always, but COVID-times required new non-traditional innovative solutions.

Moving businesses online

Industries fast-tracked their adoption of Industry 4.0./5.0 technologies. Many of them, such as, the automotive industry, started moving online more rapidly (Analytical Center Industry4Ukraine, 2020):

- ŠKODA dealers in Ukraine were starting to implement a new dealership concept in the context of Industry 4.0, simplifying the process of buying a car and making it user-friendly^[1].
- Entrepreneurs in the food industry either started to change business models and work with deliveries or started new projects in the production. Both versions relied on modern digital tools and online services. Online food delivery services became a booming sector (Antoniuk, 2020).

Engaging informed decision-making with help of AI and Industry 4.0-ready systems

Managerial decision-making processes also transformed radically. Industry 4.0-ready systems were taken aboard of enterprise resource planning (ERP) to manage all aspects of a production-based or distribution business, aligning financial management, human





resources, supply chain management, and manufacturing or distribution with the core function of accounting:

The pandemic forced big Ukrainian grain trader MGrain (<u>https://www.m-grain.com/</u>) to deploy SAP S/4HANA Cloud system for enterprise resource planning (ERP) to effectively manage their day-to-day business activities such as accounting, procurement, project management, risk management and compliance, and supply chain operations[2].

- The New Products Group of Companies (https://newproducts.com/), the leader in the Ukrainian snack and beverage market, joined the trend of digital transformation in 2020 and reported a new level of cooperation with distributors and customers with the use of Secondary Sales control system by SAP Business One which ensures accurate forecasts and helps them serve more than 25,000 customers and 106,000 active outlets worldwide[3].
- The leader of the pharmaceutical market of Ukraine with a share of 6% and the largest exporter of medical products Farmak (https://farmak.ua) was the first among Ukrainian pharmaceutical companies to implement the SAP SuccessFactors system to automate the most important and time-consuming HRprocesses in the field of personnel management[4].
- To fight against COVID-challenges KERNEL (<u>https://www.kernel.ua/</u>) created a virtual version of its decision making and operational infrastructure. KERNEL is the world's leading and Ukraine's largest producer and exporter of sunflower oil, a major supplier of agricultural products from the Black Sea region to international markets. It is a vertically integrated company with more than 30 legal entities located throughout Ukraine and about 12.7 thousand of staff. Non-standard digital tools were developed and introduced to provide the employees, a.o., managers, with information for business decisions in any geographical location, and would allow to implement HR processes, get all the necessary services and access to reporting, and at the same time would allow them to sign and agree on all documents related to business activities: contracts, orders, primary financial documents from a smartphone to address the challenges of the pandemic.
- Myronivsky Hliboproduct (https://mhp.com.ua), Ukraine's largest agricultural produce company with over 50% of the country's "industrially produced poultry", started digital transformation in 2020, integrating and synchronizing all internal processes related to enterprise resource planning, customer experience, purchasing, HR, and others.
- Some enterprises declare that initiated due to COVID-19 digital transformation has increased their investment attractiveness, improved the transparency and reliability of the company's reporting, accelerated the collection of information, and minimized errors due to the human factor. One of them is Naftogaz Group (www.naftogaz.com), the largest state-owned company in Ukraine implementing a full cycle of field exploration and development, production and exploration drilling, storage of oil and gas, processing and distribution of oil products, natural gas and liquefied gas to consumers. To become more flexible and efficient in times of global crisis Naftogaz started running the intelligent systems for procurement of materials and services, payments to contractors, shipment of products, accounting transactions, handling of tax invoices and declarations, monitoring the implementation of budget limits^[5]. For employees, the focus has shifted from





routine data collection and aggregation tasks to analytical tasks. Automated processes and technologies allowed to move the enterprise towards a virtual organization.

 Businesses started actively using AI-based digital platforms, for example, Vanongo platform (https://vanongo.com) that connects business and individuals with a network of drivers for smart deliveries.

Increasing supply chain resilience

Emerging technologies, including the Internet of Things, big data, cloud computing, additive manufacturing, and blockchain started being used more actively to streamline supply chain resilience in Ukraine, increase their robustness during an emergency or an unexpected and dynamic catastrophe, provoked by the pandemics.

Farmak company was forced to implement a fast introduction of Industry 4.0 solutions for supply chain management - an Integrated Business Planning (IBP) system, a cloud-based planning software that uses real-time information to help companies respond more quickly to market and business volatility, as well as to manage the supply chain disruptions caused by the COVID-19 pandemic.

Moving towards smart production

The unique advantages of smart manufacturing and smart agriculture production in automating the factory floor and incorporating new services into all kinds of products is a great advantage in the times of extreme vulnerability of human employees.

- Kernel deployed a single innovative ecosystem of modern agricultural production DigitalAgriBusiness. By February 24th, 2022, 100% of the fields were covered with quality RTK signals, the basis for precision farming. 100% of the company's fields were monitored using satellite images, copters, as well as IT tools that agronomists work with directly in the fields. The data of this monitoring was automatically stored in the database and became the basis for efficient and timely decision making and visualization using an analytical GIS portal, containing all the information about the processes taking place in the fields.
- Myronivsky Hliboproduct launched Virtual Zootechnician project for building smart production based on automated processes[6]. They constructed a management system for all processes of poultry farming, including the collection of data on equipment and the automatic selection of optimal microclimate modes with the use of drones for autonomous monitoring of the production processes.
- MAS Seeds Ukraine, a Ukrainian subsidiary of the French seed company MAS Seeds, which is the part of the agricultural cooperative group MAISADOUR, started using data science for selecting better quality seeds.

Emergence and development of new markets

Spurred significantly by the coronavirus Ukraine started massive transformation and development in the spheres of e-governance and e-health, where the use of digital health apps and software is becoming a daily practice, e.g. governmental related app DII VDOMA for monitoring person's self-isolation status.

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Some new digital markets, such as Telemedicine, have grown and developed significantly due to the pandemic and the emergence of new medical 4.0 technology. COVID-19 has overwhelmed the capacity of health care systems, limiting access to traditional services. Telemedicine has emerged as a tool to provide care continuity to patients while limiting the risk of contagion (Hojouj, 2021).

Developing digital infrastructures for Industry 4.0

Mobile companies accelerated the development of the 4G infrastructure, connecting new settlements to the network.

III. Implementing AI solutions at national companies

Cyprus

Interest and openness towards AI at national companies and startups

Around the world, industry is in the throes of a digital transformation that is accelerated by exponentially growing technologies (e.g. intelligent robots, autonomous drones, sensors, 3D printing). Enterprises at organizational and operational level, need to adapt to this rapid change, if they are not to be left behind by developments in their sector and by their competitors. Following this lead and the trend of digital transformation Cypriot companies have already positioned themselves in relation to this digital transformation and the opportunities offered to them by utilizing Industry 4.0 processes. The following trends could be observed among companies (mainly in the manufacturing sector) in Cyprus:

- Companies started focusing on innovative solutions that will transform their processes
- Although companies are already investing in new technologies, their focus for the future will be to advance the digital skills of their employees
- Companies want to further integrate digital capabilities into their production line
- In the near future, companies will be using their data analytics capabilities in order to predict their customers' behavior.
- Companies aspire to introduce digital features during the sale phase in the near future.

The government in 2019 also launched the "National AI strategy for promoting the integration and development of AI" to businesses in Cyprus. Its principles address the Inclusive growth, sustainable development and well-being, transparency and explainability, robustness, security and safety, investing in AI R&D, Providing an enabling policy environment for AI and building human capacity and preparing for labor market transition.

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It is worth mentioning that Deloitte's Innovation and Entrepreneurship Center conducted a nation-wide survey in September 2017 among medium and large size manufacturers in Cyprus, in order to assess the existing situation and readiness to adopt Industry 4.0 processes and methods and move towards more contemporary practices in the near future (3-5 years). The data was collected through a structured questionnaire sent by email to the twelve leading medium and large manufacturing companies in Cyprus. The survey shows that Cypriot manufacturing companies are advancing their digital capabilities and are looking for ways to digitize their processes. Survey participants seem to understand that digitization can bring enormous benefits for their businesses, and anticipate that they will continue to promote the search of new and innovative solutions in the near future.

Industry 4.0 capabilities: Only 3 out of 11 respondents appeared to have robust organizational structures that support Industry 4.0 processes. Despite that, they recognize the need to improve their capabilities and advance Industry 4.0 capabilities in the following years, showing thus the desire to enhance both human and physical capabilities in the near future. Information

Management Capabilities: the analysis of the data collected suggests that companies have invested in digital technologies (i.e. sensors, connectivity devices) that enable them to interrupt production at any given time, and reveal the desire to integrate such capabilities to deepen production line interaction with suppliers, customers and partners.

New Technology Implementation: Regarding data utilization, findings reveal that the majority of companies perceive that they have the ability to use data in order to generate value. At the same time, they anticipate that in the near future, they will further advance their data analytics capabilities by using data to analyze customer behavior, guiding thus decision- making.

Digital maturity: Currently, the majority of companies do not use digital products/services during the sales phase, but aspire to make significant changes in this field over the next few years. The results indicate that companies already acknowledge the importance of social media platforms in their interaction with customers, however, the need to further enhance this type of communication in the near future is even stronger.

Obstacles and challenges in implementing AI solutions

Firstly, Cyprus has low rates of technology adoption by business. Relative to the benchmark coun-tries (EU27), Cyprus for example has relatively few firms selling online. Few companies use enterprise re-source-planning software, electronic invoic-ing or big data analytics.

The World Economic Forum Executive Opin-ion Survey seems to confirm the assessment that Cyprus lags the benchmark countries. Also, firms in Cyprus do not cooperate with academia as much as they do in other countries bench- mark countries. This suggests that there are barriers to translating Cyprus' excellence in academic research into innovation in the business sector.





The dominance of service sectors (especially tourism) and the lack of large firms may contribute to the ob-served low technology adoption and innovation activity in Cyprus. When comparing the innovation performance of SMEs, Cyprus is much closer to, and even above, the EU average.

Furthermore, a supportive legal framework for innovation helps promote technology transfer and cooperation. Intellectual property rights protectionon which Cyprus continues to improve and legislation allowing universities to create spin-offs are, among others, all factors that influence technology adoption and innovation activities. At the same time, lagging technology adoption in the public sector may act as a drag on private-sector technology adoption and innovation is concerning, as a lack of adoption of digital technologies does not only affect productivity, but also reflects on the ability of firms to adapt and take advantage of opportunities presented by new trends and developments.

Best practices for using AI to upgrade companies to Industry 4.0./5.0

The Cypriot Government devotes particular attention to policy actions fostering research and innovation, including the creation of a Centre of Excellence for applied research in AI, and the formation of new financial support and funding schemes. The establishment of a special Task Force for Researchers is also considered to help the AI Expert Group in developing AI policies.

A vibrant start-up ecosystem in AI will be fostered through the development of an AI accelerator programme, to support the start-up and growth of AI business ventures. This programme will provide expertise in developing AI solutions, and will help firms accessing expert communities. Besides creating opportunities to team up with other firms and research institutions, and facilitating the access to flexible and effective financial funding, this programme will also provide dedicated support to testing and open data environments (including regulatory sandboxes). The growth of the AI start-up ecosystem will be encouraged through national funding programmes and state incentives, which will be complemented with European funding programmes (e.g. Horizon2020).

The Cypriot Government also commits to encourage the use of AI in the public administration by means of automatic decision chains to accelerate administrative processes. Introducing more AI-related applications in the public sector will increase transparency and foster citizens' trust in the state and institutions.

Success stories: Medochemie Ltd and Remedica Ltd

Quality and affordability are the hallmarks of Cypriot-made pharmaceuticals, which are sold in over 100 countries across the globe. The industry is led by Medochemie Ltd and Remedica Ltd, which invest heavily in research and innovation and spend significantly on continuously upskilling their workforces. A prime example of the sector's significant potential for growth and foreign investment was the €260 million acquisition of Remedica by South Africa's Ascendis Health Ltd in 2016. The South African corporation wanted a strategic platform within the EU for expansion and growth in the generic pharmaceutical industry in both European and emerging markets. The alliance has given Remedica the

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funding to embark on a new phase of development and the benefit of synergies with Ascendis. Medochemie, founded in 1976, develops, manufactures and distributes mostly generic pharmaceuticals and invests up to 7% of its turnover in research and innovation. The company has 13 state-of-the-art manufacturing sites, of which nine are in Cyprus, one in the Netherlands and three in Vietnam. Its Cyprus factory can produce and pack 1.5 billion tablets and 300 million capsules per year. The company has expanded from its Cyprus base into promising markets across the world – to the Middle East and Africa, Far East and the Americas – and now operates in 107 countries. Cyprus' ideal location enables these two award-winning companies to distribute their products to markets in the region and far beyond. Their products bear 'made in the EU' labels – a badge of quality that assures consumers that what they are buying has met rigorous testing standards.

Vassiliko Cement Work

Another major manufacturer and one of Cyprus' biggest exporters is Vassiliko Cement Works, which boasts Europe's largest single clinker production line and operates its own eponymous port. The company has an annual capacity of two million tons of cement, more than twice the island's domestic needs. Its international customers are mostly Cyprus' neighbours in the Eastern Mediterranean. Vassiliko has a variety of programmes to keep training and upgrading the skills of its 340-strong workforce, and a 'talent academy' that trains unemployed graduates for six months to a year, some of whom enter the workforce when vacancies arise. The company has embraced renewable energy sources as part of operations, which garnered it a 'Gold Environmental Protector Award' in 2019 and a special honorary best performance distinction, and the Global CemFuels 'Outstanding Alternative Fuels Project' award in 2020. The company also launched an 8 MWp photovoltaic park in 2020.Cyprus has a 4,500-year-old history of copper mining, and today's production methods are of the highest standard. Substantial investment in research, innovation and the latest mining technology has enabled Hellenic Copper Mines (HCM) to commercially exploit ores depleted by millennia of extraction. HCM set a European first in 1996 by introducing hydrometallurgy, a cost-effective and environmentally friendly way of exploiting low-grade ores, and it is a pioneer in bioleaching. The high price of gold has also made it worthwhile for HCM to begin processing ores bearing the precious metal that it amassed while mining copper and to extract new ones, along with silver-bearing ores. HCM employs just under 100 people, nearly a third of them university graduates, and some 50 contractors daily, providing welcome employment in the rural Solea district and contributing to the rehabilitation of remote areas. HCM exports 100% of its production to European destinations and its copper is classified among the top copper metal producers worldwide in terms of its purity (99.999% cu). Although currently the only operating mining company in Cyprus, some exploration companies are active because the island remains rich in low-grade mineral wealth. The mining of metals accounts for about 5% of Cyprus' industrial exports, a figure which would be far higher if industrial minerals and cement were included. Given the island's small domestic market, manufacturers have adopted an international outlook to achieve growth.

Elysée

A good example of this is Elysée, an award-winning Nicosia-based company that designs and develops irrigation and piping systems that are sold in 65 countries from Europe and

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the Middle East to South Africa, Japan, Australia and New Zealand. Equally ambitious is Limassol-based Muskita Aluminium Industries Ltd, which designs and manufactures aluminium products and systems that are used across the globe in sectors ranging from aviation to agriculture. With 350 highly trained staff, the over 60-year old company was a forerunner in the European aluminium industry and holds many design patents and pioneered the use of robotics in Cypriot industry, both in its warehousing and production, and prides itself on fostering green initiatives. In 2019, the electricity-intensive business set up 6,750 panels with 2.5 MW in total, constituting the biggest roof solar power system in the country, which will meet almost a third of the company's demand. Today, Muskita is one of the most technologically advanced firms in its industry worldwide and the largest, most progressive factory of its kind in Cyprus. The company's systems have been tested and certified to withstand the severe rain and snow of Northern Europe, the pounding cyclones of the Indian Ocean and the cutting-edge technology, engineering, quality and skilled workforce that have been paramount to the company's success.

Conclusions for future entrepreneurs

Currently, manufacturing processes are becoming increasingly digital, and along with the information technology, data and analytics, lead the way to another industrial revolution that urges businesses to move towards a new era, capitalizing on smart machines, factories, products and services, utilizing new interaction models and going beyond the automation of production.

This new era is known as the "Industry 4.0", commonly referred to as the Fourth Industrial Revolution. The Fourth Industrial Revolution, otherwise referred to as Industry 4.0, incorporates technologies from digital, physical and biological spheres. In general, Industry 4.0 relates to the concept of smart factories, where machines are connected through the web to a system, which is able to conceptualize the whole production line and engage into decision-making processes on its own. Based on the McKinsey Global Institute data, the current automation technology can automate more than 60% of all manufacturing activities. All the biggest ecosystems, like in the US, Japan or Germany started to follow the trend which challenges other countries, especially in the EU keep up with this pace.

"By embracing technological change, converting research investments into innovative business ideas, and continuing to pioneer the low-carbon and circular economy we will pave the way for a smart, innovative and sustainable industry in Europe." (Jyrki Katainen - Vice-President for Jobs, Growth, Investment and Competitiveness)

Greece

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Interest and openness towards AI at national companies and startups

Greek enterprises, although they are aware of the need for adopting new technologies and Al solutions, seem insecure about developing and using them. These insecurities are related to the unknown territory in combination with the investment risk, which is always higher due to unstable economic situations. Besides the factor of fear, there are not enough specialized and qualified professionals to support industrial projects and promote innovation.

The focus of Greek enterprises is placed on collaborations with Universities, Research Institutes, and start-up companies. Young scientists with innovative visions are giving enterprises the opportunity to participate in high quality research and obtain new technologies with minimal investment risks. Newly founded companies and their fields of activity are confirming the production of peak technologies waiting to be used.

Obstacles and challenges in implementing AI solutions

One of the main problems is that business management should be ready to utilize the data obtained through new technologies and have a plan to include them in strategic operational, commercial, and financial decisions. In addition, smart and automated machines could help one company remain flexible and innovative if people overcome their instincts and base their decision on machine suggestions instead of their own experience. An additional difficulty for the research projects is to transition from pilots to practical use. New technologies such as IoT in order to be effective need to be applied in whole industrial units, not just parts of them. Many companies test single and isolated solutions without scaling them up. The difficulty they are facing is mainly the higher cost of a larger facility which is hard to calculate (many parameters and estimations).

Another challenging part for companies is searching for the right partners and technological providers to collaborate with. Many factories and industrial units have a clear vision of the solutions they want to adopt in their production line, but they are facing a hard time to match their needs with an Industry 4.0/5.0 technology and more significantly with the right company that provides them. Thus, digital transformation is discouraged even more.

Another important part is cyber security and data privacy. The existence of common spots and hubs between the interested parties may be very helpful in some cases, but it is an attractive spot for cyber-attacks. Therefore, an integrated solution should be accompanied by cyber security solutions from the very beginning since the majority of the transferred data are sensitive and confidential. Usually, companies mistrust those processes and avoid using new technologies because of that.

To sum up, the four main obstacles that Greek companies are facing in adopting Industry 4.0/5.0 technologies, according to SEV research, are:

- 1. Absence of educational background and resistance to change
- 2. No/ or limited motivations from the governing body
- 3. Limitations to the infrastructure to embed new technology possibilities

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4. Lack of digital skills and technical knowledge

Best practices for using AI to upgrade companies to Industry 4.0./5.0

National companies are noticing the benefits of using AI technologies and try to cope with the Industry 4.0/5.0 demands as efficiently as they can. Some benefits that have been noticed in real examples of industries that upgrade their traditional practices are:

- Quality Management: with the use of sensors, cameras and other visual means quality control is monitored in real time. Control and guarantee costs are reduced due to the use of technologies like "Digital Twin" of the production flow.
- Product Design: digital designing and techniques like 3D printing combined with automated transformation of information and data reduces the time from design to massive production.
- Predictive maintenance: remote monitoring of the machines and notifications warning for coming up damages, increase the equipment's life, reduce maintenance cost and optimize the production line.
- Predictive/Automated stock replacement: with the use of predictive algorithms, AI technologies and big data analysis the raw materials availability is increased.
- Supply automation: introduction of robotic systems in production and also sorting, storage management and inventory generally increases the yield of production
- Optimization of production scheduling: use of data analytics in combination with predictive analytics for scheduling production lowers the changeover time and manages the storage of products.
- Improved monitoring of safety and environmental conditions: smart sensors Geo-fencing improve the protection of human employees from dangerous equipment and special devices (Wearables) detect the conditions inside the working space, ensuring safety.

When referring to Greek standards, introduction of digital technologies has provided the possibility to create an observational space for supply chain and opportunities for further strategy development and establishment of new services and products. Moreover, the extended use of digital invoicing (and the adoption of tools related to that) has increased the speed of transactions and the tax incomes due to the decrease in tax fraud.

Conclusions for future entrepreneurs

In conclusion, Greek companies have a long way ahead of them in order to be able to fully adapt and utilize peak technologies. Most of them realize the market's demands and the need for modernization, but either are unable to support that on their own, or they are not





willing to take the risk. The Greek entrepreneurial world has not matured yet for fully digital transformation.

Future entrepreneurs in Greece should keep in mind building infrastructure for Industry 4.0/5.0 technology and thus being ready for future challenges. Start-ups and small companies are the main users and providers of new technologies, trying to communicate and expand their services. The Covid- 19 pandemic presented a new path and forced some companies to adopt a more digitized approach. Hopefully, this is only the beginning for the Greek industry and more innovations are about to follow.

France

Interest and openness towards AI at national companies and startups

On March 29, 2018, the President of the Republic presented an ambitious strategy in favor of artificial intelligence, accompanied by an unprecedented public investment of 1.5 billion euros over five years. Indeed, AI technologies will transform the entire fabric in the near future world economy and their appropriation by economic players is a key factor for the competitiveness of our companies.

France can claim many strengths in this area. In 2017, according to the France IA report, it has positioned itself as the first destination in continental Europe for AI fundraising, with an amount of €385 million. In addition, six major French groups are among the top 14 investors in AI in Europe: Alstom, Publicis, Schneider Electric, Solvay, SNCF and Orange.

Around 80 AI ETIs and SMEs are located in France (40 centered on AI technologies and 40 making use of AI developments). There are also more than 500 start-ups specializing in AI, spread across the whole of the territory. In addition, according to the EY barometer on the French attractiveness of June 2019, France is the country attracting the most research centers in Europe.

As far as companies using AI are concerned, 75% of managers in industry believe that these technologies will increase productivity of their collaborators.

This singular position of France in terms of Artificial Intelligence is explained by the existence on its territory of a high-performance ecosystem:

- France can claim high quality training: nearly 35 specialized masters are offered in this field in France and more than 1000 theses have been defended on the subject in the last 4 years;
- Some of the world's leading experts in AI come from French academic research. For example, Yann Le Cun, French pioneer in artificial intelligence and deep learning and current Chief AI scientist at Facebook, was awarded the Turing Prize in March last





- France implements efficient mechanisms for transferring technologies between academic actors of Intelligence Artificial and companies: between 2011 and 2016, it was the first European country in number of patents filed on these technologies;
- France is an attractive territory for investors, thanks to many incentive schemes: Research Tax Credit, Tax Credit Employment Competitiveness, Talent Passport, Visa French Tech, etc.
- The State encourages the establishment of research laboratories in France in order to develop its ecosystem: nearly 88 laboratories, R&D research centers, and more than 13,000 researchers working on our territory on AI or related issues.
 France welcomes in particular the research centers of certain large international reference groups in AI: Google, Facebook, Microsoft, Uber, Fujitsu, IBM, Criteo, or Thales, mostly run by French.

In 2019 Bpifrance carried out a mapping of innovative companies in the field of artificial intelligence. To date, 550 French startups in the field of AI were counted, having raised a total of more than €2 billion. 60% of these startups are located in IIe-de-France, but other large conurbations such as Toulouse, Lyon, Grenoble or Nice have developed local ecosystems, from which start-ups emerge promising.

Four major segments have been identified as part of this work. The application segments, which use AI to solve problems functional and/or sectoral are the majority and represent 80% of the start-ups, while the more upstream segments, which offer products /useful and specific services / technologies for the creation of applications at based on AI, have some ambitious and disruptive projects.[10]



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Obstacles and challenges in implementing AI solutions

The Ministry of Economy and Finance has made it possible to establish a diagnosis of the potential of AI in the various economic sectors in France and to assess and identify points of support and points of vigilance regarding its adoption.

At the end of this work, several obstacles to the spread of AI in the French economic fabric and three priority areas of work have been identified:

- Companies offering AI solutions find it difficult to convince investors;
- Companies that could use AI to improve their productivity and their commercial offer still hesitate to integrate it. A ignorance of the AI offer, but also questions about the effective profitability of the investments to be made in this context are observed;
- The non-availability of data sets constitutes a major obstacle for the rise of AI applications.

Example:

Amiral Technologies is a CNRS spin-off. Its innovations are the result of 10 years of academic research in Automation, Control Theory and Artificial Intelligence. Its technology is revolutionizing the processing of IIoT data for critical, complex and high value-added industrial sectors. At the heart of its innovations are its automatic feature generation algorithms for industrial time series, whatever their nature. These innovations enable Amiral Technologies' DiagFit software to produce high-performance predictive models capable of learning with little or no historical failure data. DiagFit meets the needs of our industrial customers, both in their operating contexts and their specific equipment.

Question to Amiral Technologies

What is the main difficulty you have faced with integrating AI into your products?

Today, manufacturers are still reluctant to entrust their data to training artificial intelligence algorithms and implementing neural network type algorithms, whose decisions are not totally explainable. It is necessary to overcome this reluctance stemming from our engineering culture to allow companies to take full advantage of the AI.

Best practices for using AI to upgrade companies to Industry 4.0./5.0

The five trends that will continue to evolve design and manufacturing techniques, and the different ways the industry could respond to them.

Higher Demand for Bespoke Products

Mass customization may not be new, but demand for personalized products is rising. In saturated product categories, differentiation through features alone is getting harder to achieve. On top of that, 2020 made consumers acutely aware of the things they value





most. From fast-moving consumer goods to industrial machinery, customers want products that reflect their individual needs.

This year, manufacturers will have to find ways to satisfy an even more personalizationhungry market on a mass scale. They'll need to do this while remaining profitable—despite the artisanal overheads that come with bespoke production. Meanwhile, design and manufacturing teams will need to avoid falling victim to product development systems overloaded with customization requests, which can create bottlenecks that kill innovation. Fortunately, as demand takes shape, there will be an opportunity to look again at both pricing and fulfillment. After all, research shows consumers will pay 20% more on average for bespoke products—and wait longer to receive them.

The Rise of Smart Products

Consumers are rapidly evolving new behaviors, and their expectations are rising faster than manufacturing can follow. Of the 30,000 new products introduced to market each year, some 72% fail to hit profitability targets.

After the shocks of 2020, consumers want to live better lives, so everything they purchase has to add value. But what constitutes value? Manufacturers have to get closer to end users to know the answer.

In 2021, smart manufacturers will not only focus on concepts such as big data and IoT but also get better at interpreting the data they already have. They'll use it to develop smarter products that offer bundles of extended services and benefits, which in turn provide ongoing insight into how consumer preferences and behavior are evolving. Instead of products, manufacturers should think of whole ecosystems, attaching apps or software features, or new subscription models that deliver recurring revenue (and data).

Meanwhile, product designers will need to give customer experience their full attention. Rather than focusing on new forms, features, and benefits, they'll need a stream of up-todate information from customers and suppliers, analytics to understand what the data is telling them, and tools to apply what they learn to design.

The Use of Data To Inform Automation

Automation of repetitive tasks is already well established in high-cost countries, particularly in verticals like automotive that feature standard product or series production.

The challenge in 2022 will be to apply automation in markets defined by trends like mass customization, where many processes and schematics can't be preprogrammed. For example, automation can be used to address categories of customer preference rather than every individual whim, helping manufacturers create personalized products while remaining efficient. To do this, automation systems will need to be fed with data currently sitting in manufacturing's technology silos: living on individual machines or inside disconnected software solutions.

Applying new levels of automation beyond the factory floor will also uncover value and become a key driver of new efficiencies. In the design phase, for instance, greater adoption of generative design will help automate resolution of problems, letting engineers and designers focus on value-added tasks.

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If there's a caveat, it's to avoid seeing automation as a cost-saving cure-all. The human beings in manufacturing's value chain are another kind of data silo, and the information and experience living in their heads is invaluable. Manufacturers will need to balance machine and human work or fall victim to cautionary tales.

Increased Supply Chain Resilience

When the pandemic upset supplier relationships this year, there was a knee-jerk assumption that procurement would simply come back onshore. That's proven to be untrue. Even when local suppliers have the goods manufacturers need—and the capacity to take on new orders—restrictions like lockdowns can keep people away from work sites and stop materials from getting through.

Supply chains need to be flexible enough to scale as business levels ebb and flow: 2020 demonstrated just how brittle they've become after years of relentless cost optimization. It's also revealed how much manufacturers still rely on critical strategic providers that can't easily be replaced. In 2021, manufacturers will have to adopt measures to strengthen supply chain resilience. Reviewing supplier relationships to understand where critical capabilities might lie will help shield against the impact of disruption.

Firms can invest in greater digital connectivity with strategic suppliers to strengthen collaboration. They can also take steps to spread the risk of operational downtime by finding backup suppliers for the most vital materials, services, or components. Investing in digital skill sets that support greater information sharing will take on new importance. Manufacturers might consider offering training for key strategic suppliers to help them adapt to new communication and collaboration tools.

The Convergence of Manufacturing With Both Construction and Design

Are buildings just very large products? The construction industry seems to think so. It's borrowing heavily from manufacturing: adopting tools, processes, and ways of working that reduce costs and inefficiencies. That's led to greater cross-sector collaboration in areas such as data. It's also impacting how construction projects execute. Industrialized construction has led to more prefabrication of building components for on-site assembly later—a direct nod to manufacturing processes.

For manufacturers, greater convergence could lead to stronger supply chains. Construction is also bringing more agility to the sector, creating modular factories that can be restructured and reengineered quickly to create smaller batches of high-value products.

Designers are creating products that have structural aspects, and architects are building structures that function like products. Manufacturers should be looking to recruit skill sets that complement both industries.

Placing data at the center of the product-development process has also led to the convergence of design and manufacturing, where data in the cloud centralized within software tools creates a common data experience and better collaboration across departments, from the factory floor to the C-suite. This data-led convergence can exponentially accelerate product development by breaking down silos of communication

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between departments and by unlocking the potential for greater automation, which in turn increases productivity by reducing the delays of working manually.

Automation technologies such as generative design harness artificial intelligence (AI), cloud computing, and data to automate aspects of design and manufacturing while further blurring the lines between both disciplines. There is also enormous potential to reduce waste by cutting down on the material used, reducing part counts, and moving more of the testing and validation processes from physical to simulated environments.

These convergences point toward the future of work, when designers are freed from mundane manual tasks and have more time for innovation. Executives will have more bandwidth to focus on business growth. Manufacturing professionals will gain new skills working alongside robotics and automation, while staying connected 24/7 to the entire supply chain.

As more elements of construction are manufactured in controlled environments and specialized construction robotics aid in tough manual labor, workers will enjoy safer and less physically debilitating conditions. And for all employees involved, the through line of a common data experience will make remote work—with the added utility of augmented-, mixed-, and virtual-reality tools—more efficient, whether it's simply desired or required.

EXAMPLE 1:

Founded in 2009, ARCURE is a French company, specialist in artificial intelligence applied to image processing in the industrial world. In collaboration with the CEA, Arcure has notably developed Blaxtair®, an intelligent detection system for persons, intended to prevent collisions between machinery and pedestrians in the co-activity zone. It equips vehicles with construction and handling (forklifts particular), operating in factories, warehouses, recycling sites, public works sites, careers, etc. Sold nearly 5,000 copies in more than 30 countries, Blaxtair is used by global industry leaders and adopted by vehicle manufacturers.

Question to ARCURE

What is the impact of AI on your customers' business?

In its lifetime, one in two forklifts will collide with a pedestrian, with often-disastrous consequences, both human and economic. Using AI, Blaxtair enables industrial vehicles to detect pedestrians and to avoid any danger. In 6 weeks, thanks to Blaxtair, one of our customers was able to avoid up to 3 such accidents. Blaxtair therefore puts AI at the service of business, but also lives! [11]

EXAMPLE 2 :

ITK, Intelligence Technology Knowledge, was created in 2003 to develop Decision Support Tools (DST) for agriculture. Its mission is to enable farmers to optimize the yield and quality of their crops, and to reduce the risks on their farm, while preserving the environment through better management inputs (irrigation, fertilizers, phytosanitary products). itk deploys several decision support tools to agriculture and the environment:

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Vintel, for viticulture and arboriculture; CropWin, for field crops; Farmlife, for cattle breeding.

Questions to ITK:

What is the impact of AI in your industry? What transformations does the emergence of these technologies imply?

In agriculture, Artificial Intelligence enables breakthrough innovation in modeling plant growth and herd behavior. ITK uses it to develop new services integrating all the strategic data for the conduct of operations (climate, environment, technical and economic constraints), as close as possible to the expectations of farmers, without necessarily going through the filter of research. [11]

Conclusions for future entrepreneurs

Industry 4.0/5.0 offers a solution to rethink our industry in our new environment and help maintain a strong industry in industrialized countries. It responds to three key challenges: the best competitiveness of the asset, flexibility, agility in the face of hazards and variations in demand, and the regionalization of production. It also responds to the aspirations of man, more than ever at the center of the industry. Finally, it also allows a sort of renaissance of industrial craftsmanship by making viable small structures closer to residential centers.

Industry 4.0/5.0 also brings an economic logic of creating new value. Finally, the "assessment" of the transition to Industry 4.0/5.0 cannot be reduced to a drastic reduction in industrial jobs. On the other hand, it is urgent to better apprehend, understand and explain this transformation, in order to better anticipate a transition phase which has already largely begun, with its share of difficulties: unemployment, deindustrialization, dislocation of large groups, social tensions, unsuitability of skills ... In order to shorten this phase as much as possible, it is necessary to anticipate now the reconfiguration of the social, labor and investment model that is before us. A new world is to be built!

Lithuania

Interest and openness towards AI at national companies and startups

Obstacles and challenges in implementing AI solutions

Best practices for using AI to upgrade companies to Industry 4.0./5.0





Conclusions for future entrepreneurs

The Netherlands

Interest and openness towards AI at national companies and startups

The Netherlands ranks 8th on the Global AI index (AI NL, 2021). As a country, it is determined to "build and maintain a distinctive position in both the development and the application of AI" by following a proactive and collaborative approach that brings together government, industry, education and research institutions, and civil society organizations alike (NLAIC, 2022). This joint approach is strengthened by coalitions that accelerate AI implementation, as is the case with the Netherlands AI Coalition (NL AIC).

NL AIC is a public-private partnership that was created to implement and encourage AI activities in the Netherlands. Thanks to NL AIC, governmental authorities, the business sector, educational and research institutions, as well as civil society organisations, "collaborate to accelerate and connect AI developments and initiatives" (ibid.). In doing so, they facilitate the embedding of a systems technology like AI that demands an integrated approach and close involvement of authorities. This increases companies' and start-ups' motivation to implement AI solutions, as it provides them with the necessary support.

In this context, NL AIC has developed the AiNed programme that helps Dutch companies and public institutions integrate AI solutions for economic and social growth. With a large number of stakeholders contributing to this programme and a €276 million governmental fund the AiNed programme can speed up AI initiatives and projects, create new productive coalitions, and ultimately help the Netherlands play a key role in the development and the application of AI.

Moreover, by becoming members of the Dutch AI Startup Landscape, start-ups and scaleups increase their visibility on an international level, strengthen their relationships with their European counterparts, and gain better insight into the AI landscape and the support systems on both national and international levels (AI Startups Europe, 2022). This motivates stakeholders to implement or increase their usage of AI -if it is not already at their core activities, since it provides them with a solid safety net.

In general, the Netherlands has implemented 12 policy initiatives to promote an integrated national AI plan. In doing so, it enables both the private and the public sector to engage proactively in the digital transformation of the whole country. To increase AI knowledge and skills, the country has created a national network for technology and talent development, called Innovation Centre for Artificial Intelligence (ICAI). ICAI's goal is to nurture a national AI knowledge and talent ecosystem, where knowledge institutions, companies, governments and non-profit work together in making AI the epicenter of the Dutch development (ICAI, 2022).

As a result of the Dutch proactive approach and provided that they fit the criteria (size and scalability, access to and use of data, AI skills of personnel), many Dutch companies and start-ups are already open to AI solutions and, most likely, more will follow.





Obstacles and challenges in implementing AI solutions

Al has revolutionized the way businesses use technology to solve problems and increase productivity with software apps. The use of Al tech has multiple benefits, including improvements in customer service, improvements in scheduling and billing, and -overall-the achievement of time-saving and cost-effective processes (Rezende & Alessio, 2021). However, implementing Al solutions for the first time presents several challenges:

- Before reaching any relative decision, the concerned party must do thorough research. Not all Al solutions and software apps are suitable for all purposes. Aspiring users should take their *particular niche* or industry under consideration and research the appropriate software programmes, based on their needs and end goals.
- The second step is to evaluate internal capabilities, as these may not be enough for such a tech adoption. Businesses need skilled in-house employees and a solid budget for implementing AI solutions.
- The next step entails deciding whether to build (custom AI technology) or integrate a
 premade System. The first option is complicated and time-consuming, the second
 demands a productive and often prolonged cooperation with an AI company, in order
 to set up the System correctly, minimize risks (e.g. data breaches, system failures,
 mistakes, etc.), and properly train employees.
- Lastly, the System must be tested for a significant amount of time to monitor and track data and evaluate the level of achievement of goals. With that data, the concerned party may also need to make refinements and even perform changes in algorithm settings based on multiple variables.

To help businesses tackle said challenges, the Dutch start-up *Supplai* (https://www.supplai.nl) serves as a link between them and AI: with its high expertise in implementing AI across industries, *Supplai* implements AI algorithms at companies. Its aim is "to make their existing processes more efficient and effective," by revealing the possibilities of AI in their particular field (AI NL, 2022). In sum, *Supplai* fills in the gaps of knowledge or expertise in implementing AI, by using the latest technologies. Through outcomes, quality of work and productivity rates in a wide variety of industries that would otherwise be unable or hesitant to implement AI solutions.

Best practices for using AI to upgrade companies to Industry 4.0./5.0

Smart Robotics https://smart-robotics.io/

Via warehouse automation, Smart Robotics offers complete picking solutions for production and logistics processes, thus helping its clients embrace innovation, improve their quality of work, and scale their business. The company's solid background in robotics and mechatronics, as well as its strong ties with the Eindhoven University of technology have helped its owners advance their business goals. They detected the growing need for "flexible ways of automation for high-mix, low-volume production activities" and the lack of traditional industry to respond to such a need (RVO, 2021). This inspired them to become "an employment agency for robots," where companies can rent easy-to-use robotic solutions on a monthly basis (ibid.). These solutions have high rates of reusability of the

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system, a small ecological footprint and minimal impact on the existing infrastructure. The products are standardized thanks to the company developing their own software platform and hardware. As a result, their work is highly competitive and has resulted in increasing their profits.

d-centralize <u>https://d-centralize.nl/</u>

d-centralize specialises in developing platforms with a potentially great impact on society. Using the latest technology and AI, this start-up provides high end software solutions to businesses, with the scope to bring about new solutions to problems. With its project *ITSLanguage*, the company has created a scalable backend where spoken audio may be sent to the cloud for analysis or text recognition. This platform is delivered with reference implementations that allow modern HTML5 Web Audio speech recording capability. As a result, it allows quick integration for educational or healthcare partners.

d-centralize's *inContract* project is another platform for innovation, this time in the legal sector. It aims at enhancing self-service and reducing legal fees, with an optional use of extra functionalities. d-centralize combines competitive software development with entrepreneurial thinking and owes its success to its multidisciplinary team.

Datastreams https://www.datastreams.io

Datastreams ensures high-quality data and compliant data operations via its intelligent automation and collaboration platform. The company offers an intelligent automation and collaboration platform for businesses, where trustworthy data can be shared in secure and compliant ways (AI NL, 2021). In this way, Datastreams allows companies to extract maximum value from the data, while safeguarding digital regulations, data governance and/or privacy standards.

The Datastreams platform is built by data engineering and data management experts; it streamlines and simplifies data-driven business processes using intelligent automation, thus allowing companies to maximize data value within and between organizations. With constant evolutions in digital environments, the company is quick to re-adjust by releasing new components within their platform, so that the latter is easily integrated with all the capabilities of each distinct domain. To achieve this, Datastreams keeps data ownership and compliant data management at the core of its architecture, thus eliminating the need for third party applications.

Conclusions for future entrepreneurs

Transitioning to Industry 4.0/5.0 and implementing AI solutions is one of the most innovative ways for businesses to grow and increase their competitiveness in an everchanging market. In countries like the Netherlands where industry and technology organizations are encouraged to implement innovative solutions and are supported in doing so via appropriate policy implementation, funding, collaborative networks and field labs, the drive toward transition is stronger than the barriers. However, it is advised that





all obstacles and challenges are well thought of in advance, way before commencing any business endeavor.

Looking at some of the best Dutch practices, one can conclude that, apart from a solid infrastructure and additional funding where appropriate, the biggest challenge is to cultivate and promote innovative thinking. This usually entails the creation of strong multidisciplinary teams that will combine their knowledge and expertise into creating and sharing advanced and original solutions. Moreover, their approach must be dynamic and always alert to any changes in their sector.

According to research, the implementation strategy to be followed needs to contain "bottom-up and triple helix approaches for collaboration, agenda setting and implementation" (ATI, 2017, p.2). In this way, stakeholders can maximize the value of existing knowledge, accelerate and introduce ICT in companies, as well as "strengthen knowledge, skills and ICT conditions" (ibid., p.3). Accordingly, developing, experimenting, testing and implementing new solutions becomes feasible via collaborative networks with the infrastructure to create change.

Apart from following precise preparatory steps before implementing AI solutions for the first time (as mentioned earlier here), entrepreneurs must be willing to readjust and/or advance their business goals based on the constantly evolving needs of the market, as was the case with Smart Robotics. Smart Robotics has shown that, to be resilient in a fast-paced business environment, a company must have the skills and competences to create innovative solutions with an impact on society. In this context, stakeholders need to develop open-mindedness, an ever-increasing collaborative spirit, and the will to develop innovative solutions that can help people and companies achieve sustainable goals.

As Europe embraces the idea of a more sustainable, human-centric, and resilient industry via the implementation of policies towards that direction (Kaasinen et al., 2022), the increased digitization of the business environment will enhance both the human capacity and the Smart Industry's role in solving social problems (Skobelev & Borovik, 2017). With that in mind, Dutch companies and future entrepreneurs can now look at this transition as a sound investment.

Ukraine

Interest and openness towards AI at national companies and startups

As of beginning of 2022, IT market in Ukraine experienced a significant growth over the last 10 years, with the most active dynamics during the last 5 years. Ukraine had demonstrated the growth rate of the IT services market at 20-25% annually (Invest in Ukraine, 2022). IT sector accounted to almost 300,000 technicians in software development and maintenance services. It topped the list of service exporters (over \$ 5 billion per year) and generated more than 4% of Ukraine's GDP (IT Ukraine Association, 2022).

What is important, Ukrainian tech sectors experience qualitative transformations: increasing number of companies start to develop own products distancing from





outsourcing model prevailing in Ukraine for years. The share of the companies engaged in the development of AI solutions has significantly grown.

Artificial Intelligence is one of the fastest-growing areas of expertise. The overall expertise varies from ML to robotics and recommendation systems. Machine learning in Ukraine accounts for more than a quarter of projects that Ukrainian companies work with (see Fig.5). Another aspect of the artificial intelligence in Ukraine of IoT, with almost the same number of projects.



Fig. 5 – Industry and technology distribution in Ukraine (source: www.n-ix.com)

Ukraine has become the significant player in the AI market in Eastern Europe. In 2018, according to Clutch, the leading rating and reviews platform for IT, Marketing and Business service providers, Ukraine was among the top three countries in Eastern Europe by the number of companies in the field of Artificial Intelligence. And already in 2020 it hit the first place of the ranking. According to the 2020 Oxford Government AI Readiness Index (Shearer et al., 2021), Ukraine was the number one artificial intelligence provider in Eastern Europe with almost 150 recognized providers compared to Poland's 110^[1]. They mark an important increase in the AI expertise in Ukraine: in just 3 years, the number of AI-related companies has gone up 4 times.

In their analysis of an AI ecosystem in Ukraine[2], Deep Knowledge Analytics, a leading Deep Tech analytical agency, observe 450 attractive to domestic and foreign investors AI-related companies operating in Ukraine as of beginning of 2022 (Deep Knowledge Analytics, 2022). They declare that the Software Development industry takes the biggest share of 33.8% of AI companies operational market (see Fig. 6), with respect to the business operations conducted by them.





Fig. 6 - Distribution of industries on the Market of 450 AI Companies

Companies already implementing AI technologies are primarily the ones that are engaged in software development of various kinds, a.o., for internal usage and selling their software as a service. Among 450 companies in the list there are 81% of those. And about onethird of companies work in such industries as social media and communication, marketing and advertising, and Big Data (Fig. 7). 70% of Ukrainian AI companies are located in Ukraine, however, 16% operate in United States and more than 3% of the companies are oriented to the UK market.

Billion-dollar Ukrainian startups including Grammarly (https://www.grammarly.com/) and GitLab (https://github.com/) have managed to establish a global presence while maintaining Al offices in Ukraine.

Due to the potential of the Artificial intelligence (AI) industry, investments in Ukrainian companies applying AI increased significantly over the last 10 years from \$42.4 million in 2014 to \$440.9 million in 2021 (see Fig.8) (Deep Knowledge Analytics, 2022). Global tech giants such as Samsung, Google, and Rakuten have established AI R&D centers in the country. The decline in investment happened in 2020 due to COVID-19, and in 2022 (\$1.1 million in Q1 2022) due to the war of russia against Ukraine. Due to the war, 41% of Ukrainian startups reported the lack of money but 72% will try to continue operating^[3].

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Fig.7 - Industry vectors among 450 companies



Fig.8 - Investments in Ukrainian companies applying AI

Many experts believe the vibrancy and dynamism of Ukraine's AI industry are at least partially due to the relative absence of government interference in the sector and the established free market (Goncharuk, 2021). Before 2020 AI industry had no significant state support. That can be confirmed by the Government AI Readiness Index rating which assesses the readiness of governments to implement artificial intelligence. The overall score is comprised of 11 input metrics, grouped under four high-level clusters: governance; infrastructure and data; skills and education; and government and public services.

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In 2019, Ukraine ranked 63rd among 194 countries[4] and 57th among 172 countries with an index of 49.901 in 2020[5]. The Ukraine's scores are seen on the Figure 9.



Fig.9 - Ukraine's scores in the Government AI Readiness Index 2020 rating

Increased investments in AI industry can also be seen through the scientific publishing lens (Halevi, 2022).

The number of research in AI is increasing (see Fig.10). According to Clariative, 251 AIrelated papers led by Ukrainian researchers and published between 2017 and 2021 can be found in the Web of Science, the world's most trusted publisher-independent global citation database.



Fig.10 – Ukraine's publications output growth in computer science and artificial intelligence since 2017 (source: https://clarivate.com/)

Aiming at contributing to the growth of AI & ML sector in Ukraine, several Governmental initiatives were launched.

The Expert Committee on the Development of the Artificial Intelligence (http://www.ai.org.ua/) under the Ministry of Digital Transformation of Ukraine was established at the end of 2019. The main task of the committee is to increase Ukraine's competitiveness in the field of Artificial Intelligence.

At the end of 2020, the Cabinet of Ministers of Ukraine adopted the National Strategy for Development of Artificial Intelligence[6] developed by AI experts and industry professionals. Before its adoption, the Ukrainian AI strategy was reviewed by 30 internal experts, 200 external experts and more than 30 government bodies. The process of approval took several months and was reviewed by 24 ministries (3 people from each ministry), which means that more than 400 people were involved.

According to the Strategy, AI became one of the priorities in the field of science and technology research. "Artificial intelligence is becoming one of the key transformational technologies of the economy, defense, public administration. Ukraine's success largely depends on its ability to use and increase its existing potential in the field of artificial intelligence." said Mykhailo Fedorov, deputy prime minister and minister of digital transformation of Ukraine in August 2021[7].

The experts decided that the key to the success of quick development of Ukrainian AI is people. Therefore, human capital development is prioritized in the Strategy[8] and the focus is on several areas of AI, where the country can achieve a leading global position. The Strategy seeks to reform the educational system in order to provide the next generation of Ukrainian tech companies with the AI talent and qualified human capital necessary to drive the country forward. It also aimed to accelerate the introduction of AI

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technologies throughout the Ukrainian economy to safeguard the global competitiveness of sectors ranging from heavy industry to agriculture (Deep Knowledge Analytics, 2022).

Most AI experts in Ukraine believe the two sectors that offer the greatest potential for progress are education and defense. The coronavirus crisis has created huge disruption within education systems around the world. A generation of schoolchildren has found itself forced to spend much of the past year engaged in distance learning. This has opened up unprecedented opportunities for technological solutions utilizing AI. These new habits are likely to outlast the impact of the pandemic. Meanwhile, the Russian invasion of Ukraine drives demand for AI innovations that will boost Ukraine's defense capabilities while saving lives. Ukraine's agriculture sector is another area of the economy with obvious AI potential. The vast and rapidly modernizing Ukrainian agricultural industry is the ideal breeding ground for AI developments, with numerous success stories already demonstrating the ability of local ag-tech startups to expand on the international stage (Goncharuk, 2021).

Ukraine has a vibrant community of AI professionals and enthusiasts. The country hosts many Big Data/AI/ Machine Learning events including international conferences such as AI Ukraine Conference, AI & Big Data Day, JEEConf, etc. Local communities also organize regular meetups and workshops for big data and analytics experts, such as Bottleneck Night AI/ML, DS Success Meetup, just to name a few.

Many AI-powered multi-million startups were born in Ukraine or created in collaboration with Ukrainian software engineers. Among them:

- People.ai (https://people.ai/) is an AI platform for enterprise sales, marketing, and customer success that uncovers every revenue opportunity from every customer. In 2021, it became a "unicorn" by reaching a market value of 1.1 billion dollars.
- Cargofy (https://cargofy.com/) is an AI-enabled solution for cargo delivery optimizations. It works according to an Uber-like business model and connects truck drivers with customers that need cargo delivery.
- Grammarly (https://www.grammarly.com/) is the US-Ukrainian startup that has Natural Language Processing technology at its core. It is a cloud-based typing assistant that reviews spelling, grammar, punctuation, clarity, engagement, and delivery mistakes, raised a total of \$200 million in funding over the Private Equity in November 2021.
- Neuromation (https://neuromation.io/) is a leading Enterprise AI solutions and platform provider. The company's Neuro platform is a best-in-class machine learning development tool enabling rapid model iteration with an unparalleled developer experience.
- 3DLOOK (https://3dlook.me/) is a mobile body scanning solution that aims to change the way people shop.
- Reface (https://hey.reface.ai/) is an AI powered app where people can swap faces in the videos, GIFs and images in just a few seconds.
- Petcube (https://petcube.com/), a highly crowdfunded Ukrainian startup, leverages machine learning models for its pet detection technology.
- DataRobot (https://www.datarobot.com/) is a machine learning platform that helps enterprises build predictive models at speed. The company has an R&D office in

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Kyiv, with up to 200 employees working there, according to DOU.UA, an authoritative local IT industry resource.

However, a study[9] of the Ukrainian labor market in the field of Data Science and AI that was made by the Ukrainian Catholic University shows that despite the huge hype and a significant number of AI-related activities, AI and Data Science are still not very popular on the big Ukrainian labor market. They analyze the market by tracking the number of the vacancies on big Ukrainian recruitment platforms. Results of the study made in 2020 are shown on the Figure 11.

Although the national Al labor market seems currently underdeveloped, the changes are expected in the nearest future due to the world tendencies and the emergent shortage of data specialists at the global labor market.



Created with Datawrapper

Fig.11 – The number of the vacancies tracked on the Ukrainian recruitment platforms in \$2020\$

Obstacles and challenges in implementing AI solutions

Ukraine has a chance to move forward in the context of the Fourth Industrial Revolution. But this requires drastic changes in the country's economy. The factors that hinder the process of digitization of the Ukrainian economy are (Bogoyavlenska et al., 2021):

- Underdeveloped innovative ecosystem
- A high level of bureaucratization.
- Lack of clear understanding by performers on places of ways of realization of the concept of Industry 4.0.
- Insufficient funding, which does not allow to implement innovative smart projects.

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- The global pandemic caused by COVID-19.
- Lack of state incentives for entrepreneurs to change business processes. During 30 years of its new history, Ukraine never had a consolidated and modern agenda for industrial high-tech sectors (Yurchak, 2022).
- The outflow of intellectual elite abroad (in particular, IT specialists).
- Weak interaction between the state, entrepreneurs, community.
- Low innovation activity of small and medium enterprises;
- Obsolete equipment at enterprises and lack of free funds for reequipment;
- The complexity of decision-making on implementation changes.

As for AI startups infrastructure, Ukraine is facing local and global challenges:

Unprepared legislation and the lack of government incentive. As for 2019 Ukraine lacked the legal structure to accommodate venture capital funds, according to Oleksandr Borniakov, a deputy minister for digital transformation in 2019. Today, Ukrainian legislation is still not at all adapted to work with startups, the venture capital market and their respective development (Deep Knowledge Analytics, 2022).

The lack of venture capital. This problem isn't unique for Ukraine. Globally, the world has seen a decrease in venture activity and a tendency to invest in companies that already have a finished product and, in some cases, revenue, according to DataRoot Labs COO Yulia Sychikova[1]. Tech startups "need to grow in fertile soil that is constantly watered with startup investment rounds," says Alexander Soroka, the CEO of Startup.Network, a professional network for participants on the venture market. "And ours (Ukrainian) is starting from a very arly stage, with angel investors. And finding them is very challenging, not to mention later rounds."

Undeveloped infrastructure and week communication between startups and potential investors (Deep Knowledge Analytics, 2022). The existing business incubators and various venture funds do not have enough qualified staff to assess the prospects of a project, the risks and feasibility of investing.

- The migration of new business outside the country. Young entrepreneurs consider the United States or European countries to be the best environment for their business development.
- Insufficient protection of private investments.
- Raider risks.
- A lack of intellectual property protections.

Among key problems for AI Market in Ukraine experts name (Deep Knowledge Analytics, 2022):

 The need for solid educational ground in the AI & ML field. Low quality education at public institutions. Only few Ukrainian universities have divisions focused on AI

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(NURE is among them). Therefore, people who want to get into the AI & ML field and have certain skills, get the basics of the discipline in other ways (private educational courses, online-courses, foreign educational programs). The shortage of AI experts is also partially provoked by the companies, attracting university professors into the commercial sector.

- The lack of managers with fundraising experience. The culture of IT-product entrepreneurship in Ukraine is quite young. Ukrainian entrepreneurs need to get experience in product development organization and skills in fundraising.
- The need for network-based industry events. Current events are mainly focused on PR and do not facilitate creation of new partnerships, exchange of the international experience and development of the AI ecosystem in Ukraine.
- The absence of defined specialization of Ukrainian AI market. Although Ukraine has a potential to become a global AI player, from the tactical point of view, it's essential to focus on a few market segments from a medium perspective. The practical application of artificial intelligence is at the intersection of different disciplines. Creating and applying a good AI solution requires domain knowledge, programming and math, as well as the data and business space in which these solutions will be piloted and developed. According to Oleksandr Krakovetskyi, co-founder and CEO of DevRain, to become a world leader in artificial intelligence, a country has to have good technology, have an ability for systematization, expertise at the state level, strong universities and the market. With few exceptions and great potential, Ukraine does not yet have all these or are at the initial stage of development. However, it can become a leader in one or more specific narrow areas for example, in the use of artificial intelligence in agriculture, certain areas of medicine or e-sports[2].
- Lack of market-focused analytical and investment platforms.
- The lack of data and the poor quality of available data. According to the Global Open Data Index, which provides the most comprehensive snapshot available of the state of open government data publication, Ukraine hits the 31th place among 94 countries[3]. There is also a problem with personal data – there are legal obstacles for using it.
- Cybersecurity risks. Many data breaches have already occurred in an effort to collect data for Al initiatives. However, starting from the 24th of February 2022 the major challenge for any developments in Ukraine is the russian full-scale war against Ukraine.

According to Ukrainian Startup Fund in March 2022:

- 24,3% of all Ukrainian startups continued working, 46,7% worked partially, 28% did not survive, 1% changed their field of activity.
- 99% of surveyed companies needed additional funding.
- 41.1% of surveyed companies didn't have enough savings to continue working.

37.4% of surveyed companies needed relocation of the team.

Best practices for using AI to upgrade companies to Industry 4.0./5.0

Use case of Bookimed





Bookimed (https://bookimed.com/) is an international medical tourism platform founded in 2014 by Yevhenii Kozlov and levgen Khotianov to provide solutions for treatment abroad. They provide people with the platform for hospital search and treatment arrangement. The company started to work with 5 employees to help cancer patients from Ukraine and neighboring countries find hope for cure abroad. Since then, the geographics of the patients have expanded greatly. By now Bookimed has helped more than 570 thousands of patients from all over the world. In 2017, the company raised \$500,000 in funding from AVentures Capital, a leading investment fund in Ukraine. In 2018 the team already counted 87 people.

Every patient request is processed by certified doctors - coordinators. They help with hospital choice, paperwork, and medical trip arrangements. When the amounts of the processed information on the platform, including the information about doctor coordinators, patients and hospitals providing various treatment options have essentially increased, a company faced a bottleneck in the processes and a need to improve their operations.

A new Al-system was developed by another Ukrainian company DataRoot (https://datarootlabs.com/) for Bookimed to find the best possible match between patients and doctor coordinators. Doctors have different medical backgrounds and can work with specific kinds of people. The patients can also be different from person to person. DataRoot developed an analytical data-gathering system that obtains patients behavioral data from Bookimed website, such as, countries, content that attracted patie look at different pages, type in different queries and spend differing amounts of time on our pages. There are more than 300 different behavioral parameters for the users on the website fed to a neural network which will determine which doctor coordinator will match the specific needs of a customer. In order to find out what kinds of patients can work well with them, the neural network can analyze all background cases of doctor coordinators.

A neural network continues to learn from the patient-doctor interaction data. A tutor system is set up through which doctors can teach the network about the items that are not interesting or appropriate for them. The system is working autonomously. After the launch of the system the conversion rate has increased and it continues to grow, as well as the company's profits.

Use case of PrivatBank

PrivatBank (https://privatbank.ua/) is the largest bank in Ukraine. It serves more than 19 million customers. The bank analyzes a huge amount of data: from geographical coordinates and routes to customer preferences on social networks. The main sources of information collection include the following:

- POS-terminals, ATMs and self-service terminals. They allow you to track the priority routes on which the client goes most often.
- Accounts in social networks. If a user logs into a banking widget through social networks and agrees to give the bank access to the account (for example, to raise

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the credit limit), then there will be more data about him. You can find out with whom he communicates, what kind of content he likes. Based in this information, it's possible to use predictive analytics (predict customer behavior) and identify unscrupulous customers.

 "PrivatMarket", an e-commerce platform from Privatbank where individuals buy goods, and companies make purchases. The bank analyzes customer preferences in order to understand which products to offer.

This data is analyzed using special Al-software, then scoring is carried out. For example, a credit history of people from the environment of a borrower can become a predictor. Data about this could be taken from social networks. If the client's friends and acquaintances do not repay their debts, the bank believes that he will do the same. Moreover, even musical preferences are important. Privatbank has found that lovers of chanson worse repay debts than fans of jazz and light music.

It's difficult to assess the overall economic effect. However, there are some specific cases. For example, due to accurate analysis, it was possible to additionally attract UAH 1 billion of deposits (about \$ 40 million).

Visa in collaboration with PrivatBank has rolled out its Visa Token Service in Ukraine that offers a secure environment to speed up innovation in e-commerce and mobile payments. The platform analyzes the number of transactions, their volumes, time, place and other parameters that will allow banks and businesses to determine the segment of customers for which the provision of discounts or other offers will be most attractive. The service is available to Visa cardholders with NFC-enabled mobile devices that run on the Android operating system

Usecase of Lactalis Ukraine

The Lactalis Group is a French family company with almost 90 years of history. With 266 plants in 55 countries and more than 85,000 employees worldwide, the Group is one of the world biggest dairy products manufacturers that owns international brands Président, Galbani and Parmalat. Lactalis Ukraine (https://lactalis.com.ua/) is one of the important divisions of Lactalis Group in Eastern Europe. In 1996, the Group established a joint French-Ukrainian enterprise with Mykolayiv Municipal Dairy Plant. Today, Lactalis manufacturing sites in Ukraine produce almost 250 products under the brands Président, Dolce, Lactonia, Lactel, Fanny and LokoMoko. The company employs more than 750 employees in different regions of the country.

In 2020 Lactalis Ukraine realized the need to rebuild their merchandise and data processes to enable better control over the sales. The main goal was to get a deeper understanding of how Lactalis merchandise works and how the company can improve the work with the shelves in retail shops.

A new AI-based image recognition solution Picsell developed by Outforz (https://outforz.com/) was introduced to the merchandise processes.

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It allowed:

- automatic detection and verification of the correct location of the SKU on the shelf;
- detection of out of stock on the shelf;
- comparison of the location of the SKU with the planogram;
- estimate the number of facings on the shelf;
- estimate the length of the shelf;
- monitoring the prices of competitors' products;
- monitoring the performance of merchandisers, including task management systems and motivational programs.

The product is based on a self-learning neural network automating the verification processes for SKUs with an accuracy of 95-98%.

The company has been able to save 20% of their budget on merchandising at once. They've also been able to gather better data with the shelves visualization tool. As a result, the sales have increased by 10%.

Conclusions for future entrepreneurs

Industries are nowadays being shaped by two different paradigms: Industry 4.0 proclaims transition to digitalization and automation of processes while emerging Industry 5.0 emphasizes human centricity of industrial processes.

The technological progress has revolutionized modern industries and accelerated the transition towards unprecedented digitization, networking, automation and artificial intelligence. Development periods are getting shorter; individualization of the production on demand is no more news; product development is becoming much more flexible and efficient. Several years ago, it looked like digitalization could be a key to all industrial problems. But life appeared to be more complex.

The current world geopolitical crisis and related hybrid threats (hybrid wars), including the cybersecurity threats in form of massive cyberattacks; wars (such as, aggression of Russia against Ukraine); related refugee and other humanitarian crises have a huge impact on the global industry and economics and particularly on the Industry 4.0 and smart manufacturing. After the first excitement from the digitalization effects, it became obvious that the world requires a much higher level of process resilience, production sustainability, and decision-making quality than it has been foreseen according to the Industry 4.0 concept. This explains the growing popularity of the Industry 5.0 concept, which (unlike Industry 4.0) is supposed to bring humans back into the loop of the industrial processes to address the emergent resilience and sustainability concerns.

Implementation of AI should not diminish key aspects of humanity – morality, human relationships, cognitive acuity, freedom and privacy and the dignity of work. A virtues-based approach should be used to resolve ethical dilemmas, rather than utilitarian ethics.

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The biggest challenge that awaits future entrepreneurs is to find reasonable ways to marry the two extremes of automation and value-based human-driven processes, which inherits the most valuable features of both - efficiency of the Industry 4.0 processes and sustainability of the Industry 5.0 decisions.

Successful co-existence of Industry 4.0 and Industry 5.0 concepts would mean increase of productivity without removing human workers from the manufacturing processes. It is also impossible without further development of collective intelligence technologies enabling human and machine collaboration, a.o. for efficient value-based decision making.

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