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SPECIAL ISSUE

Sibiu Innovation Days 2021

Hybrid Conference

28.10. – 30.10.2022

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Sibiu Innovation Days 2021

28.10.2022 – 30.10.2022
Hybrid Conference

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Day 1, Thu, 28, Oct. 2021

9:00 - 10:00 **Opening Speech**

Prof. Dr. Eng. Adrian Florea, Director of KTC HPI-LBUS
Prof. Dr. Habil. Sorin RADU, Rector of LBUS
Prof. Dr. Eng. Ioan BONDREA, President of the Senate LBUS
Mrs. Ligia DECA, Presidential Adviser, Department of Education and Research, Presidential administration
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Mrs. Astrid FODOR, Mayor of Sibiu
Prof. Dr. Eng. Dr. Ec. Stelian BRAD, President of Cluj IT Cluster
Mr. Octavian OPREA, President of Authority for the Digitalization of Romania (ADR)

10:15 - 11:50 **Keynote speech**:

Towards European Digital Sovereignty
by Prof. Dr. Christoph Meinel, Director and CEO at Hasso Plattner Institute Potsdam Germany
Mobile Screening for Diverse Populations with Genetic Syndromes

by Prof. Dr. Marius George Linguraru from Children's National Hospital / George Washington University, Washington DC

12:00 - 13:45 **Workshop – 1**:
Challenge for a successful Tech Transfer; the specificity of the process in Romania
by Dr. Florin-Calin Paun, Innovation Architect

15:30 - 17:30 **PANEL 1: Artificial Intelligence**
Epure Ovidiu – moderator
Boarding for our next destination: the Metaverse
by Radu Orghidan, Vice President at Endava
Personalization of customer experience in modern systems
by Bojan Mrazovac, Head of Research and Development at NTT DATA Romania
AIOps and DevOps: Shaping the future of society through technology
by Sergiu-Valentin Dilimot, Squad Line Manager at Visma Software S.R.L
Infrastructure requirements for an AI-enabled architecture
by Radu Buciuceanu, Lead Architect at Nerds Computing and Mihai Radulescu Technical Storyteller at Nerds Computing
Optimization of operational processes using Artificial Intelligence
by Vlad Cazan, Co-fondator at KFactory
17:50-20:00 **PANEL 2: Smart health**
Prof. Dr. Ing. Remus Brad- moderator
Shaping the Future of Healthcare
by Isabela Buhai, Delivery Partner | Healthcare, Europe & UK at Endava
Collaborative Efforts Are Essential for Deep Learning to Help Children's Health and Rare Diseases
by Prof. Dr. Marius George Linguraru from Children's National Hospital / George Washington University, Washington DC
Your Personal Assistant": Design of an Integrated IoT System for a Personalized Coach for Healthy Aging
by Ciprian Candea, CEO at Ropardo
Digital transformation of health and care – Empowering citizens and building a healthier society
by Birgit Morlion, Programme Officer at European Comission DG CONNECT
The advantages of modern Medical Information Systems and patients' access to the Electronic Medical File
by Alexandru Bârsan, Executive Manager at GamaIT

17:00 - 19:00 **Workshop 2 - Demo session - AGVs & Cobots / Autonomous driving**
with Ovidiu Chicea, Team Leader, Side Functions 2 at Continental Romania

Day 2, Fri, 29, Oct. 2021

9:00 - 11:30 **PANEL 3: Startups, Entrepreneurship and Personal Development**
Etcu Mihai – moderator
Building tech startups in Romania
by Monica Obogeanu, Startup Programs Manager at Orange

From graduation to entrepreneurship. Develop your skills: initiative, creativity, motivation, drive and leadership *by Tudor Gorcia, CEO at TNT Computers*

SpectThe Importance of Agility and the Human Factor in the Entrepreneurial Process *by Dr. Florin-Calin Paun, Director of Innovation and R&D*

The difference between sand and cement in entrepreneurship! *by Catalin Mihacea, Managing Director at Agile Networks Technologies*

Entrepreneurship competences training for employees - funded by EU funds *by Etcu Mihai, Learning & Training Team Leader at Continental Romania*

11:50 - 14:00 **PANEL 4: Digitalization / Industry 4.0 Challenges**

Alin David – moderator

Digital Automotive Era: Innovative Technologies of the Future *by Alin David, System Engineer at Marquardt Schaltsysteme SCS*

Cybersecurity in Continental in 2021 *by Marian Marin, R&D Software Project Manager & Team Leader at Continental Romania*

Smart Device for Digital Signage System *by Marius Patroi, Co-Founder & General Manager at Spectroo.eu*

Smart Factory Romania – Gearing up for the digital transformation of manufacturing through collaboration *by Bogdan Pirvu, Associate professor at Lucian Blaga University of Sibiu*

Industry X: From Research to End of Life -> Products for the Future *by Vlad Toncian, Test Equipment Planner Engineer at Marquardt Schaltsysteme SCS*

Diversity + Inclusion = Good security *by Monica Iovan, Head of Security Development, Visma*

15:30 - 17:30 **PANEL 5: The future of work: upskilling, reskilling, the Long-life-learning, new jobs, new skills**

Etcu Mihai – moderator

Workforce analytics in teleworking *by Prof. Dr.Ing. Claudiu Kifor Director, research center in sustainable products and processes & Dr.Ing. Sergiu Şt. Nicolaescu Postdoctoral Research Engineer at Lucian Blaga University of Sibiu*

How digitalization transforms the future of work *by George Bontas, Country Leader BearingPoint RegTech*

OMiLABs in Action: Driving Innovation and Digital Transformation through Open Models *by Dr. Wilfrid Utz, Managing Director at OMiLAB NPO, Germany*

Future of matchmaking in recruitment *by Cătălin Viorel VACON Talent Pipeline, startup from Sibiu*

Skills required for success within the digital society. Hard vs Soft skills *by Răzvan Voica CEO & Co-Founder at The Informal School of IT*

17:50 - 20:00 **PANEL 6: World / European Challenges from RDI / innovative Partnership**

Prof.Dr.Ing. Adrian Florea - moderator

Changes in the EU R&I landscape post-COVID 19

by Ramona Samson, Chief Economist Unit at European Comission

Health research funding in Horizon Europe. The Work Programme 2021-2022

by Alexandru-Sorin COSTESCU, Scientific Policy Officer at European Comission

Experiences of innovation in the field of digitalization in public and private sectors

by Matteo PORTA, Senior Mechanical Engineer Industrial Design & CAE at RINA Consulting S.p.A., Italy

INNOHUB Continental Sibiu – Presentation & 2021 Projects

by Cosmin Biris, Senior Expert & Dinu Gruian from Continental Romania

17:00-19:**00 Workshop 3: Innovation In Triad: Perfect Synergy of mechanics, electronics and software!**

with Florin Ignat, Daniel Benea, Catalin Stan from Marquardt Schaltsysteme SCS

Day 3, Sat, 30 Oct. 2021

9:00-10:00 **Keynote speech:**

How digital transformation can support the economic growth

by Prof. Dr. Eng. Dr. Ec. Stelian BRAD, President of Cluj IT

10:10-13:00 **PANEL 7: Smart cities**

Prof.Dr.Ing. Adrian Florea - moderator

Challenges and actions for Sibiu Smart City. The importance of creative communities

by Raul Apostoiu, City councilor, chairman of the Smart City Digitalization and Strategy Commission of the Sibiu Local Council

Technology connecting citizens with the city

by Prof.Dr. Lasse Berntzen from University of South-Eastern Norway

ReInventing Cities. Building bridges with companies, technologies and authorities.

by Eduard Dumitrascu President Romanian Smart City Association

Proactive approach to buildings management and maintenance leading to improved quality of life for citizens in a smart city

by Catalin Dragoi, Services and Digitalization Leader CEE - Honeywell Building Technologies

Call to actions for a sustainable digital city

by Cristian Pațachia, Development & Innovation Manager at Orange

How parking systems help reduce carbon emissions?

by Marius Miroslav, CEO at fastPark Co. S.R.L.

Key Success Factors for Smart City Construction

by Vlad Doicaru, Public Affairs and Government Relations Director at Huawei Technologies SRL

"Digital City, Smart City, Intelligent city, Brained City: An Advanced and Integrated Vision"

by Paulina Mitrea - PhD Prof. UTCN - Coordinator of Brained City, Group /Cluj IT and Leader of Smart City Unit -DIH4S/ClujIT

14:30 – 17:00 **PANEL 8: Smart agriculture applications Sustainability, Green society**

– moderator Prof.Dr. Lasse Berntzen

Pay As You Throw - PAYT Economic Instrument

by Marian Popa, Director at Public Service for Management, Sanitation and Environmental Protection, Sibiu

Innovation in Agriculture – The IoT revolution is here

by Prof.Dr. Lasse Berntzen from University of South-Eastern Norway

Agriculture applications: Reuse of existing ADAS solutions from passenger cars for the safety of agricultural equipment

by Ichim Marius from Continental Romania

Use of UAS systems in collecting agro-climatic data

by Sebastian Pop, Manager at AeroDrone SRL Braşov

Using drone technology for preserving the economic sustainability of the agricultural holdings

by Profesor dr. ing. Anca Sipos at Lucian Blaga University of Sibiu

16:30-17:00 **Announcement of the Hackathon Contest winners**
Closing session SID2021

Digital Transformation - A Prerequisite for Sustainability in all Economic Sectors and for Society at Sibiu Innovation Days 2021

Professor Adrian FLOREA, PhD [1],
Professor Stelian BRAD, PhD [2]

[1] *Director, Hasso-Plattner Knowledge Transfer Institute at Lucian Blaga University of Sibiu, adrian.florea@ulbsibiu.ro*

[2] *President, CLUJ IT Cluster, stelian.brad@clujit.ro*

Abstract

Launched as an initiative of the Cluj IT cluster and supported by the Hasso Plattner Institute in Potsdam, Germany, Sibiu Innovation Days (SID) represented a necessity for Sibiu, for the university, for companies in the area, in the idea of bringing together of all decision makers that acts around the concepts of digitalization, innovation and knowledge transfer to a smarter society and a better life for its members. During the three days of the SID2021 conference we explored, with the guidance and expertise of our invited speakers, the process of digital transformation and how this can help our community of students, researchers, business, and decision makers to add value to their projects, initiatives and day to day activities. This paper briefly highlights the societal, economic and environmental challenges to which digitalization should solve and that have been brought up at SID2021.

According to European research studies [1], the only way for the EU to maintain a strong, sustainable and competitive economy is through innovation. However, at present there are large imbalances between degrees of innovation of EU countries. Relatively recent statistics at European level place Romania as modest innovator. In terms of digitalization, Romania is on the last position in the DESI classification[1], with many areas lagging behind, such as human talent, public administration, and adoption by the business environment. Greater collaborative efforts are needed on the part of clusters, universities, and research institutes to position themselves as vectors for the transfer of technological progress and to boost the regional innovation. One solution to alleviate this disadvantage is to develop international collaborative networks that replicate the best innovation models in advanced countries and adapt them to less developed countries or regions in Europe by stimulating territorial innovation. The partnership between universities and private sector has become a defining factor for the growth of innovation and quality in the research area [2]. Launched as an initiative of the Cluj IT cluster and supported by the Hasso Plattner Institute in Potsdam, Germany, Sibiu Innovation Days (SID) represented a necessity

[1] https://ec.europa.eu/newsroom/dae/redirection/document/80563

for Sibiu, for the university, for companies in the area, in the idea of bringing together of all decision makers that acts around the concepts of digitalization, innovation and knowledge transfer to a smarter society and a better life for its members.

We are currently facing a complex of societal, economic and environmental challenges that require courageous structural transformation measures at the level of companies, public institutions and administration to ensure balanced and responsible development. To enable this, we need to extract and use massive data from anthropogenic and natural ecosystems, as well as technical systems capable of transforming data into information and then knowledge, which will then allow us to make wise decisions. We find that extended digitization and the transformation of the way we do things through the contribution and help of digital technologies cannot be associated with a cult for digital, but with an urgent need regarding the quality of people's lives and the economic health of companies. Sibiu Innovation Days 2021[2] brings to our attention several vectors that reflect these transformative paradigms.

Challenges at the societal level through the emergence of digitalization in all sectors of activity, from industry, medicine, smart city management, smart and autonomous mobility to the changes introduced, and the challenges posed for business and education by the pandemic, the advancement in digital technologies like Artificial Intelligence and Cybersecurity, the specificity of technology transfer in Romania, the importance of startup development and entrepreneurship education, all these are current issues for all members of the Sibiu community and were discussed at Sibiu Innovation Days. At the same time, the participants learned the vision of the European Commission for Research and Innovation on these issues through the presence of decision-makers from this European institution.

For the second time, *Sibiu Innovation Days* reconfirmed its position on the regional and even national scene, positioning itself as a promoter of innovation and also a connector between private actors, representatives of public authorities, the local ecosystem and academia, research, bringing into attention current issues at a supranational and implicitly national level. SID conference series are already a reputable reference of the academic environment in Romania and played from its first edition in 2020 a fundamental role in the development of collaborative networks between specialists from industry, administration and research community from universities.

During the three days of the SID2021 conference we explored, with the guidance and expertise of our invited speakers, the process of digital transformation and how this can help our community of students, researchers, business and decision makers to add value to their projects, initiatives and day to day activities. The event was looking to strengthen the collaboration among all these stakeholders, while also improving the

[2] https://events.ulbsibiu.ro/innovationdays/

way in which we understand and use the innovative services available in Transylvania and the Sibiu region. The conference activities emphasized current research and development concerns of companies active in the area, as well as created new opportunities for collaboration among participants active in a wide array of industries and fields. While highlighting contributions from Hasso Plattner Knowledge Transfer Institute, active in "Lucian Blaga" University of Sibiu, to the development of the local innovation ecosystem, the conference represented an important component in consolidating Sibiu City's position as an emerging innovation center.

With this 2nd edition, SID offered a very rich and exciting program, focused on digital transformation seen as a prerequisite for sustainability in all economic sectors and for society. SID2021 topics and presentations aimed adapting industrial and administrative processes in the context of digitalization, as well as towards value creation through structural transformation and generating of new businesses, startups or spinoffs. At SID2021 a particular attention was paid to the successful knowledge transfer, seen as a boost for a territorial innovation, to its challenges and specificities in Romania. The topics are very timely, focusing on the challenges of the ongoing 4th Industrial Revolution and the growing role of Artificial Intelligence (AI) and Cybersecurity in systems development. Very interesting lectures presented the European approach Towards Digital Sovereignty and Cybersecurity challenges in 2021 in two main multinational companies from Sibiu – Continental and VISMA.

The „*Artificial Intelligence*" panel included interesting lectures and debates regarding immersive media augmentation through cognitive computing, personalization of customer experience in modern systems with applicability in automotive and autonomous driving, interoperability and infrastructure requirements for an AI-enabled architecture, reducing downtime, improving productivity and optimization of operational processes through AIOps and DevOps.

In the „*Digitalization*" panel the speakers revealed the Industry 4.0 challenges and innovative technologies with emphasize on Automotive sector and Digital Signage, the gearing up for the digital transformation of manufacturing through collaboration, the necessity to apply digital technologies to optimize processes and reduce costs but also to reinvent experiences, focus, and ways of work, thinking future products from the research stage.
For the second consecutive year, the health domain was approached at SID. The lectures presented digital solutions for shaping the future of healthcare, for mobile screening for diverse populations with genetic syndromes. It was highlighted the necessity of collaborative efforts between software and hardware developers and medical sector for a personalized coach for healthy aging, for implementing medical information systems that allow patients' access to their electronic medical file, and empowering citizens with new generation technologies to build a healthier society.

One new panel organized for the first time at SID was "*Startups, Entrepreneurship and Personal Development*" knowing the importance of startups for effective and efficient innovation ecosystems and also the lack of entrepreneurship skills for many of computer science and engineering students. The lecturers presented the challenges but also success recipes for building tech startups in Romania, what skills you need to developed from graduation to entrepreneurship, why the agility and the human factor is important in the entrepreneurial process and funding opportunities from European level for training entrepreneurship competences of employees.

The „*Future of work: upskilling, reskilling, the long-life-learning, new jobs, new skills*" panel radiographed the extent to which companies and universities have evolved following the pandemic in terms of how employees work, whether by teleworking employee productivity has remained unchanged or what changes generated by pandemic has brought good and what not, both at the level of companies and employees. The panelists have shown their research results about workforce analytics in teleworking and how digitalization transforms the future of work, examples of digital platforms that drives innovation and digital transformation through open models, what are the hard and soft skills required for success within digital society, how the recruitment process evolved and why is needed a matchmaking between candidates and employers.

The „*Innovative Partnership*" panel presented the changes in the European research and innovation landscape post-COVID 19 which aim restarting the economy and helping private investment to get moving again and also, the health research funding opportunities by Horizon Europe program. The debates tried to identify how can Romania support cross-sectoral actions to optimize costs and results so as to increase the effectiveness of EU funding in the field of innovation and how can Romania create a friendly environment for innovation that supports the transition to the green economy through the programs and mechanisms provided by the EU. The panel was ended presenting two success recipes implemented in Italy and Romania, first illustrating experiences of innovation in the field of digitalization in public and private sectors and second illustrating how developing innovative concepts are focused on manufacturing and work environment using state-of-art technologies.

Even if society in the digital age is dynamically developing, the changes must be sustainable and take into account the limited natural resources. In this context, Sibiu Innovation Days 2021 tackled issues related to development of smart societies from a greener perspective. The last day of conference tackled the challenges and holistic actions from multiple perspectives (digital, smart, connected and green) for building smart and sustainable digital cities. It was revealed the importance of creative communities, deeper collaboration and using of smart technologies for connecting citizens with the city. A smart city need to have smart citizens. The quality of life for citizens in a smart city may be improved by efficient governance and proactive approaches to buildings management and maintenance, reducing the carbon emissions

by smart parking solutions, smart mobility, etc. Exploiting of concepts like IoT, 5G, Big Data, cloud computing, data analytics under restrictions of data privacy, security, integrity in the context of smart city were debated during the panel.

The last panel of the Sibiu Innovation Days 2021 was dedicated to „*Smart agriculture applications, Sustainability, Green society*" panel. The sustainability issues of modern society like waste management and proposed economic solutions, food ensuring in the context of population growth, modernizing agriculture practices using IoT systems, drones and robots, using of unmanned aerial vehicle systems in collecting agro-climatic data, and reusing of existing ADAS solutions from passenger cars for the safety of agricultural equipment all these represented topics of discussions in the panel.

In collaboration with ULBS partners – the industrial companies Continental Automotive Systems Sibiu and Marquardt Schaltsysteme Sibiu, we organized two industrial demonstrative workshops as part of Sibiu Innovation Days 2021 conference program.

On 28.10.2021 took place the first industrial workshop entitled „*WS2: Demo session - Building Blocks for Autonomous Driving*". It started with a short introduction about the technical background of lecturer and included on agenda the presentation about what Continental does in the Advanced Driver-Assistance Systems (ADAS) Business Unit, and more importantly, how does this. The applicative part of the WS2 consisted in a set of exercises, where, starting from short datasets of test which encodes *„what the vehicle sees"* the participants should use some development tools / environment (MS Excel, Python, Matlab, Visual Studio Code etc.), to parse tests and to create a simple visualization application to understand the way the environment "*looks*". The users need to write small functions that have specific purposes (discussed during the workshop). In the end of the workshop the conclusions were drawn and open discussions took place and the participants were required to provide feedback. Judging by feedbacks and also that the time allocated for workshop of the 90 minutes was overtook with more than half of hour, important conclusions were that the young students and participants appreciated the technical quality of the presenter and of the workshop in general and are eager for such demonstrative events in future, if possible, in physical mode.

On 29.10.2021 took place the second industrial workshop entitled „*WS3: Innovation in Triad: Perfect synergy of mechanics, electronics and software!*". The goal of the workshop was to promote technologies and smart products developed and produced by the Marquardt company and how the students/participants with complementary skills (mechanical, electronical and software) could be part of the development and test process in a synergic way to realize a one-of-a-kind product for the Automotive Industry. The WS3 also added to this innovation triad the possibility to automate the production processes through the use of collaborative robots, which is another area of

competence in Marquardt and which is emerging rapidly at a global level. Finally, the workshop concluded with a preview of the future of gesture-recognition technology and with predictions on how it can be implemented in daily use: for controlling various functions and characteristics of the vehicles all the way to controlling household appliances. The workshop was disseminated in live stream available on the Marquardt Romania social network platforms, on the Sibiu Innovation Days website and on the local newspaper web page reaching a large target audience of different ages and on different countries.

We are glad to say that this second edition of the event was a real success which set an example of good practice especially in the current „normality" marked by the epidemiological context. More than 400 participants registered for the event, and almost 2000 people were following online stream with 8 technical panels, 3 keynote presentations and 3 workshops involving more than 54 experts from industry and academic environment and delegates from local, national and international authorities and organizations, European Commission experts, and businessmen (from multinationals and established international brands to local startups) from Romania, Germany, France, USA, Italy, Norway, Austria. At the same time, they presented points of view, challenges and solutions related to digitalization in public services, representatives of local administrations (various services of the mayor's office and of the Sibiu City Council) led by the Mayor of Sibiu.

At the same time, we are convinced that the collaboration relations between organizers and all participants will not only continue but will flourish in the interest of the ecosystem we represent.

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[2] Nicolaescu, S. S., Palade, H. C., Kifor, C. V., & Florea, A. (2017). Collaborative platform for transferring knowledge from university to industry-a bridge grant case study. In Proceedings of the 4th IETEC Conference, Hanoi, Vietnam (pp. 475-488).

Digital Transformation to Support Resilient Economies and Stakeholder Capitalism

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Abstract

In a world that is shaped by globalization and global value chains we must identify smarter ways to handle complexity and to build more adapted organizations to nonlinear behaviors of the environments where they operate. We highlight in this paper the role of digital transformation to assist the creation of more resilient economies in front of various crises and how this can facilitate the creation of better-balanced economic models.

Keywords: digital transformation, economic resilience, digitalization, digital economy

1. Introduction

Current and foreseeing global challenges impose adaptation of economies and profound structural changes in almost all economic sectors to ensure sustainability of businesses [1]. Sustainability deeply depends on the resilience of businesses in front of multiple shocks that shape the business environment [2], [3], [4]. Destructions or blockages generated by extreme weather conditions due to the climate change, global disturbances provoked by pandemics (e.g., COVID-19), bottlenecks and fluctuations in the supply of raw materials caused by unbalances in regional value chains, disruptions generated by current macro-economic models and conflictual international contexts dictated by egoistic political interests, as well as many other noise factors – including significant differences in terms of values and mentalities within the groups of populations worldwide – make our world more and more fragile and unpredictable [5], [6], [7], [8], [9], [10]. Under these circumstances, any effort to bring relevant and timely information about the evolution of various systems and ecosystems and capacity to put them altogether and analyze in an aggregated form would increase the possibilities to identify influences, behavioral patterns, and to define better global leadership capabilities. Moreover, the morphosis of systems by adopting information-driven characteristics for better adapting to highly entropic metasystems is desirable. Thus, digitalization and digital transformation at various levels (organizations, economic sectors, countries) is a necessity for the years to come. This is also one of the hot topics on the current political agendas worldwide. Nevertheless, things related to digital transformation are not simple when it comes the time to put them into

practice because transformation is about changes and radical innovation, about understanding and adopting complex technologies, and about the capacity to deeply understand where, how, when, and why to intervene in the current systems to demonstrate fast and undisputable benefits from these specific transformations. In this context, this paper underlines some key issues related to digital transformation and how they are aligned with a more ethical and resilient economic model of the future.

2. Situations that impose structural changes

Sustainable economic development is crucial for nations because this should arise with the creation of new jobs, intentionally better paid jobs, diversification of economy, business expansion (or at least retention), fortification of economy, intentionally improved quality of life, and increased tax revenue [11], [12]. Economic development entails structural transformations (e.g., in factors of production, sectors of economy, public finance, foreign trade, household consumption, etc.) [13]. Structural transformation must lead to higher productive activities. But the true sustainable economic growth happens when competitiveness at micro-economic level increases (physical productivity and financial productivity). Any other positive interventions at macro level are supportive for developing a favorable economic environment, but not sufficient. Digital transformation is only a part of the wider structural transformation, but it is influenced by several other categories of transformations, as it is shown in Fig. 1.

This means, we must see digital transformation more than digitalization. Digitalization is the process of using digital technology to collect data from organizational processes and to carry out activities using digital technology in order to increase performance in terms of productivity, quality, traceability, responsiveness, etc. and to better visualize and understand the way in which various processes take place in the value chain of the organization [14], [15], [16]. A good example of digitalization is the paradigm of industry 4.0 [17]. Digital transformation is the process of structuring an organization and significantly redefining its strategy through the widespread adoption of digitalization at the organizational level in a form in which digital technology is not seen as a supporting function but as a strategic competence in which the organizational culture is driven by digitalization and the model of relationship with the beneficiaries is a new one, based on digitalization in substantiating the value proposition and in ensuring a unique quality [18], [19], [20].

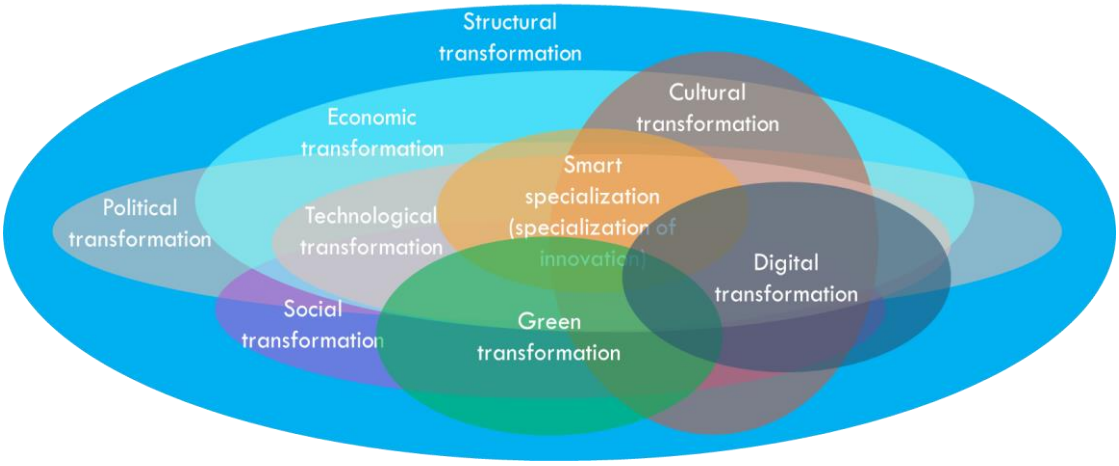

Figure 1. Types of structural transformations

We see that digital transformation is not about digitalization, even if it counts on digitalization. Digital transformation is about a paradigm shift in doing businesses; it is about more sophisticated business models where value proposition, key processes, monetization, partnerships, market channels and customer relationships are designed for and driven by digital technologies.

From this angle, digital transformation might be seen as an action designated to support those business sectors where current business models become obsolete in front of new contexts and challenges. Digital transformation is applicable to any sector, from education, health, administration, entertainment, sport, to energy, agri-food, manufacturing of any kind, mobility, construction, finance, consultancy, etc., and even to the IT sector. For example, adoption of collaborative platforms and dynamic hiring of experts using online platforms and smart contracts is part of digital transformation seen in the IT sector. In simple words, we talk about doing things smarter and better. In this context, the question is "How digital transformation can help to increase competitiveness at micro-economic level and improve the business ecosystem (aggregated productivity) at mezzo and macro-economic levels?" For answering to this question, we must first understand which are the situations when structural changes (or transformations) are necessary. Fig. 2 shows six of the critical situations where necessity for such transformations must be considered.

It is still a challenge to decide what kind of structural transformations (see Fig. 1) must be tackled in the cases indicated in Fig. 2. However, the goal must be a sustainable economic growth, which considers at economic level the paradigms of circularity [21], shared value [22], smart specialization [23], and resilience [24], prosperity [25] at social level, and at environmental level responsibility for preserving or regenerating natural resources for future generations. This leads to intelligent management of resources (natural, financial, human, technology), meaning in our view the ability of all stakeholders (policymakers, managers, employers, citizens) to solve without compromises various conflicts in the use of limited resources such that to get maximum results in a way that is ethical, responsible, and eco-sustainable. Looking to the Raworth model [26], these kinds of actions are more than simple recommendations; they are urgent necessities.

Organization: Constant decline of the profit due to depreciation of the business model (e.g., traditional IT outsourcing in Romania)
Economic sector: Constant decline of productivity (e.g., traditional manufacturing sector in Romania)
Country: Stagnation or lowering productivity of most of the industrial sectors over a longer period

Organization: Constant decline of return on operating assets and decline of attractiveness for investors
Economic sector: Value added does not follow a positive slope for several years
Country: Constant increase of the public debt and commercial deficit (e.g., see Romania)

Organization: Signs of deep structural changes in the related industry (e.g., industrial transition to green-blue, circular economy)
Economic sector: Signs of transitions to other S-curve(s) of technologies and changes of the value chains (e.g., automotive – electric, servitization, life-cycle)
Country: Deep structural changes in demographics and labor structure (e.g., European Union)

Organization: Abundance of similar players in the market with no strategic differentiation
Economic sector: Lack of diversification over a longer period (note: even specialization requires diversification) or increase in "absorption inhibitors" (this requires disruption)
Country: Constant decline of the gap between aggregated price and cost factors at macro-economic level

Organization: Increase in adoption of new technologies at operational level (e.g., with focus on quality, productivity, adaptability)
Economic sector: Changes in the supply chains (e.g., reshoring due to automation and digitalization)
Country: Instability at macro-economic level (e.g., inflation, national debt/GDP, balance of payments, ST-LT interest rates etc.)

Organization + Economic sector + Country: Change of the general context caused by global or regional crises that require more resilience and clear adaptation to radical new rules of survival

Figure 2. Situations that require structural transformations

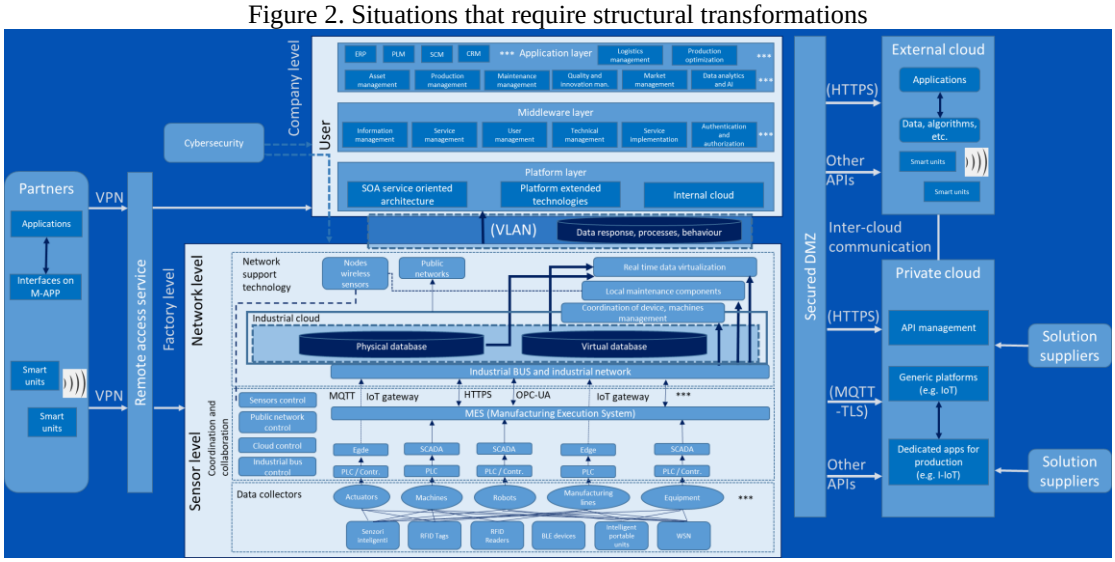

Figure 3. The architecture of a wide-digitalized enterprise

3. The logic of digital transformation

Deep digital transformation integrates digital technology into all areas of a business (see Fig. 3); thus, radically changing the way of delivering value to customers. In this respect, digital transformation encourages and assists the development of a digitalized economy. Digitalized economy is something else than digital economy. Digital economy is only an enabling economy for the digitalized economy.

Digital economy is the economic activity that results from everyday online connections among people, businesses, devices, data, and processes. It stands on hyperconnectivity of people, organizations, and machines by means of Internet, mobile technology, and Internet of Things (IoT) [27]. On the other side, digitalized

economy refers to the adoption of digital technology in a way that transforms services or businesses by replacing manual (non-digital) processes with digital ones or replacing outdated digital technology with upgraded digital technology, including in some cases the adoption of artificial intelligence (AI), cloud and edge computing, blockchain, virtual and augmented reality (VR/AR) [28]. Digitalized economy is about enhancement and transformation of any economic sector in a way that makes it more productive, agile, resilient, "creative", traceable, etc.

Figure 4. The pyramid of digital transformation at organizational level

Figure 5. The logic flow of digital transformation

The challenge for digital transformation is "What to do"? but also, "Where to do"? and "How to do"? This is a cultural issue, and it is about the commitment to evolve at individual level, organizational level, and economic sector level (see Fig. 4). In order to succeed in the long-term journey of digital transformation, an organization must start with a clear strategy for business digitalization, and with a plan for redefining the business model within this strategy. The strategy must include a pillar for developing digital skills for its employees, a pillar for digital-connectivity with its suppliers and customers, a pillar for inclusion lean-agile digital innovation in all key processes that define the value chain, a pillar for staff involvement and development

of a culture for continuous innovation, and finally a pillar for aligning the business to a model that embeds digitalization in all applicable processes (see Fig. 5). Based on an extensive digitalization process, data are collected from all relevant areas of the business and analyzed with specialized technologies (e.g., statistics, machine learning, expert systems, etc.) to be transformed into information and knowledge, which are finally used for creating competitive advantages (Fig. 5).

If data collection and analytics is a challenge (but one that can be handled with nowadays know-how), the major challenge (with a still low scientific foundation), is about what data to collect, for what purposes, and what "smart" algorithms to use to transform data into valuable knowledge. For example, what data do we need to deliver effective analyses for the board of directors and how to combine them in order to make more visible the proper evolution of the company, beyond traditional accounting and financial data? When does the breakeven point actually happen for a given equipment? What thinking pattern has each of our employees? How can we unveil hidden practices within the organization? Etc.

In other words, we must avoid "fetishization" of data, because data are not relevant without deploying them into competitive actions. We need to think in terms of sustainability, differentiation, more value added, higher quality of jobs, etc. Digital transformation must consider all stakeholders and bring advantages for all. For example, we might want to know how much value weight is dynamically brought by each department to ensure the competitiveness of our business such that to design a more ethical salary policy, and maybe to share the annual profits to all stakeholders according to their contribution in the equation of company's competitiveness.

And when we talk about stakeholders, we must consider the company itself, active and passive shareholders, managers, expert collaborators, employees in the primary and secondary processes of the value chain, customers, suppliers, partners, society in general (citizens), government, and the planet. Thus, data we collect and the means they are collected must be driven by the business strategy. Another perspective in digital transformation is the sustainability of a given business model. There are economies where most of the business models are driven by basic factors (e.g., primary agriculture, business process outsourcing, textile lohn, software outsourcing, mining of raw materials, forest exploitation), other economies where majority of the business models are driven by productivity factors (e.g., manufacturing services), and other economies where most of the businesses are driven by innovation (e.g., design and development of robotic technologies). Each national economy is a mix of the three models, but with differences in size and intensity. For example, today's (i.e., 2021) Romania's economy is mostly driven by productivity factors.

In a national economy, every economic sector is dominated at a certain moment by one of the three models mentioned above. The dominated model is maintained as long as the index of price factors is higher than the index of cost factors. Various noise factors erode over time the ratio of these indexes, making the model unsustainable. This pushes the economic sector to transform itself and adopt the upper model. Sophistication increases from the models driven by basic factors to those driven by productivity and further to those driven by innovation. To prolong the life

of their models beyond the inflexion point, some companies migrate from the parent

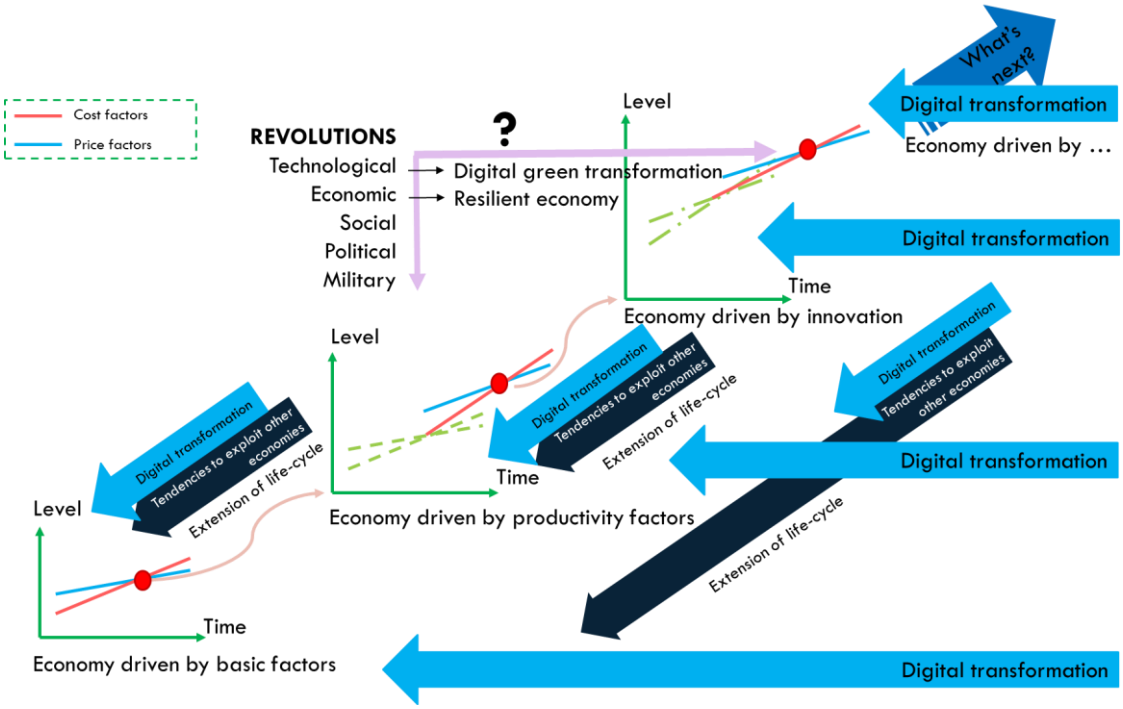

Figure 6. Economic models and related challenges

economy to other economies where the model is still viable (see Fig. 6). Digital transformation or at least digitalization is necessary in such cases to keep the headquarter and subsidiaries connected. Also, to become part of a connected business system and to build a connected value chain, companies must consider digitalization and/or digital transformation in any of the models that shape their businesses (Fig. 6).

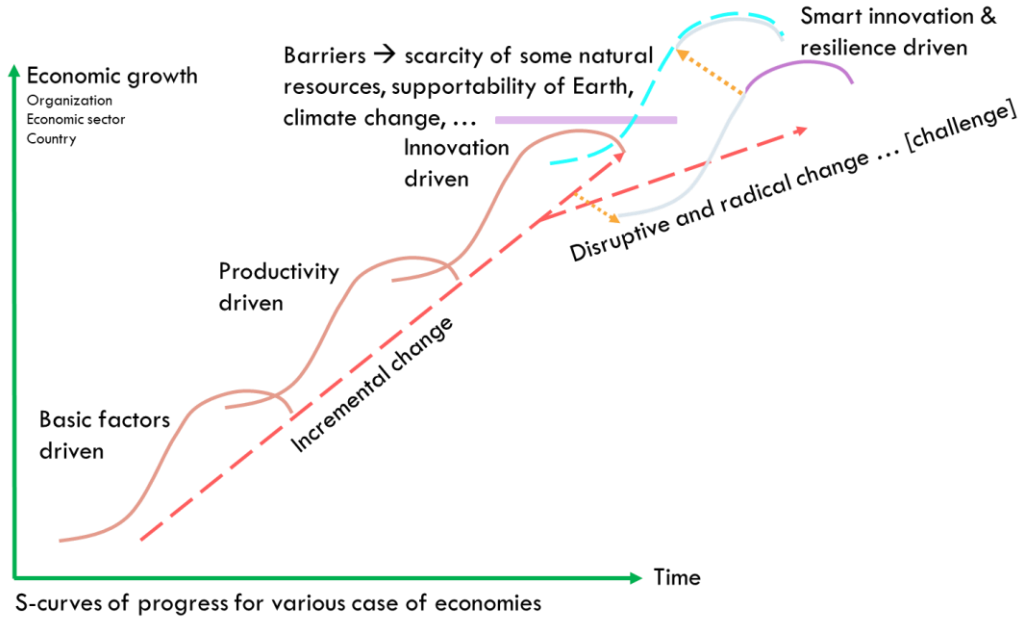

Figure 7. Disruption towards a new macro-economic model

Besides all these aspects, now we are experiencing a situation where some economic sectors and some national economies face the challenge of transition from the innovation driven model to something new (see Fig. 6). This is because the aggregated cost factors in those economies challenge the price factors, making obsolete the traditional innovation driven businesses. The problem with innovation driven models is that they are expensive and capital intensive, and many of the past and present-day innovations have also generated or are generating harmful side effects that unbalance the systems where they have been implemented or are operating nowadays. For example, fossil fuel driven cars or airplanes are great innovations, but they produced a lot of pollution on Earth. Nuclear powerplants supplied us energy, but with a lot of costs for environment and with continental catastrophes in the case of some technical accidents. Internet produced a revolution in connectivity and spread of information, but it opened the gate for harmful side effects on people's privacy, large scale tendentious manipulation of masses of population, poor quality information, etc. In conclusion, innovations must be reconsidered and "re-invented" such that to be more sustainable and resilient. We call this metamorphosis "smart innovation" (see Fig. 7). It embeds more "intelligence" and considers fulfillment in a balanced way of requirements expressed by all stakeholders.

Nevertheless, in comparison with the S-curves of progress of the current economic models, whose evolution was more incremental, "smart innovation" involves more disruption and radical changes because it faces with a complex of barriers, such as scarcity of some natural resources, climate change, supportability of our planet, etc. (Fig. 7). The VUCA crisis (vulnerability-uncertainty-complexity-ambiguity) requires adoption of digitalization and digital transformation to better understand and master the new conditions and their related requirements.

Even if economic growth is the engine of economy, economic growth must not be a goal for itself, but a way to create social welfare and wellbeing, having in mind at the same time the implications on natural ecosystems. We simply consume all natural resources in an unacceptable egoistic manner, pollute the planet without any sense of guilty, and without thinking what legacy we will leave to future generations and without thinking that we are not the single living beings on the Earth. Digital transformation makes sense only in relation with sustainable economic growth and social welfare; and it must be seen as part of the whole set of structural transformations necessary for supporting this goal, not in isolation. Digital transformation must be an ingredient in the recipe of resilient economy and must support economic resilience.

4. The new economic paradigm: resilient economy for stakeholder capitalism

Resilient economy seems to be the new transformative model for sustainable economic growth. Resilient economy is about a more ecologically and socially ethical capitalism, where all stakeholders are part of the decision-making game, not only the shareholders of businesses and politicians, as it happens nowadays. Instead of giving a

definition for this economic model, a better way to describe it is to highlight its core characteristics. They are illustrated in Table 1.

Table 1. Characteristics of a resilient economy

Cluster	Characteristic	Description
Policy	Multidimensional indicators	Political decisions must be framed by social wellbeing and environmental quality in equal weights
	Independence between fiscal policy and economic growth	Decouple economic stability from economic growth and adopt fiscal policies for environmental protection
	Limited power and empowerment	Reduce imbalances in economy and democratic power, including new forms of democracy
	Decentralization	Diversified decentralization to be more agile in case of crises, including finance and security
	Responsibility	No dominant institution for decision making
Business	Prediction	Focus on early predictions for major threats
	Reconfigurability	Design reconfigurable organizations
	Shared value	Share value with all stakeholders
	Shifting profitability	Internalize the cost for environmental damage
	Sustainable investment	Invest more on technologies with low material consumption and more brain and labor intensive
	Smart innovation	Invest in innovations with no or low secondary side effect on short and long term (considering all stakeholders)
	Nonfinancial disclosure	Include environmental objectives in the business standards
	Sustainable business model	Adopt business models with low environmental footprint and high social ethics
Financial	Metrics for long term	Integrate life-cycle and environmental categories
	Expanded interpretation	Include environmental and social objectives in the targets of public institutions
People	Sustainable consumption	Optimize consumption by including strong penalties for some categories of products and services
	Sufficiency	Extra-charge the quantity per capita
	Affordability	Shelter, food, and basic stuff ensured for everyone
	Fairness	Smarter models to value public jobs and private jobs – pay-for-value

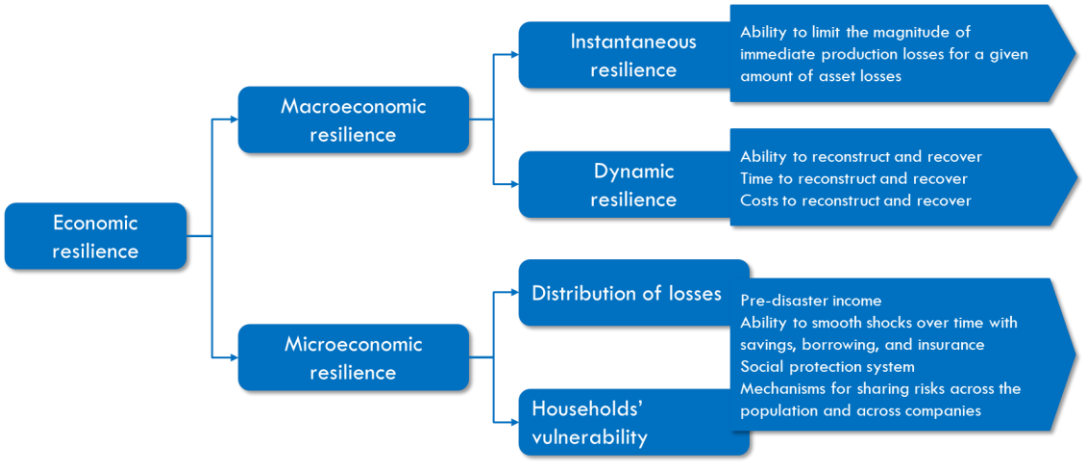

Figure 8. Components of economic resilience

Resilient economy must not be confused with economic resilience. Economic resilience is the capability of a national economy to take preparatory crisis-

management measures, mitigate the direct consequences of crises, and adapt to changing circumstances. In this regard, the degree of resilience will be determined by how well the actions and interplay of the political, economic, and societal spheres can safeguard the performance of the economy – as measured against the societal objective function – also after a crisis [29]. The components of economic resilience are illustrated in Fig. 8.

Digital transformation can generate new resources and capabilities in organizations for better facing to crises. An example how digitally driven economic sector benefits from digital transformation in the case of COVID-19 pandemic is shown in Fig. 9 (formulas are synthesis from various sources). This is due to the fact that most processes and supply chains remain functional, and most markets remain available.

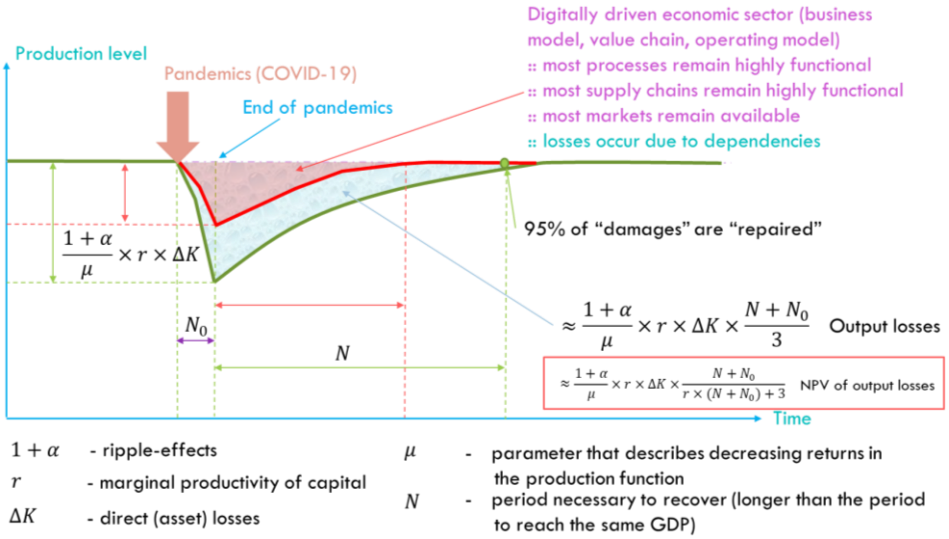

Figure 9. The effect of digital transformation in economic resilience

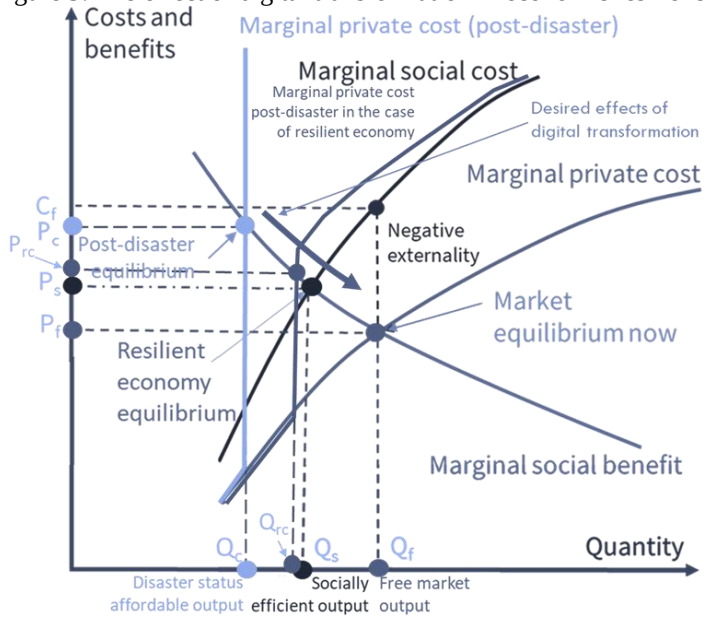

Figure 10. The economics of resilient economy with digital transformation

In the traditional capitalism, free-market economy makes the rules, and everything related to economic growth moves around its rules. In the stakeholder capitalism, where not only the politicians, shareholders and entrepreneurs dictate the rules, but also the natural environment, employees, and citizens are included in the decision-making process, resilient economy becomes the dominant ruler. This means that negative externalities are supported by those that produce them, and not by the outsiders, as it is happening in the free-market economy. But as it is shown in Fig. 10, in the resilient economy the equilibrium is reached with lower quantities of outputs and higher prices per output. This is not attractive both for consumers and producers.

However, by changing the business models this situation can be solved. This means that, instead of selling products and services, we sell solutions to a problem. In this paradigm prices are not any more relevant. Business models move towards servitization, share of consumption, product-service systems, or total-cost of ownership (e.g., instead of selling cars, we will sell mobility solutions, as it is shown in Fig. 11). With these business models we can produce less, increase in the same time profitability for producers and savings for consumers, without affecting consumption, but making it more sustainable. As Fig. 10 shows, even disasters have less impact on economy in the case of resilient economic model. If digital transformation is part of this model, the negative effect of a disaster is even more lowered. Fig. 10 shows how digital transformation act in the context of resilient economy for lowering negative effect of expected or unexpected crises.

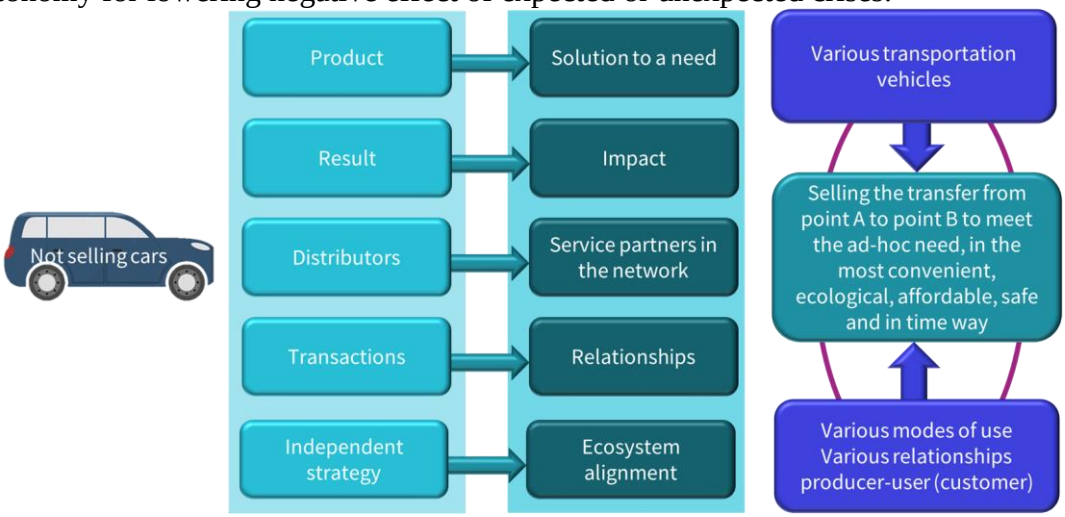

Figure 11. Example of servitization in the mobility industry

To develop a resilient economy, value chains must be digitally driven. This is required because life-cycles approaches, circular economy, transparency, stewardship, controlling, accountability, and traceability are parts of resilient economy, and the new business models and their value chains are significantly more sophisticated. An illustrative example is shown in Fig. 12. As in the example from Fig. 12, the original equipment producer (OEM) must develop long-term partnerships with a wider and more diversified market players. Flows are more sophisticated, and, without an

extensive digitalization, the partnership cannot be realized and maintained. In this

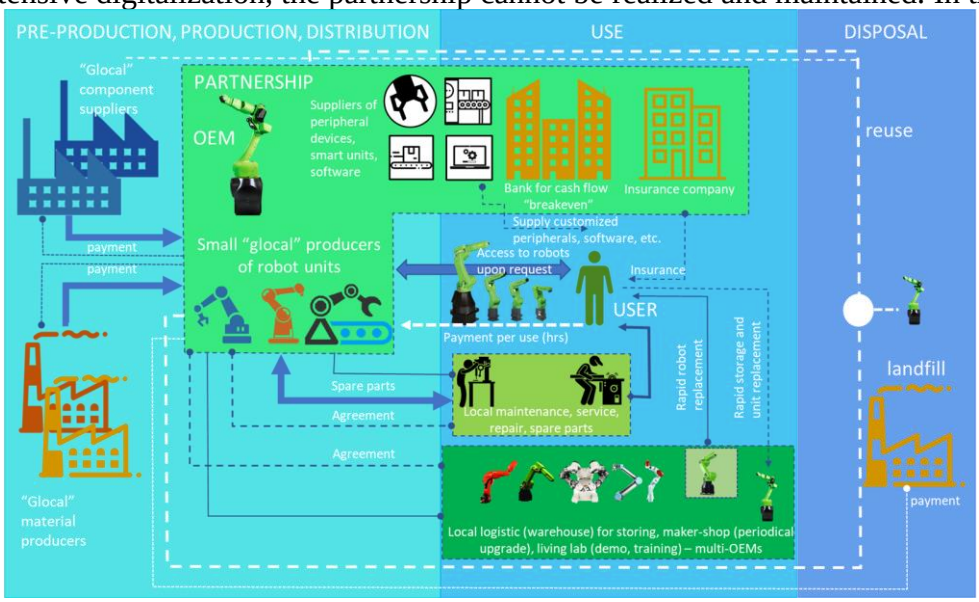

Figure 12. An example of value chain in the resilient economy

partnership, smart contracts, and autonomous economic agent (AEA) models might be seen as good practices. This is illustrated in Fig. 13. Also, without digital transformation the business is not sustainable (e.g., smart connected products and subscription-driven business relationships with consumers).

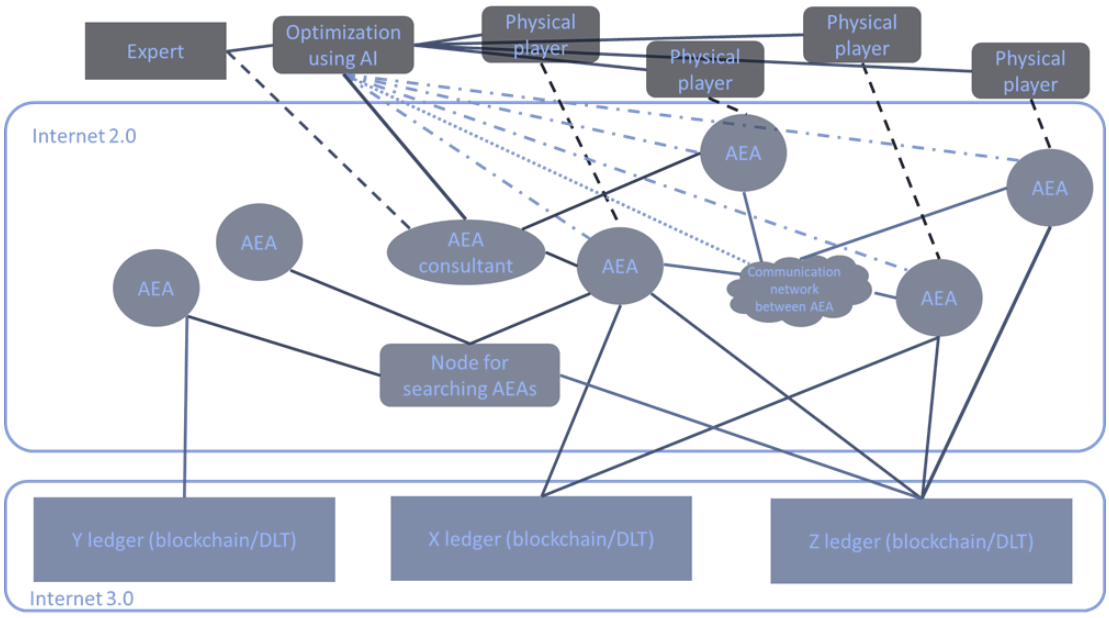

Figure 13. Example of supply chain optimization using autonomous economic agents

In the resilient economy circularity and servitization sustain each other. As Fig. 14 shows, servitization involves 24/7 remote control of equipment, 24/7 support and

assistance, smart maintenance, pay-per-use, service-driven business model. Circularity requires value optimization, transparency, collaboration, and stewardship. For materializing these requirements, digitalization and digital transformation are necessary. Digital transformation embedded within circular and servitization business models also ensures more economic resilience, because it is known that economies with more experienced workforce, higher rates of entrepreneurship (including higher share of self-employment), and which combine high diversity with high sophistication of the economic sectors, are more resilient.

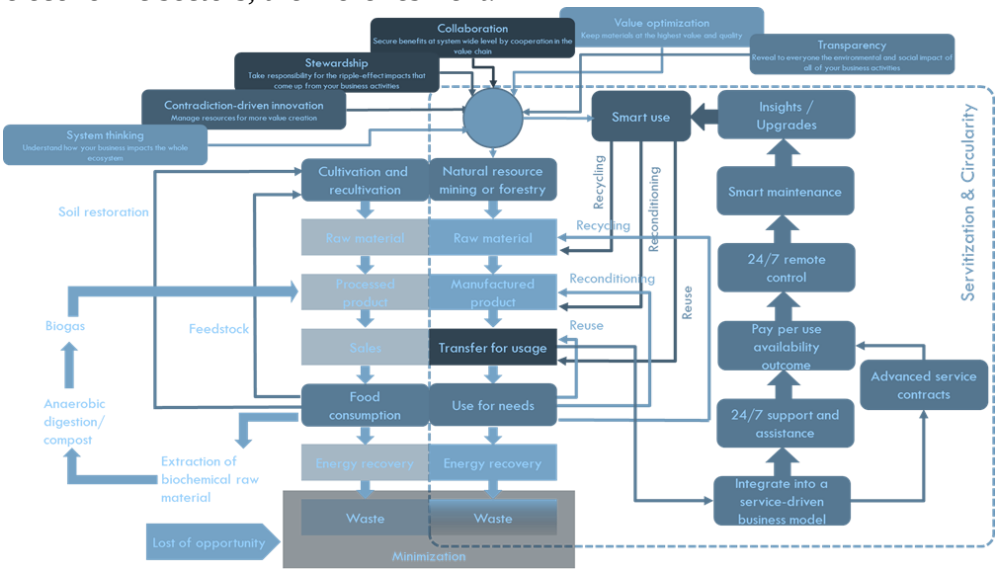

Figure 14. Symbiosis between circular economy and servitization for a resilient economy

5. Types of digital transformation to support economic growth in resilient economies

In the past the focus was to ensure more static and stable businesses, with little innovations. Today such approaches are lethal for most of the businesses. To overpass this fragility, nowadays efforts are done to achieve flexibility, agility, and robustness. This comes with investments in digitalization. However, future is destinated for super-agile organizations, where adaptability and dynamism are key qualities. These issues call for digital transformation, which moves many of the business activities in a new dimension, the digital dimension. To achieve this goal, intelligent constructions of organizations are required. On one hand this involves proper people and technologies to act agile and flexible. On the other hand, this calls for capacity building to combine strengths of people and digital technologies. Digital and digitalized technologies are focused on productivity, ensuring endurance, speed, accuracy, consistency, repeatability, specialization, and contributing to resilience. They also provide support to analyze complexity and optimize decisions. People, on the other side are focused on doing complex things. They bring a series of capabilities, such as creativity, dexterity, versatility, problem-solving, responsibility, adaptability, and also resilience.

Thus, digital transformation is about digital technologies, digitalized technologies, and digitally skilled people.

Within the value chains, companies operate in different positions. This influences the types of digital transformation which is suitable for a given company. Considering the specificity of economic models that characterize various economic sectors (see Fig. 6), the type of digital transformation is also related to this issue, too. We can extend this analysis at country level, too. In this paper we underline four types of digital transformation that might be applied to organizations, economic sectors, or national economies. They are shown in Fig. 15 and lead to either reconfiguration, modernization, diversification, or radical genesis of ecosystems. All these four types of digital transformation might be seen in an organization, economic sector, or national economy. Nevertheless, one of the models prevails for a given case.

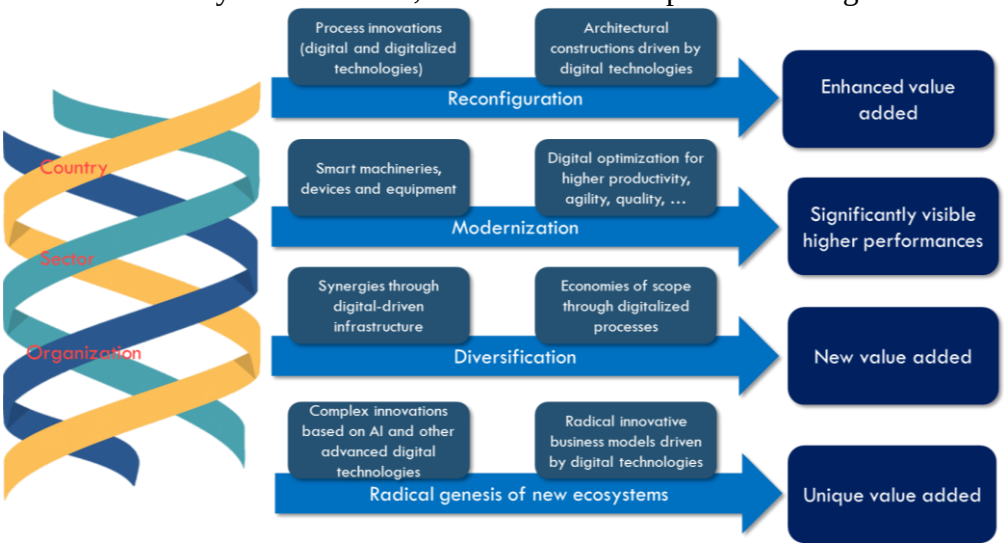

Figure 15. Types of digital transformation

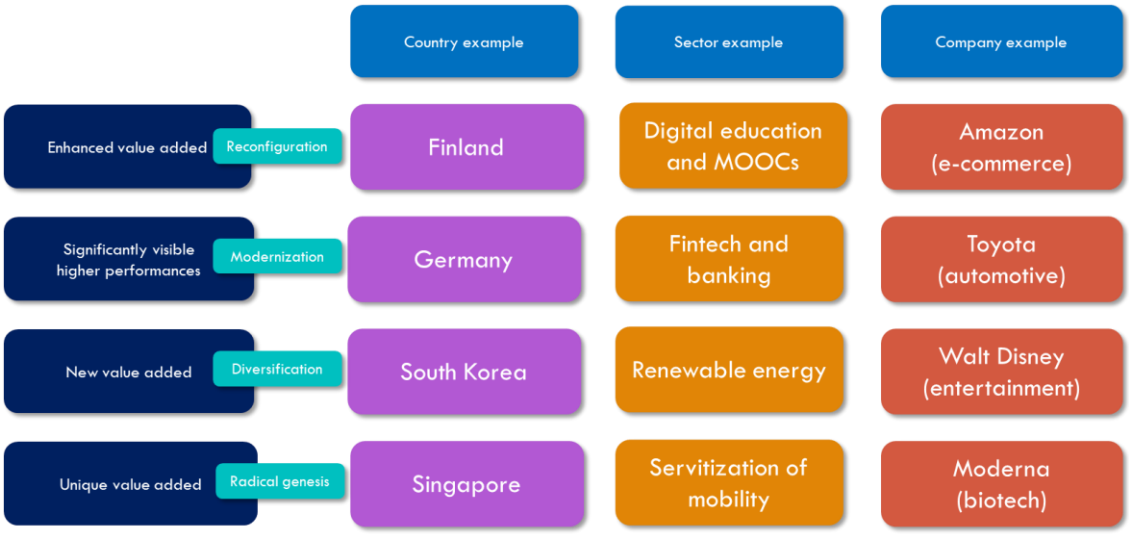

Figure 16. Examples of digital transformation initiatives

Fig. 16 indicates some illustrative examples of digital transformation initiatives at organizational, sector and country levels. Finland is a good example of country that is prepared for reconfiguring its economy through digital transformation. In this respect, its digital transformation strategy is focused on the so-called "platform economy". It is an appropriate example of country with a low size of population, but with highly educated people. Germany is a good case of large country where digital transformation is led by modernization through a major focus on industry 4.0. South Korea directs digital transformation to diversify its economy. This is visible in the synergies between different industries and economies of scope that make a small country, but with a large population and many educated people to excel in many economic sectors. Singapore, a very small country, with high density of population, highly educated people and agglomerated in a knowledge hub, is one of the best examples of countries that uses digital transformation to radically reinvent its economy. This country sees its economic growth by synchronizing emerging technologies, such as blockchain, Internet of Things (IoT), artificial intelligence (AI), personalized medicine, social robotics, green technologies, smart city, intelligent agriculture, renewable energy, etc.

At sector level some suggestive cases are also highlighted in Fig. 16. For example, the use of online platforms, augmented and virtual reality, web-based simulations and other digital innovations enhances the value added of education and large-scale accessibility. Students can learn at their peace and from any place, can interact with their mentors and mates in a flexible way. Another example of economic sector that benefits from digital transformation is the banking and financial. The transfer of more and more of the banking activities and interactions with customers in the cyberspace has brought visible higher performances in terms of speed, timesaving, and flexibility. But this sector is also shacked by a radical digital transformation, observing the remarkable development of virtual currencies. Energy sector is another example of sector that benefits a lot from digital transformation. Relevant examples in this respect are the smart grids and smart contracts in energy supply, as well as remote management of new sources of energy. In the automotive industry we observe a movement from selling cars to selling mobility solutions. This is driven by digital technologies.

At company level, Fig. 16 exemplifies four well-known cases. For example, using autonomous mobile robots and automatic management of resources in its global warehouse network, Amazon has made a step forward in the e-commerce industry, by speeding up and diversifying delivery. Toyota is a great example of improving production performances by extended digitalization of technological processes. Walt Disney is diversifying its business portfolio by adopting digital technologies and building up a "scalable dream factory". From cartoons, to movies, entertainment platforms and thematic parks, and vertical partnerships Walt Disney is one of the most prominent innovators in the entertainment industry by means of digital technologies. It also uses digital technologies to create and sustain brands. The last example is Moderna, the start-up that has revolutionized the pharma industry by adopting artificial intelligence, cloud computing, IoT, and robotics to create a new drug in a matter of minutes and then to instantaneously

transfer the results from the lab to the production facility. It uses the global network intelligence to collect data and design its products.

Through digital transformation organizations are capable to translate from complex constructions where most people usually perform simple tasks, to simple constructions, where people are assisted to perform complex tasks. If in traditional organizations information is led by people, in a digitally transformed organization people are led by information (e.g., with the assistance of artificial intelligence). If nowadays processes are designed to shape people's behavior, in the future smart organizational processes are designed to shape technology. Thus, in the future, people will assist technologies (e.g., man-in-the-loop), whereas nowadays technologies assist people. This is a radical paradigm shift in operating and doing businesses.

Value of digital transformation must be seen at the business model level, operating model level, and value chain model level (see Fig. 17). Digital transformation must create and capture value if it is proper embedded in the business model. At operational level digital transformation produce value due to various economies arising from scale, scope, and learning. At the value chain level, additional value is created by digital transformation from the networking effect, collective innovation, and extension of the business systems. All together shall be deployed into various key performance indicators, such as wide interoperability, extended connectivity, high agility and adaptability, high flexibility, capacity to better predict evolutions, faster generation of results, better capacity to customize results, faster recovering in the case of crises, increased automation, capacity to visualize behavioral patterns, traceability of operations and outputs, increased work discipline, and capacity to achieve a much faster scaling-up. All these key performance indicators are related to sustainable development. Digital transformation scripts a rethinking of how an organization uses technology, people, and processes in search of new business models and new revenue streams, driven by changes in customer expectations around products and services. The benefits we highlighted at organizational level can be extrapolated to economic sectors or national economies. Therefore, digital transformation must be seen one of the priority areas of intervention at organizational, sector or national levels for the years to come.

Depending how wider and deeper adoption of digital technology is achieved within an organization, there are expected various levels of impact on business performance (e.g., output volume, diversity, customer satisfaction) (Fig. 18). Utility of digitalization and digital transformation is related to the complexity of the business. Not all businesses need sophisticated digitalization. The type of business and the level of complexity of the results have an influence of the sophistication of digitalization.

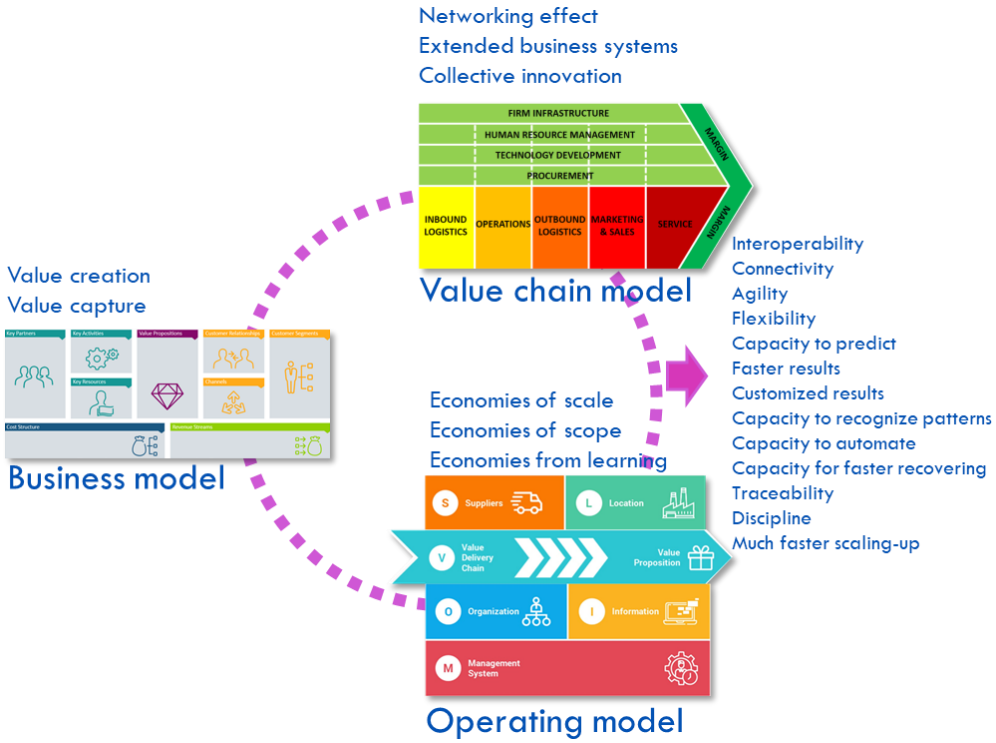

Figure 17. The value of digital transformation

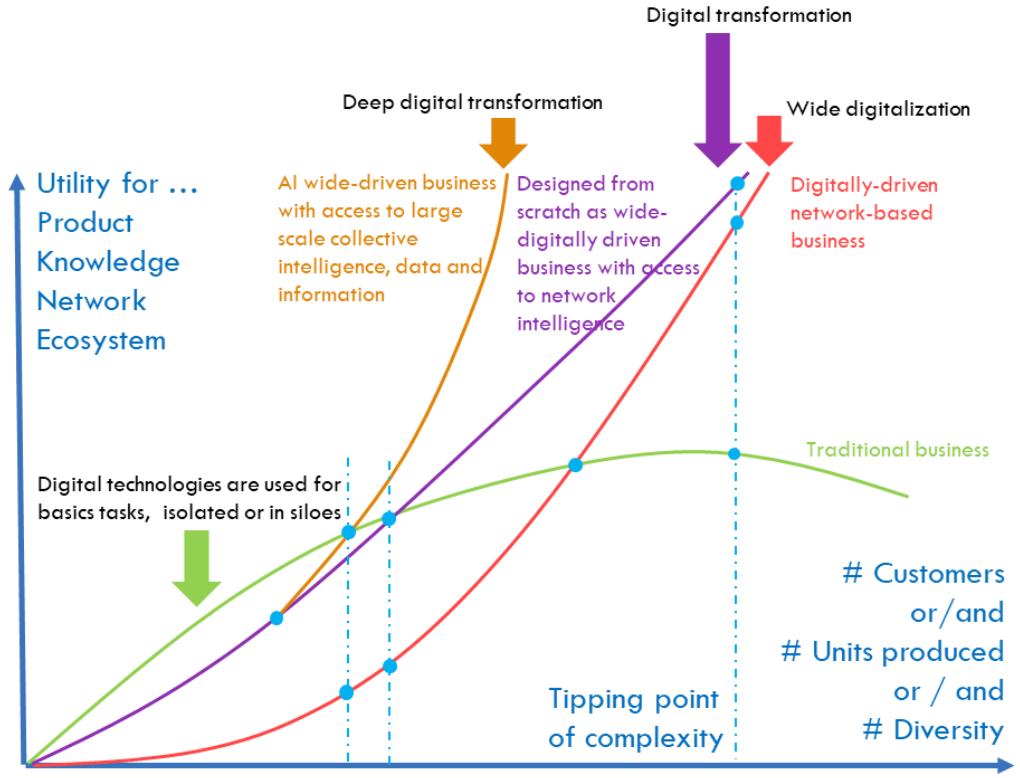

Figure 18. Effect of digital technology adoption

For example, in many traditional businesses, lack of wide digitalization does not necessarily impact competitiveness if complexity of outputs is not high. Isolated use or in siloes of digital technologies for assisting secondary processes such as accounting, payroll, or for automating some operations might bring value added. However, beyond a critical point, maintaining the processes in the traditional paradigm of digitalization will rather lower the impact than improving it, because complexity comes with additional costs in such cases. Above a certain level of complexity, wide digitalization creates exponential higher benefits, meaning that it opens the gate for rethinking both processes, and business systems. These benefits can be obtained even at lower levels of output complexity if digital transformation becomes part of the business strategy, because it redefines both the business model and the portfolio of products and services (e.g., smart connected products, servitization, data-based services, etc.). This is also facilitated by the fact that, digital transformation can lead to wide connectivity with knowledge flows, supplier networks, customers, etc., thus benefiting of collective intelligence from the wide knowledge network. A deep digital transformation delivers even more benefits because of the intensive use of artificial intelligence in many areas of the business (e.g., over 200 areas of a business can adopt artificial intelligence).

Digital transformation is not a panacea to future VUCA challenges. Organizations must consider several other transformative paradigms, such as organizational development, collaborative and open innovation, and management of resilience (Fig. 19). Organizational development is an approach that assists organizations build their capacity to change and achieve greater effectiveness by developing, improving, and reinforcing strategies, structures, and processes. Organizational development considers multi-lateral diagnoses and adoption of various good practice standards, such as total quality management, innovation management, circular economy principles and standards, strategy management, etc. But the limited internal resources at the disposition of an organization for fast adaptation to changes calls for open collaboration with external partners, in novel collaborative models, such as polycentric innovation. Unexpected crises often create jumps in VUCA. A good example is the crisis created by COVID-19, when organizations had to reinvent their workspaces and the concept of work-office. Operational processes suffered wide transformations and new supply chains have been invented or activated, too.

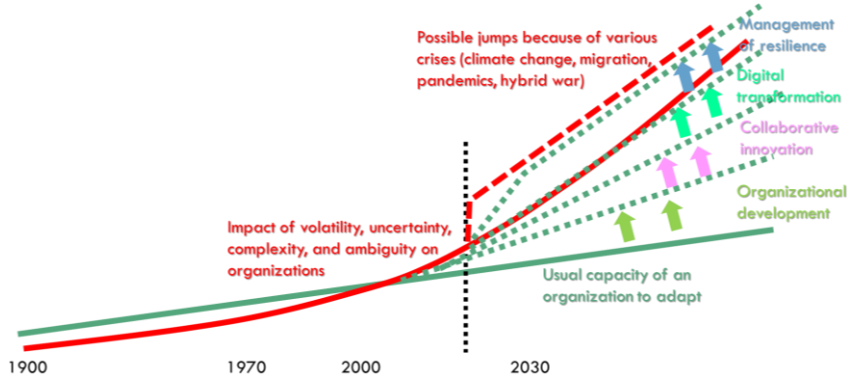

Figure 19. Digital transformation as part of a kit of concepts towards the power to adapt to crises

Thus, a new objective function must be considered by organization; that is, resilience. It appends to the list that already includes productivity, quality, innovation, safety, and ecology. Digital transformation will help to build an effective resilience management system; or seeing from a different angle, we might say that without digital transformation organizations will strive to put in place a highly resilience business system.

A short reflection on system evolution highlights an interesting fact. Evolution does not simplify things. It comes with a payment for each gain. For example, we can increase productivity and agility without human operators, but technologies that are put in place to make this are more and more sophisticated. In fact, this paradox is true, because we want to replace something very complex and complicated – which is the human operator or human expert – with machines and machine-based processes. Therefore, the more transformations towards an "autonomous economy", the higher the challenges for people to design and implement adequate technologies to face these challenges. So, the new normal for this ambitious journey of humankind is VUCA. Are we prepared to deal this ambition? If we look back, we find that people have always found solutions to the proposed goals of progress. This should give us confidence in the success of our future endeavors.

6. Conclusions

This paper looks to digital transformation from micro, mezzo, and macro perspectives to reveal its potential and benefit in the future economy. The analysis is done with the intention to reveal its value from a transformative understanding; that is, how to use digital transformation to transform the current micro, mezzo, and macro-economic models into something that is more sustainable, ethical, and resilient. So, beyond any short-term interests to adopt digitalization and digital transformation for improving competitive advantages, this adoption embeds a huge potential to construct a better world and facilitates the effective adoption of several other powerful paradigms, such as circularity and resilience.

The problem of adopting digital transformation models is not simple, because a deep digital transformation requires system and architectural innovations that exceed the borders of organizations. Deep digital transformation of your organization without similar efforts done by your suppliers and partners is less effective. It is like the revolution of vehicles, from fossil fuel engines to electric motors. It is not sufficient to innovate the car driving unit, but also the network of charging units in cities, towns, and villages, and along the roads, and also the redefinition of the energy generation and supply technologies. Even if the electric car has lower carbon footprint over its lifetime of operation, if the technology for provision of raw materials for batteries and the sources of energy are pollutant, we make worse things than better. Thus, additional energy required by the future electrical vehicles must be supplied from renewable sources of energy, and the processes required to manufacture the systems that produce renewable energy must be clean.

It is the same situation with digital transformation. It is expected to obtain new or higher value, higher agility, higher resilience, and less costs from systems driven by digital transformation paradigms, but we must investigate the overall ecosystem, and

to promote a holistic perspective, to also understand its side effects. It is not sufficient to investigate the success stories of digital transformation, because it might happen to also have failures in some other companies following the same strategy. Because digital transformation counts on data, we need to avoid the "Wald effect"; that is, to be sure that we look to the right parts of the system when collect and analyze data. We need to avoid the trap of looking only to those parts of the system that are accessible and to resources that are visible. The problem in many cases arise from areas that are less accessible or invisible; that is, solution to a problem might not be in what is seen and present, but in what is missing.

It is also necessary to engage digital transformation in synergy and in parallel with other transformations and improvements within the targeted system. Investments in digital transformation in an environment with poor cultural transformation and lack of innovations in marketing and networking has little chances of success. Digital transformation is not to invest in digital technologies just for having access to data. Digital transformation brings new processes, thus additional costs. To be financially feasible, reforms in rethinking process to generate savings is necessary. And, as in any other cases of successful innovations, adoption of digital transformation requires alignment to the "9x effect"; that is, the benefits obtained from this adoption to be significantly higher than the efforts and discomfort generated to give up to current processes and behaviors.

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Using drone technology for preserving the economic sustainability of the agricultural holdings

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Abstract

In the present era, precision agriculture, through the set of innovative technologies that it uses, allows to effectively manage the terrain, machinery, and input acquisition, considering the specific natural variation of the environmental conditions. One of such innovations is the unmanned aerial vehicle (drone) technology which has gained popularity and has been widely used in adopting efficient strategies for preserving the economic sustainability of the agricultural holdings. The need for an efficient management, the complex climatic, technological, economic, and biological changes that have recently occurred at the level of agro-systems impose a continuous and accurate knowledge of the growing production resources and the vegetation state in cultures. In this context, the article investigates a series of particularities regarding the use of geospatial and informational technology in the process of taking, storing, analyzing, and interpreting them to optimize inputs, considering the state of the crops and the degree of soil supply in each relatively homogeneous area of the terrain.

Keywords: economic sustainability, precision agriculture, unmanned aerial vehicle.

1 Introduction

This article is based on the certainty that humanity is living in a limited resource environment, which is currently under major pressure from climate change and population growth. It requires the production, use and promotion of knowledge in the direction of the adoption of new models, at the level of production and consumption processes, to implement the principles of biology and ecology in economic development. One of the aims of this research is to assess the possibilities for the agricultural sector to cope with the pervasive and incisive challenges posed by climate change, population growth and the limited nature of resources, especially the limited

availability of agricultural land and freshwater reserves. The impact of these challenges on the need for sustainable agricultural development is major given that agricultural production must increase by 70% by 2050 to respond positively to the food needs of a population expected to reach 9 billion at that time [1]. Relevant options for a favorable response to the highlighted challenges can be identified using information and communication technology (ICT) services, the Internet of Things, but especially unmanned aerial vehicle (UAV) technology associated with image data analysis [2]. The use of information and communication technology services results from the need to aggregate and process information from multiple sources; the use of remote sensing techniques and image analysis allow the assessment of the health of vegetation and is done by aerial monitoring of crops with the help of UAVs, manned vehicles and satellites and the subsequent processing of images captured by them [3,4]. Knowing that satellite imagery is expensive and often has unsatisfactory image quality, and aerial imagery captured by manned aircraft although at a good resolution is costly, we will promote access by agricultural enterprises to aerial crop monitoring services with the help of so-called UAVs and drones, because it offers good resolution images at affordable costs. Thus, agricultural enterprises are encouraged to adopt a smart approach to specific activities, to promote the concept of precision agriculture, which involves the development and implementation of innovative technologies and the use of smart aggregates to carry out / improve activities efficiently and effectively [5]. The impact of drone use is positive because it provides real-time information on areas affected by disease and pests; the variability of the crop's reaction to the action of stimuli such as: irrigation, herbicide, fertilization; contributes to the reduction of the quantities of plant protection products [6,7,8,9], the correct estimation of biomass [10,11,12] etc. The images collected by the drones are processed with the help of software dedicated to assessing the state of vegetation of agricultural crops by obtaining vegetation indices: global vegetation index (GVI); Vegetation Index with Normalized Differences (NDVI); green standardized vegetation difference index (GNDVI); adjusted soil vegetation index (SAVI) etc. The most widely used of these is NDVI (Normalized Difference Vegetation Index) and Near Infrared (NIR) 800 nm. Its usefulness lies in assessing the development and density of vegetation as a result of estimating biomass, green intensity (Greenness), production, fraction of active radiation absorbed in the process of photosynthesis (fAPAR), leaf surface index (LAI), identification of dominant plant species etc. [13,14,15].

2 Research methodology

The present research focused on the descriptive aspect of the problem, ensuring the understanding of aerial monitoring of agricultural crops with the help of drones and the explanatory part focused on identifying variables and their relationships [16]. Due to the complexity of the studied issue, the research was conducted according to the case study methodology recognized by the ability to provide an accurate picture of current phenomena and to understand the causes that determined them, respectively by adaptability to territorial specificity [17].

The research methodology was based on the direct study of the ways of collecting data from secondary sources such as literature, and main through field experiments; of the methods of processing with the help of software, respectively of their interpretation, use and storage. The case study was carried out on the land of the agricultural enterprise SC Agri-Trade Oravița SRL located in the S-W of the country, in Caraş-Severin County and consisted in highlighting some particularities regarding aerial monitoring of agricultural crops and real-time signaling of changes and vulnerabilities in agroecosystem.
The main objective of the research is to highlight the role of taking real-time information on the state of vegetation of agricultural crops and their location underlying the decisions of the company's management. For this, several research directions were pursued: the review of the specialized literature regarding the use of drones in agriculture; organizing field research for the operation and retrieval of information using drones equipped with multispectral sensors; information processing using software and their interpretation; use of the results obtained.
The DJI Phantom 4 drone was used in the aerial crop monitoring action (fig. 1). The drone's guidance system is based on GPS, each recorded photo having correlated geographical coordinates (in the WGS system) of the camera's position. The flights were made at a height of 50 m, according to a flight plan made by selecting a terrain area on a Google Earth or Map support (fig.2).

Figure1. Drone DJI Phantom 4

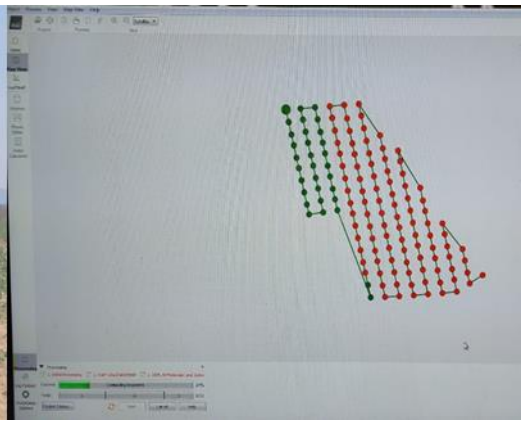

Figure 2. Flight plan

3 Results and discussion

The case study carried out within the agricultural enterprise SC Agri Consorțium SRL highlights a series of particularities regarding the implementation of precision agriculture. These belong to the field of agrophytotechnics and artificial intelligence. Those of agro-phytotechnical nature reside in the structure of crops, specific to the phytotechnical agroecosystem, represented by the following crops: wheat, oats, corn, rapeseed, sunflower, soybeans, peas, alfalfa constituted in a crop organized for four years covering an area of 4540 ha.

The peculiarities of adopting artificial intelligence in production and management processes stem from the use of IoT technology, wireless sensor networks and UAVs for data collection, processing, interpretation of results and choice of optimal decision options. The whole process leads the agricultural enterprise to adopt a resource management based on proportional management taking into account the need for plants that can vary spatially and temporally [18].

To highlight these features, a field research was organized for the operation and retrieval of information using drones equipped with multispectral sensors. The multispectral images obtained were processed using agisoft and global mapper software, which allowed obtaining relevant data that underpinned the company's management decisions that led to the judicious allocation of inputs [19]. Picking up information with the help of the Phantom 4 drone was done from a height of 50m according to a flight plan by selecting a terrain area (the analyzed plot) on a Google Earth support.

The interval between the photos, their number and the distances between the drone's routes is directly related to the flight altitude and is automatically calculated for a correct overlap and obtaining the orthophoto plan in fig. 3. It is georeferenced and is an important source of information on topographic measurements. plant density and health, quality of agricultural work, etc. It also contains the set of information necessary to assess the state of vegetation after processing them with the help of the mentioned software and to obtain the vegetation index with normalized differences NDVI. Monitoring the differences in NDVI leads to critical solutions at an early stage regarding the vegetation saturation of agricultural crops.

The information obtained from the capture of images using drones and their software processing is also used in the creation of a geographic information system (GIS). Within the agricultural enterprise SC Agri Consorțium SRL, it fulfills the role of geographically referencing the cultivated plots of land, ie of corresponding to the reality in the field. The GIS software used is called pmx_AgroLand and works with software called Agronavia.

The adoption of this geographical information system responds to the need for farms to record and manage data on cultivated areas, obtained production, agricultural inputs used to provide summaries and reports to state institutions, respectively to support and guide the farmer in decision-making on development, implementation and innovation. in the specific technological process.

Figure 3. Field image and orthophoto plan

4 Conclusions

The present research highlights the role of artificial intelligence in the optimal management of inputs and ensuring the sustainability of agroecosystems. The adoption of artificial intelligence in specific activities is encouraged and involves the development and implementation of innovative technologies and the use of smart aggregates to perform / improve activities in terms of efficiency and effectiveness. The impact of drone use is positive because it provides real-time information on areas affected by disease and pests; the variability of the reaction of the culture to the action of some stimuli, the correct estimation of the biomass, etc.

The images collected by the drones are processed with the help of dedicated software for assessing the state of vegetation of agricultural crops by obtaining vegetation indices. The most widely used of these is NDVI.

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The adoption of the GIS system allows the recording and management of data on cultivated areas, production obtained, agricultural inputs and the preparation of specific reports, and the adoption of optimal decisions.

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Industry X: Products for the Future

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Abstract

The authors of this paper are introducing a new concept for definition of the future of Industry 4.0 and are presenting details and characteristics of the concept Industry X in regard to the current global digitalization of Automotive Industry. Starting from the Mechanical Age (Industry 1.0) and until the Digital Age (Industry 4.0) which is already ongoing, the authors are identifying and defining the shape of the nearby future through the so called "Quantum Age" or the next step in the Industrial Revolution: Industry X.

Keywords: industry, digitalization, automotive, future, industry 4.0, smart products, predictions, concepts

1. Industry X and the "Legend of X"

The main and most important question that is nowadays on all stakeholders from all the industries is "How to define the future?" We look around and everything is more and more digitalized. Starting from our satellite alarm clock in the morning, going to work in autonomous vehicles, shopping everyday goods with help from a digital assistant and delivered by drones and up to automatically creating night scenes in our smart homes, we are surrounded by technology which was already envisioned by humans a few years ago and included in the Industry 4.0 or the "Digital Age" Can we go further with this development? Which is the next step? What is future? Is the future already here?
The logical step after Industry 4.0 is Industry 5.0, but still the number is too small in comparison with the leap that the technology is taking. How many increments to have for this? Since the future is still not clearly defined and in constant change then why not to use a general variable to define the "Quantum Age": Industry X.

What is legend behind the letter "X"? Let's remember together when we first encountered this letter in a context outside of learning the alphabet. It is clear for most of us, "x" was the "mysterious" symbol used in the mathematical equations to mark the undefined value which actually represented the goal of the operation. Basically X is a symbol of a discovery waiting to be made, and in this mathematical example, this discovery can be done through algorithms. How can we apply any algorithms to discover the X from the Industry?
Until we discover the concept let's look at telecommunication industry. From 0G which was the analog wheel telephones (pre-cellular devices), 2G GSM networks, 3G GPRS

and EDGE networks, 4G and nowadays high speed 5G protocols we are asking one question how many G's are going to be?

Coming back to the Industry we are have the same question: How many X's are there in the "Industry"?
Therefore, ***the "X" from "Industry X" represents the same undefined value towards which we all must evolve!***

1.1 How many "X-s"?

How many X's are there in the "Industry"? If we look at the timeline starting with the 18th century all the way to the present day and peeking into the future, we can say for certain that there could be no upper limit for what value X could take in regard to defining the Industrial Ages.
What is certain is that the frequency with which X was incremented increased significantly in the XXI century.

And who knows, maybe in the more-or-less near future, jobs like quantum computer scientist, quantum communication (or quantum encryption), cognitive computing or brain-machine interface could be more than just "Buzz-words". And are we as Humanity be in our second version? Will we be Humanity 2.0 or Humanity X, mirroring the evolution of the Industry? Can we also increment our society in order to be prepared for The Future?

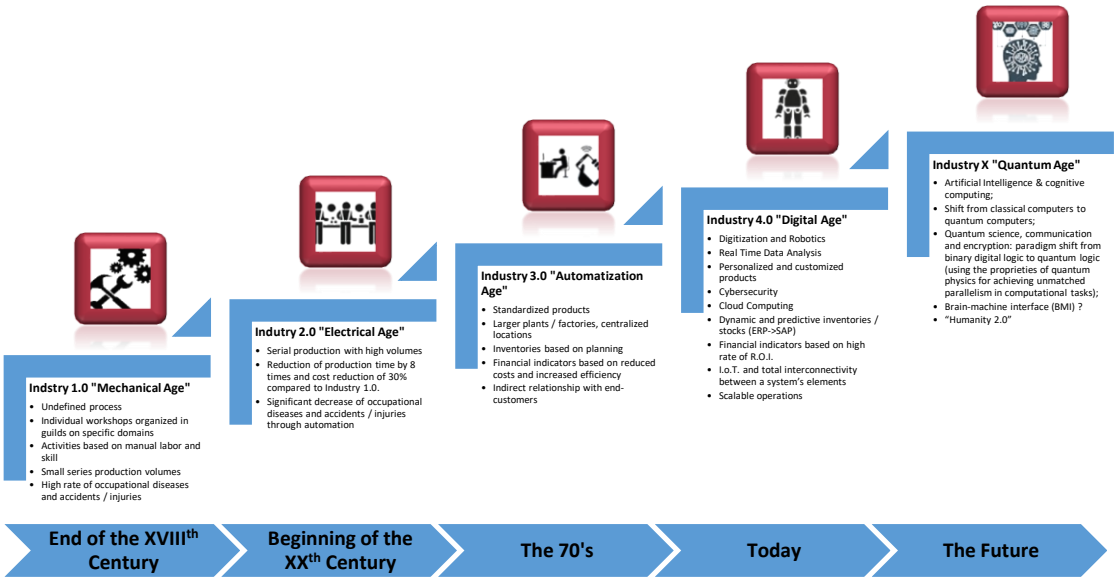


Figure 1. History of Industrial Evolution

And of course, the Future is not fully predictable but there are a few emerging theories in regard to new careers or specialized roles inside Organizations, such as:

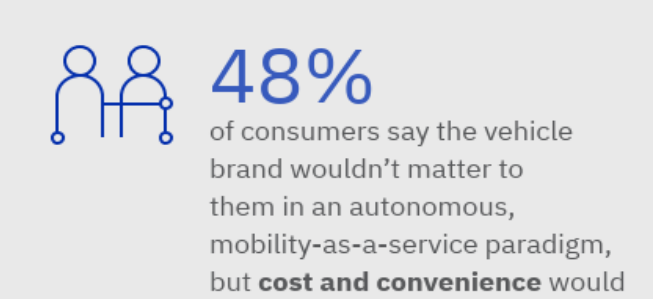
- Artificial Intelligence (AI) scientists (experts beyond the current level of A.I. development);

- Augmented Reality (AR) and Virtual Reality (VR) engineers / designers / architects;
- Quantum (computer) scientist, Quantum computer architect;
- Internet of Things (IoT) consultants / experts.

2. Industry X – Predictions about Automotive Industry

Although 2030 doesn't seem like so far in the future right now, according to the data acquired in 2019 by IBM Institute for Business Value - IBV (through a twin-survey program - one addressed to Automotive Executives and one addressed to Automotive Consumers), we are about to face significant changes in this dynamic industry, even though we might not realize this just now (even though the recent sanitary and semiconductor crisis might have *hinted* to us that change is coming).
In this regard, there are some interesting predictions for the Automotive Industry for the 2030 *landmark*, of which we can mention a few key points[1]:

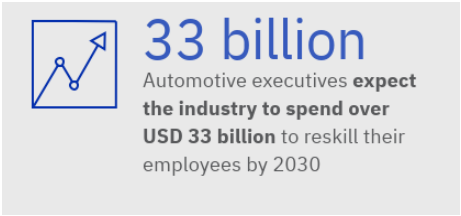
- **Reinvigorating the brand:** both consumers and automotive executives put less emphasis on the well-established brands in an *soon-to-be* Autonomous era: manufacturers and brands need to prioritize in-vehicle digital experiences in order to stand out "from the crowd", because having a world-wide recognized logo on the front of the radiator grill will not be sufficient if the experience of the user will be stuck in the "analog" era. Given the fact that 48% of consumers say that vehicle brand wouldn't matter to them in an autonomous era, but cost and convenience would matter says a lot about the shape that the consumer market is predicted to take by the end of this decade.



- **Reinventing the experience - for both consumers and employees:** applying digital technologies to optimize processes and reduce costs won't be enough as this is already a well-known strong point of today's Industry paradigm. What is essential is to use the current and upcoming digital technologies to reinvent experiences, focus, and create new ways to work thus bringing previously unattainable value.

- **Reinforcing the expertise:** the shortage of expertise already impacts the industry today and this should come to no surprise: finding the right skills in house while also accessing them throughout the ecosystem are critical to a company's success in the upcoming years. That is why, half of the automotive

executives that took part in IBV's survey state that in order to succeed or even **survive**, their organization will have to "digitally reinvent themselves". The same executives estimate that the industry will spend at least 33 billion USD to reskill their employees by 2030: that means over 4 billion dollars annually by the end of the decade.



Citing the same source from IBV, the predictions for Automotive Industry for 2030 include also the following points:

- Every person will own 15 connected devices;
- Up to 15 percent of new cars sold could be fully autonomous by 2030;
- Software will account for 90 percent of innovations in the vehicle and lines of code will be a hundredfold what they are today;
- Car-sharing could make up 26 percent of global miles traveled.

What is especially interesting for us from this list is the statement that "*software will account for 90% of the innovations*" which signals the fact that from the physical (or construction) point of view, vehicles could have reached their pinnacle in regard to innovation - and let's be honest, this can be seen nowadays too: there is little improvement or innovation room for the physical layout of a vehicle, since everything is standardized and streamlined and premium car lines really use state-of-the art materials for their products.

However, in regard to the software of the vehicles, "the sky is the limit" and only time will tell how many innovations and technologies we will have embedded in our vehicles. For example, imagine that even though we'll still have the classical "front and rear" seats layout, who says that we won't be able to use this setup in creative ways, like having front seat passengers facing the rear-seat passengers around an "*in vehicle* coffee table" while the car autonomously drives itself to the next destination. Who will need a dashboard if the vehicle can recognize voice commands and drive autonomously to the designated place? Do we need a total redesign of a vehicle's construction process to achieve this? No. Do we need hundredfold lines of code, intelligent technologies and intelligent regulations to achieve this (by 2030)? Yes!

Coming back to IBV's survey, as shown in the infographic below, we can see that for consumers, configuring their vehicles in a personalized manner and having "healing functions" for their vehicles represent one of their highest interest levels. Additionally, vehicles will have to have learning capabilities to adapt themselves on-the-go, according to their current exploitation environment. This information emphasizes the idea that automotive manufacturers will have to "Reinvigorate the brand" and "Reinvent the experiences".

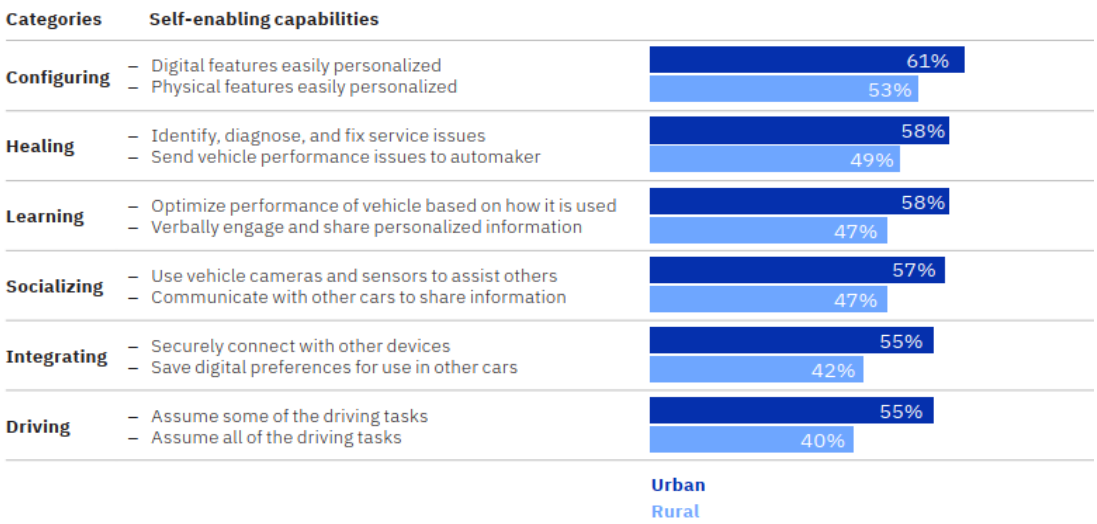


Figure 2. Consumer Interest in new capabilities for the future vehicles (according to IBV Survey)

3. Products for the future: what can we learn from fiction and how can we create these products

What about products for the future? Let's see what we can learn from fiction, more specifically from the science-fiction movies of the past that had an impact on our culture. Let's see how we perceive this movies today, considering the technological advancements of the 21st century.

Moreover, we would like to invite you to a thought experiment: try to imagine how the present day youth will see this movies. Or better still, ask them!
Will they understand why "*Star Trek*" (1966) and "*2001: A space Odyssey*" (1968) seemed so ground-breaking at their time? (Except the interstellar space travel of-course, which is still SF for us even today). Can they understand that in 1966 having a hand-held device that allowed you to connect with your acquaintances seemed to be science-fiction? Can they understand that back in 1968 having an A.I. that recognizes and responds to voice commands seemed to be "out of this world"? And indeed, video phone calls were a S.F. element in 1968. Try explaining that to them, especially if they had online-school in the past year. Will today's youth ask "Alexa", "Cortana" or "Google Assistant" for an instant search of these movie's synopsis over the web? Will they realize that this gadgets were only fiction a few decades ago?
Could they understand that the self-driving cars shown in "*Total Recall*" or "*Demolition Man*" seemed to be a "sci-fi" idea by the time this movies were shot? Or will they dissconsider today's actual self-driving cars saying that they were present since a movie shot in the '90s?

Our point is that we must take into consideration the perception that today's younger generation has over technology and to realize the fact that they will be much more tech-savvy than any generation before: and this is important to understand because we will

have to create, design and implement products that will fit their needs too and it's safe to assume that their needs will be much different from what most of us were accustomed to. Also, today's younger generation will soon join the professional workforce of the tech-industry: now we are not sure if any of this sides is prepared for each other's vision.

Besides the already mentioned movies, other notably influencing motion pictures of the past that represent nowadays mundane gadgets and technologies are:

- "*Metropolis*" (1927): early humanoid robot prototypes
- "*Blade Runner*" (1982): digital billboards, interactive holograms (flying cars not quite "usual" yet ☺)
- "*The Terminator*" (1984): fully autonomous humanoid robots, military drones
- "*Enemy of the State*" (1998): mass surveillance
- "*Minority Report*" (2002): targeted advertising

Leaving the fiction and cinematography behind, there are a few tools at our disposal which we could use in order to create the needed products for the Future. This tools include, but are not limited to:

- Analysis of today's "success stories" and pushing them to the next level;
- Using the lessons-learned concept at its full potential, having comprehensive processes derived from this concept and truly learning from past mistakes;
- Innovating continuously in a scalable manner, while keeping the industry environmentally conscious;
- By using market studies and trends and by adhering to human behavior psychology.

3.1 "We put the future at your fingertips"

So how does our Company put the future at your fingertips? [2]

The products developed and manufactured by us have state of the art technology and materials embedded in their design, and the their area of appliance ranges from "drive authorization systems" (high-tech remote controls with customer specific design and multiple bandwidth capabilities), "haptic feedback touchpads" that seem no different from the precision and sensitivity of a smart device touch-screen, "display switches" that enable the customer to personalize their interface in a variety of ways or the flexible "knob switch" which can be customized to control any household appliance.

For the next years or decades, the "Future Car Concept" created by our Company brings a new meaning to the term "functional environment" by being able to basically transform any surface of the car's interior into a control module. This can be realized using the interactive projection module which will use a light beam to project the desired control interface on any surface and will also recognize the human's input over that light beam. In addition to this the ambient lighting, functional lightning and human-machine-interface modules will be integrated into a single package which can be accessed through a new operation and function concept.

4. How can we futureproof our organizations

Future-proof is a "*buzzword*" nowadays, but besides sounding modern and technical we have to admit that its message is powerful and meaningful: future-proofing is the key process an Organization must establish now in order to exist in the future.

Below, we will discuss seven key points that we think are essential for any Organization that aims to "futureproof" itself in the near future [3], [4].

Watch ever-changing dynamics of their customer's expectations
Admittedly, behind and in front of every digital device is "a" human, today and tomorrow. Talking about humans and studying the human nature hidden behind and in front of these glass (capacitive?) screens and finding the target audience is the base of future-proofing any digital strategy. A "future-proof" digital marketing strategy aims at anticipating, analyzing and defining a buyer profile that would prevail in the future. In simple words, the strategy should aim at identifying and anticipating the change in needs that the customer may experience in the coming time.

No one can possibly predict the future change in customer behavior but a significant amount of change in usage pattern and user's expectations can be defined with meticulously watching the triggers that lead them to purchase and their adaption rate to newer, advanced technologies over time. Once these triggers have been successfully identified, businesses can formulate a future-proof digital strategy that would connect with them and trigger them to convert in future as well.

Rethink past strategies to anticipate future strategies
Looking back at the evolution of the digital landscape, many technologies have changed the way businesses work and many others seem like a far-fetched dream. No technology emerged abruptly out of nowhere; they all evolved from their preceding technologies. A look back at the past strategies can help businesses analyze the patterns of digital evolution and anticipate the future advancements. Like Henry Ford analyzed the consumer demands and came up with a revolutionary idea of the car in the era of horses, we need to use our past experience to think what digital strategies may work for our business in the coming time. Also, follow the digital trends to find a pattern of the digital transformation so that we can formulate future-proof strategies for our business.

Leverage data and information in our advantage
Over the years, businesses have accumulated (at least) trillions of bytes of data surrounding customer behavior. Right from storing and generating data to recognizing the patterns and coming up with unique strategies, data can help the businesses become intelligent and assure success. Leveraging this data into actionable insights can help businesses fool-proof their digital strategies. Business Intelligence systems can also do all the work related to big data and assist the businesses in making informed business decisions. Investing in Business Intelligence systems that analyze stored as well as real-time data can help businesses in future-proofing their digital strategies.

Incorporate the latest mobile technologies
With the unprecedented penetration of mobile phone technology and applications in everyday life (personal and business-wise) not paying heed to mobile technologies might hamper with the digital strategies. Businesses should focus their digitizing efforts around mobile phone offerings. It is crucial to ingrain the latest mobile technologies in business's core strategy to safeguard the efforts in coming time. From the internet of things (IoT) connecting things and people together to other evolving technologies like private clouds, contactless payments, BYOD (Bring Your Own Device), MDM (Mobile Device Management), and block chain for cryptocurrency transfer, there are many technologies that must be included in the digital business strategies to ensure it is ready and future-proof for the mobile age.

Increase scalability and flexibility
Whether the business operates in healthcare, financial services, retail, or government, there is no question that fragmented legacy systems continue to pose a barrier to innovation and action. This puts a strain on both their infrastructure and operational efficiency.
By increasing integration between isolated systems and fragmented data, Organizations will have a more connected foundation enabling them to scale along with new technologies into the future. Whether they would like to add machine learning, AI, or VR technology into the mix, deployment is much easier with this strong foundation in place.

Streamline operations
Having an integrated data platform reduces the overall complexity of the business' operations, team, processes, and solutions. This sets a new baseline for their operating procedures, making it more efficient and freeing-up capacity to execute on new initiatives into the future.

Strategic innovation
In today's business landscape, guessing is no longer an option when it comes to making the next move. Designing an integrated data platform gives an Organization access to insights on how to better serve their customers, identifies areas that are slowing them down, and enables the stakeholders to forecast impacts based on previous results, setting up for long-term success.

4.1 The Lifelong learning Continuum

One way of futureproofing our organizations is by assuring a strong and synergic collaboration with the Educational Institutions, being that at a local, national or global-level. Let's call this collaboration the **Lifelong Learning Continuum** [5]. And why continuum? Because this process has to be a constant positive reaction loop, not a "one-time" event.
Besides this, this iterative process will have a constant positive impact on the Organizations, on the newly formed workforce and on the Educational Institutions,

which can provide well-prepared new generations of personnel by staying in contact with the current and future industry needs, demands and trends.

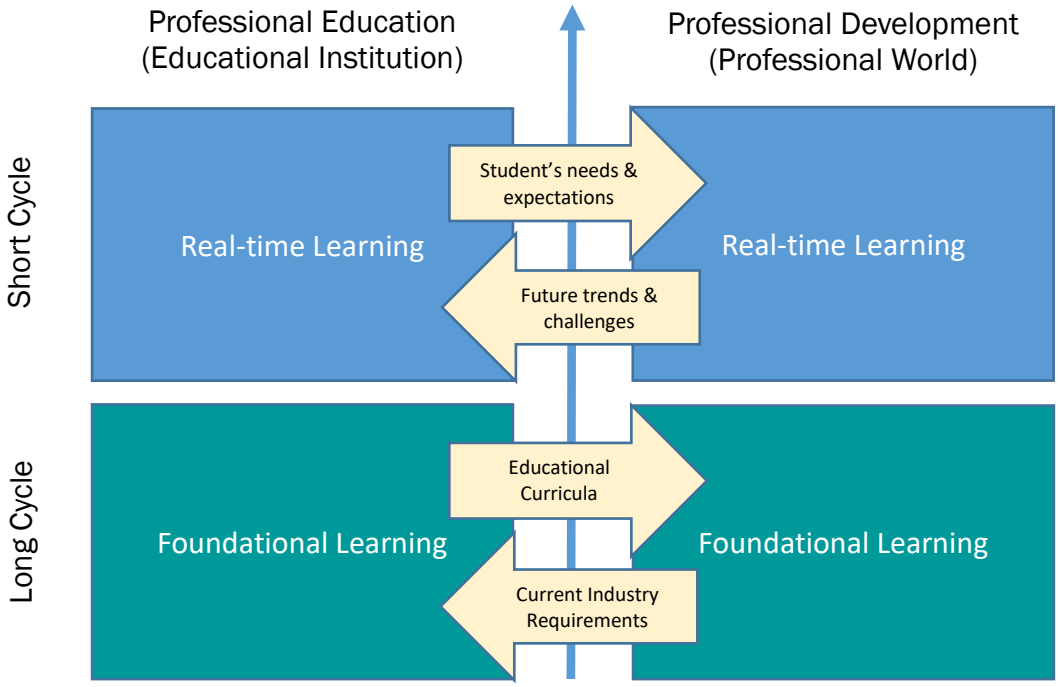


Figure 3. Diagram of the Lifelong Learning Continuum

The Continuum can be implemented in two discrete cycles:

- One "Short Learning Cycle", representing the real-time learning "on the site" of the Organization, with several increments over one year (for example): in this short cycle the communication channels are driven by the student's needs and expectations and future trends and challenges;
- One "Long Learning Cycle", representing the essential foundational learning, provided by the Educational Institution and by Professional World: the communication channels in this cycle are driven by the educational curricula and by the current industry requirements.

As interfaces and communication channels for each cycle, we can define the following:

1. For the "*Short Cycle*" from the "*Professional Education*" to the "*Professional Development*" we have the **Student's needs & expectations** channel, consisting of:
    - Direct communicaiton between Institution and Company;
    - Specific interfaces designed to optimized information flow;
    - Meetins with students' representatives for obtaining information and input.

From the "*Professional Development"* to the "*Professional Education"* we have the **Future trends and challenges** channel, which consists of:

- Inform Educational Institution about the futureContinous updates regarding the Industry evolution and standards;
- Present opportunities and requirements from Industry;
- Provide feedback in regard to student's progress and performance at work.

2. For the "*Long Cycle*" from the "*Professional Education*" to the "*Professional Development*" we have the **Educational Curricula** channel, consisting of:

- Communicate the current educational curricula to the Company;
- Offer a transparent review of student's skill through specific qualification metrics;
- Offer a plan for future improvement and update of Educational Curricula based on the feedback received from the Company

From the "*Professional Development"* to the "*Professional Education"* we have the **Current Industry Requirements** channel, which consists of:

- Continous updates to the Educational Institution in regard to actual Industry requirements;
- Include employees & professionals in the day-to-day teaching cycle of students (double-role personnel);
- Establish dedicated communicaiton teams, channels & interfaces with the Institution.

Of course, this lifelong learning continuum can work only if the two cycles rely on each other and evolve continuously.

5. Conclusions

As we see, there are still many unknown parameters and variables that will form the future – framework of the industry and there are maybe almost as many possible paths for the organizations, the consumers and the society itself to take into that direction. What remains to be seen is which of this paths is the most efficient or sustainable, and unfortunately we cannot rely on the GPS to find it out. What we can rely on is on the never-failing capability of humans to adapt to new environments, new situations and new challenges as well as on the ingenuity of our species which we developed over the countless generations and which helped us not only to overcome obstacles but to shape our ecosystems to our needs.
Maybe for a smooth transition to the next Industrial Age (which is, by the way, "*knocking at our doors*") we won't need to go to huge efforts and "*reinvent the wheel*", but rather just use today's tools and know-how and facilitate and empower the integration of younger generations into the professional world. After all, what better

baseline than this can one have for the strategic development of their Organization for the future?
So, in the end, the "X" remains a mystery, remains the goal of the discovery, just like in the mathematical equations. Weather we are close to find it out or not, remains to be seen.

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Key Success Factors for Smart City Construction

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Abstract

The Smart City is not a new concept. In fact, the digital city appeared in the information era and the wireless city emerged in the Internet era, but the Smart City had not been clearly defined until the digital era. Unlike traditional informatization, a Smart City is not simply the combination of informatization in all industries. Not only is a smart city a top-leadership project, it reshapes the digital capabilities of all industries in a city, while also addressing systematic challenges.

This paper presents Huawei perspective on Smart City development, including the conceptual framework, governance, type, connectivity, structural enablers. The paper describes also the strategic vision and a Smart City construction path, from the strategic planning, solution design and implementation.

Keywords: Smart City, Digital Administration, IdeaHub, WiFi 6, Digital Power

1. Introduction

According to a U.N. report, by 2030 two-thirds of the world's population will be living in cities, the urban population in developing countries will double, and the area covered by cities could triple. This rapid urbanization is increasing pressure on city infrastructure and services, forcing many cities to rethink how they operate [1]. The urban population predicted to grow to 66 percent of the global population in 2050. Cities already generate over 70 percent of an average country's GDP, more than 70 percent of energy consumption, and over 50 percent of global greenhouse gas emissions.

Worldwide demographic and technological trends are driving the need for cities to rethink how they use ICT, existing infrastructure, and core resources like government workers, citizens, and community and business groups [2].

This paper presents an ICT infrastructure provider perspective on how a Smart City shall be deployed in order to address the various challenges and to be successful in solving the citizens and administration needs.

1.1 Digital Economy

We can define 4 main eras in the human history:

- Agricultural era were the main pillars was the family and geographical relationship being centered on the families and organized in clans of natural economy.
- Industrial era were the business relationship were enabling companies of commodity economy
- Digital era 1.0 was based on the network relationship which have supported the communities of digital economy 1.0
- Digital era 2.0 is based on a scenario relationship which have created a the digital economy 2.0, inclusive and sustainable

In the Digital era 2.0 the Digital Economy becomes a consensus among countries. According to G20 definition, Digital economy refers to a broad range of economic activities that use digitized information and knowledge as the key factor of production, modern information networks as an important activity space, and ICT as an important driver of productivity growth and economic structural optimization.
Among the new social and economic values that digital economy brings are the creation of new jobs, convenient public services, public safety, environmental protection and better healthcare services.
Resuming, the Smart City and digital administration is about efficient governance based on a professional and efficient city management, enhanced livelihood supported by livable environment, improving the living experience and vibrant economy that aims to increase the competitiveness, attract talents and financial investments.

1.2 Insights

1. Dig more value out of the data: about 90% of the total data has not been widely sensed, collected, aggregated and analyzed. These data comes from various sources of the physical world such as urban life, tourism, weather, traffic, construction, manufacturing, production, business, services and communication. In the digital world these data could be stored in the internal IT systems or Big Data.

2. Break the barriers for deeper collaboration: the legacy systems can be transformed to a new system?

3. Build a smart environment that supports creativity: The city have resources such as things, people and data that can create an eco-system for co-creation based on investment, urban development, research and development, test-bed, collaboration and trade market which shall output back to the city invention and innovation.

4. Enable intelligence for faster services rollout: There is always a gap between stakeholders "next week" expectation versus the technology departments six to nine month reality. As Peter F. Druckner was mentioning, "Enterprises will never have enough gifted people. The purpose of an organization is to enable ordinary human beings to do extraordinary things." The technology purpose is to be one of such enablers for the cities.

2 The Huawei Smart City concept

A Smart City shall be integrated, data-driven and intelligent. There are several elements such as applications, AI, big data, Internet of Things, Geospatial Information System, Cloud, Data Center, connectivity and devices that are forming a layered structure for the Smart City as in figure 1.

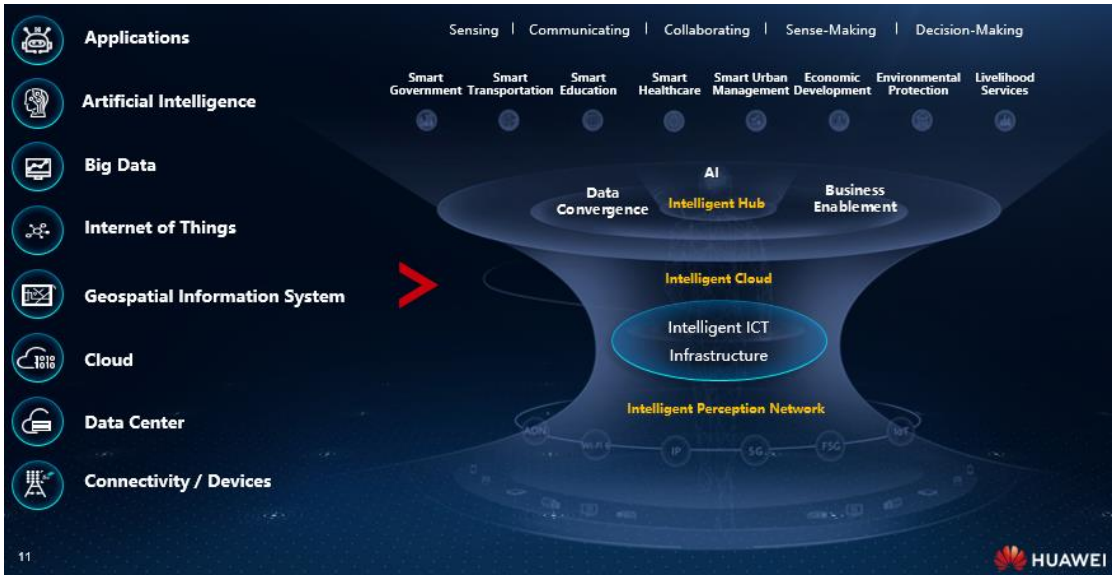

Figure 1 – Smart City layered structure

Like a living organism, a Smart City has a nervous system that comprises a "brain" (the control center), the Intelligent Operations Center and "peripheral nerves" (the network, terminals and sensors) gathering real-time information about the health and status of the city, its environment and infrastructure [1].
The conceptual framework for a Smart City is defined as in figure 2.

Figure 2 – Smart City conceptual framework

Smart is about the data – the data strategy contains three components in a cycle.
The first is the data monetization and the expected values from data: to reduce data associated costs and operating costs, to streamline processes and improve customer experience, to increase staff and partner satisfaction, to reduce risks, to develop new products and services. Data shall be considered as assets and create a data ecosystem
The data governance is considering to ensure efficient quality of data throughout its lifecycle.
The data architecture is the "how's" question in managing data lifecycle.

According to IDC the data generated in average by cities will reach in 2025 a volume of 175 ZB, a 5.3 time increase comparing to 2018. Connectivity becomes a critical service in order to assure the traffic of such a data volume.
Different means of connectivity to meet different needs of the city. For example, sensors can provide data on the transportation system performance enabling the brain to manage congestion, smooth demand and safely reduce delays for citizens [1]. The technologies to be consider are ideally both fixed and mobile such as 4G/5G, NB-IoT, all optical network and WiFi 6.

The digital platform creates a "fertile land" where the applications flourish. A Smart City develops into a living organism featuring sustainable growth and self-evolution. It provides an open and inclusive platform to enable all solution providers to participate in the development and enables new ICT technologies to be easily used by wide spectrum of users and developers.

The structural enablers from the framework are:

The strategic communications – The key Stakeholders
The governance – the Structure, Enterprise Architecture and funding mechanism
The Operations & Maintenance – the policies and standards, the organization, the ICT Platforms and the team roles

The Cyber Security – the strategy and the technology
The ICT capability development – The digitally-ready professionals and the digital inclusion
The digital ecosystem – the framework

An important part of the digital platform is the end to end security that shall contain the data security, the application security, the big data analysis, the ICT infrastructure security (cloud, IoT and network) together with the security management.

Last but not least a "privacy by design" policy shall be considered having a clear purpose, processing, retention and disposal mechanisms, using solid encryption and watermark and being auditable. A strong Cybersecurity policy is also required.

3 The Huawei Smart City solutions

From the Huawei Smart City solutions and products portfolio several ones are relevant especially considering the new pandemic reality and challanges:
IdeaHub, a key productivity tool for smart education and administration that can be used for distance class learning. The main purpose is to transform the classrooms into smart-terminal-equipped, interactive, collaborative, creative and engaging environment. There are several scenarios as following:

- Digitalize the classroom, improving the in-class efficiency in order to be more interactive and engaging
- Promote the usage of digital contents and multimedia tutoring

Among the technical features it worth to be highlighted:

- WiFi 6 tri-band, support more than 50 concurrent users connection
- Multicast protocol optimization, avoid disconnection and latency
- The Classroom Management Software supports screen sharing, group teaching, files dissemination or collection, poll and survey, digital testing, and screen lock.

The digital City Hall solution enables the local administration transformation by digitalization: resource sharing, eliminating information silos and platform based, solving the informatization requirements. It provides mobility, allowing working anytime and anywhere with a unified portal for mobility and having end to end security protection for mobile office. It is intelligent by achieving efficient administration via intelligent process that facilitates collaborative linkage together with the intelligent data analysis and smart decision making algorithms.

The digital power solution helps building a low-carbon emissions city enabling photovoltaic green energy to be main power source.

4 The Huawei Smart City strategic vision and values

4.1 The strategic vision: Platform plus Ecosystem

The strategic vision for Smart City focus on customer requirements and provide a holistic set of Smart City solutions. The platform strategy is based on open, elastic, flexible and secure. The ecosystem strategy is based on co-existence, mutual growth and regeneration.

The Smart City construction path shall include the strategic planning, the solution design and the implementation phase. The stages are the feasibility analysis, the conceptual design, the high-level design, the bidding and procurement, the low level design and the construction and operations.

5 Conclusions

A Smart City shall be treated as an ongoing program and not a one-time project. The key success factors for Smart City construction require top-leadership projects, strong execution teams, industry leading digital partners and solid investments.

As a leading global ICT company, Huawei has helped urban authorities across the world to create digitally-connected ecosystems that have transformed the way cities function – improving connectivity between people and things to generate innovation, economic growth and social progress. Huawei's Smart City solutions have been deployed in more than 120 cities across 40 countries [1].

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Industry 4.0 & how manufacturing is adapting to the new technologies

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Abstract

Producing various objects is old as mankind. Basically every product realized by individuals or groups can be assimilated with a basic manufacturing process. During times, humas managed to manufacture objects for their own usage or for commercial purposes, into small workshops and using basic tools

1 A brief history of Industry X.0

Producing various objects is old as mankind. Basically every product realized by individuals or groups can be assimilated with a basic manufacturing process. During times, humas managed to manufacture objects for their own usage or for commercial purposes, into small workshops and using basic tools.

A first major shift came during the First Industrial Revolution (Industry 1.0) in the 18th century where, instead of items being produced by basic means, processes were invented and allowed items to be produced by machines. This began in England in 1760, then finally reached the United States by the end of the 18th century.

The First Industrial Revolution marked a shift from an agrarian and handicraft economy to one dominated by machinery and significantly impacted industries like mining, textile, glass, and agriculture.

The dramatic reduction of material cost and production time impacted several industries including the textile industry. Prior to this period, textiles were mainly made in people's homes and merchants would provide the basic equipment and materials needed. This meant workers would make their own schedules, which made it difficult to regulate. Inventions as the steam engine, the spinning wheel, and the water wheel changed the face of manufacturing and set its path to an innovation that is present in our days.

Because the demand was greater than the supply, one major downside of those times it was the pressure on the lower working class. Until 1833, almost no standards existed for workers, which meant long hours and dangerous working conditions, especially for children. This led to the 1833 Factory Act, which placed restrictions on the working hours of children and set standards to protect workers.

The next shift in manufacturing is the period between 1871 and 1914, known as the Second Industrial Revolution (Industry 2.0), as result of extensive railroad and

telegraph networks, which allowed for faster transfer of people and ideas. Introduction of electricity allowed factories to develop modern production lines. As fact, the first assembly line was patented in 1901 by Ransom E. Olds, producer of Oldsmobile cars. His method allowed his company to produce 20 units per day, which eventually increased their output by 500 percent in one year. As effect, Oldsmobile was creating more vehicles, allowing a drastic decrease of prices in the same time. The method used by Olds ended up serving as the model for Henry Ford which created his own system. Ford is now credited as the actual father of the assembly line as well as of automotive mass manufacturing.

The Second Industrial Revolution was a period of great economic growth, with an increase in productivity, but also caused a surge in unemployment since many factory workers were replaced by machines.

The Third Industrial Revolution (Industry 3.0), also known as the Digital Revolution, began in the ’70s in the 20th century through partial automation using memory-programmable controls and computers.

The central point of this phase is the mass production and widespread use of digital logic, MOS transistors, and integrated circuit chips, and their derived technologies, including computers, microprocessors, digital cellular phones, and the Internet. These technological innovations have transformed traditional production and business methods. Basically, we can say that the digital revolution converted technology that had been analog into a digital format.

Is important to mention that Industry 3.0 is still present, most of the factories being at this level of evolution.

2 The Fourth Industrial Revolution

Nowadays everybody relates to The Fourth Industrial Revolution, known as Industry 4.0 - an union between physical assets and advanced digital technologies -like Internet of Things (IoT), Artificial Intelligence (AI), robots, drones, autonomous vehicles, 3d printing, cloud computing and others, that are interconnected, having the possibility to communicate, analyze and act. Organizations adopting Industry 4.0 are more flexible, responsive and intelligent, therefore more prepared for data-driven decisions.

Industry 4.0 originated in 2011 from a project in the high-tech strategy of the German government, which promotes the computerization of manufacturing. Actually the term "Industrie 4.0" was publicly introduced in the same year at the Hannover Fair.

There are four design principles identified as integral to Industry 4.0:

- Interconnection — the ability of machines, devices, sensors, and people to connect and communicate with each other via the Internet of things, or the internet of people (IoP)
- Information transparency — the transparency afforded by Industry 4.0 technology provides operators with comprehensive information to make decisions.
- Technical assistance — the technological facility of systems to assist humans in decision-making and problem-solving, and the ability to help humans with difficult or unsafe tasks

- Decentralized decisions — the ability of cyber physical systems to make decisions on their own and to perform their tasks as autonomously as possible.

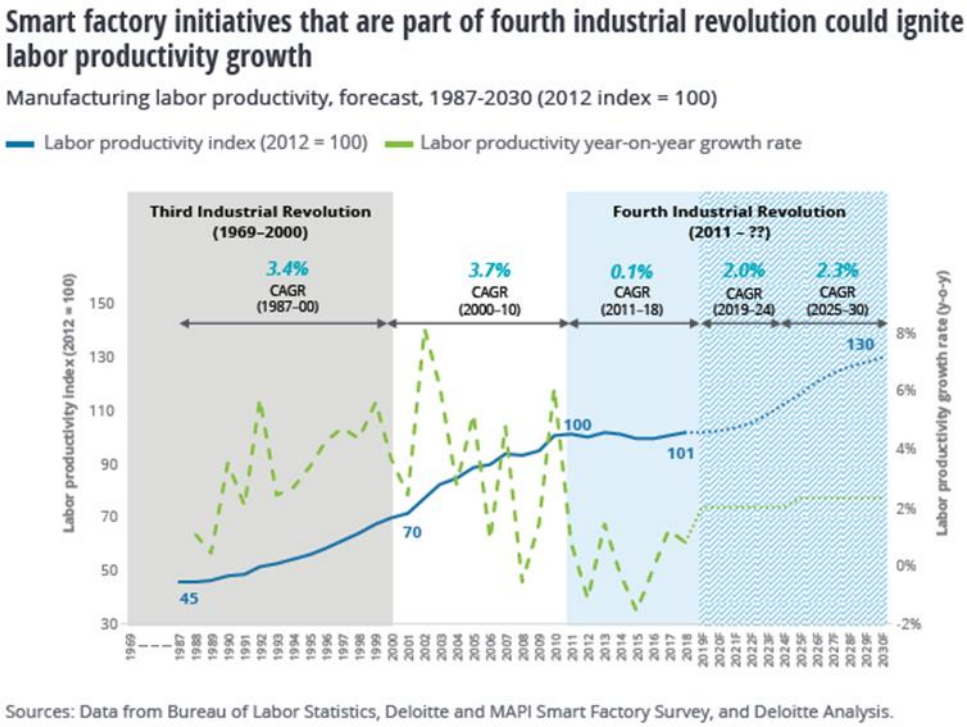

Fig.1 Industrial Revolutions

Since 2011 the focus of technology companies was to include the newest technologies into their products and deliver Industry 4.0 principles into real production. This also was possible due to an unprecedented evolution of technologies, easy to adopt and integrate, shorting the time for creating and launching of new products.
The reality showed that for some years after 2011, Industry 4.0 solutions struggled to gain traction, manufacturing companies being reluctant into changing their processes.
Meanwhile, between 2010-2018 studies show that manufacturing productivity appears to be stuck. Labor productivity continues to perplex most manufacturers, posting annual growth of around 0.7 percent between 2007 and 2018, in a stark contrast to the 3.6 percent average annual growth rate seen between 1987 and 2006. With other words, economic output is moving in lockstep with the number of hours people work, rather than rising as it did for much of the last seven decades.
Taking into account the market and the adoption speed, it is estimated that in the next 10 years there will be two steps into Industry 4.0 evolution : (1) 2019-2024, a slower phase, then (2) 2025-2030, when factories will adopt with accelerated speed the new technologies.

The numbers are based on studies that estimates 85 percent of manufacturing decision makers believe smart factory initiatives will be the main driver of manufacturing competitiveness in the following five years.

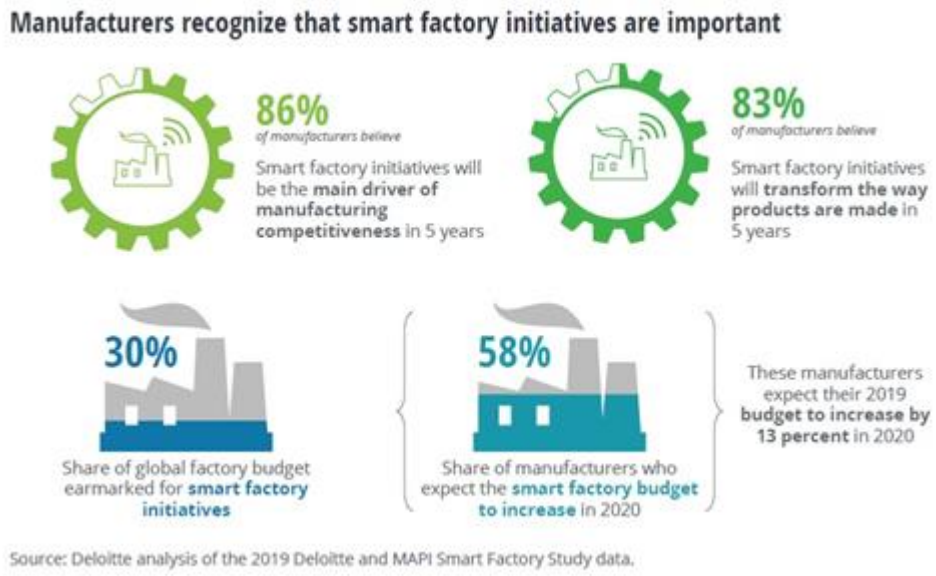

Fig. 2

As a conclusion, the market is starting to embrace Industry 4.0 technologies, even all started at a slow adoption rate since 2011, and understands that the value added by new technologies will boost productivity and profits.

3 The path to new technologies: a big challenge for small and medium manufacturers

When Industry 4.0 was first announced, the early adopters were the companies which afforded to invest and had the human resources to handle complex digital projects: the big enterprises.

The situation has not changed much since 2011: big companies from automotive, aeronautics or other industries had founded research and development centers, hired IT teams, opened accelerators for Industry 4.0 startups. Those companies are investing huge amounts of money into developing technologies related to Industry 4.0 (sensors, robots, software, etc) that allowed them to become real smart factories, to improve productivity and boost profits.

But approx. 80% of manufacturing companies from the EU are small and medium sized companies. They face many constraints, starting from mentality to budgets and digital education.

An extras from a CapGemini Research Institute study from 2020 shows that "organizations realize that they have a massive task ahead in scaling their smart factory initiatives. Of all the organizations that have smart factory initiatives, nearly 60% say their initiatives are either struggling or that it is too early to comment. Only 14% said they would characterize their smart factory deployments so far as a success."

The major challenges faced by manufacturers in achieving performance at scale are seen as following:

- Deployment and integration of digital platforms and technologies (for 51% from study responders)
- Data readiness and cybersecurity (46%)
- Hybrid, soft, and digital capabilities (45%)
- Leveraging data to continuously improve operations (42%)
- Vision, leadership, and transformation (40%)
- Being efficient by design (38%)

Another big challenge met in all small and medium factories is the level of digital education of employees. People are not used to work with digital systems and to change this a massive effort is needed from their employers. In many cases, decisions not to acquire a digital system are taken exclusively due to lack of personnel digital knowledge, a situation that leads to a vicious circle : digital solutions are not implemented due to people's lack of knowledge, and people do not gain more knowledge due to lack of digital solutions at their workplace.
To help small and medium manufacturing companies to digitally evolve, the future I4.0 solutions and vendors need to take into consideration simultaneously aspects like:

- Affordability : as possible, the solutions offered should be packed as service (SaaS)
- Ease of use : the usability should be facing the fact that many users have almost no digital education
- Technology usage : complex technologies should be transparent for end users. Augmented analytics, natural language understanding and others should ease the mission to adopt the solution for end users
- Reachable support : when users have questions, vendors need to be there on multiple channels like web chat, phone, mail - whatever is handy for end users.

4 The story of KFactory: the role of startups into Industry 4.0 ecosystem

Part of the Industry 4.0 solutions ecosystem at EU level is KFactory (www.kfactory.eu), a Romanian based startup.
KFactory is positioning itself in the first wave of Industry 4.0 startups which disrupts the manufacturing industry and innovates a core process specific in all sub-sectors - performance management of production line - the most important issue for manufacturing CEOs (as described in all relevant studies).
KFactory targets exactly the companies described above - small and medium companies, without IT knowledge and important investment budgets.
Flexible and intelligent, KFactory provides decision makers and managers with a clear picture of performance, resource utilization and efficiency. The system is able to

signal in advance the possibility of production incidents, either of a technical nature, either related to supply, maintenance or quality.

KFactory started as a product dedicated to data collection and data analytics. It evolved in time as a platform with four major components :

- KFactory Core, collects data from various sources and actors, and understands the process, showing weak points.
- KFactory Analytics, a business intelligence tool that wraps up historical data, correlations, trends and patterns, delivering a clear view over factory performance.
- KFactory Knowledge, dedicated to predictive performance and predictive maintenance by learning from actual data.
- The Team of Virtual Engineers, an unique solution that allows operational personnel from factories to interact with data and internal processes using Microsoft Teams

KFactory is proposing to tackle top 10 operational issues for manufacturers :

1. Data collection is manual or not working as it should
2. Decisions are hard to made because events are not visible in real time
3. Human actions affects substantially the production process
4. The performance of the production line is not high enough
5. Processes like maintenance, quality and supply chain needs improvement
6. The factory has a complex IT landscape, with multiple data sources
7. Advanced IT solutions are used, but context analysis is complicated
8. Long and exhausting meetings are often required to understand root causes of problems
9. Entire teams struggles with data aggregation and report consolidation
10. Data is isolated inside departments and not used into daily decision-making process

The various KFactory components are managing the issues with dedicated functionalities like automated data collection from industrial equipment, real time

notifications on multiple channels, dedicated analytics engine that allows managers to make data-driven decisions and seamless integration with other IT solutions from the IT landscape.

One good example of how KFactory is helping its customers into resolving operational problems is the rollout from G - Romanian industrial group, a joint venture with a French manufacturer with 17 factories around the world. It holds an annual turnover of 70 million euro and around 700 employees working in a 24/7 regime.

G customers are automotive companies, spread around all continents, but 70% of its production is for its biggest customer - Dacia-Renault group.

The challenges of G in production were multiple :

- No visibility of the production process. Operators were writing down on paper the shift evolution (stop reasons and pieces made), then a data collection team was introducing data into Excel. Usually reports were available for management in 1-2 weeks after the production moment, making any analysis late and ineffective.
- Every time operators were encountering issues, either they were expecting a manager to pass near them and announce the issue, or they were leaving the workplace and starting looking around in the factory for responsibles.
- Due to incomplete and late reports, improvement decisions were almost impossible. Also the entire chain dependent on the production cycle was ineffective, including maintenance, quality, supply chain and commercial.

The G management estimated a loss of around 1 million euro per year in revenue due to the cumulative effect of the operational challenges.

KFactory started the roll-out with two industrial presses as a pilot project. The first objectives were to accurate read data and accommodate operators with the application workflow.

After six months of pilot project, due to the good results, G management decided to extend KFactory to another 8 industrial presses.

Nowadays, KFactory is used on 45 industrial equipment into G : industrial presses, welding machines and robots.

As result of KFactory rollout, the production flow was optimized :

- The operators are interacting with the KFactory mobile app on a tablet near the industrial equipment, giving inputs on projects or stop reasons.
- The tablets read automatically the sensors from equipment, showing production realized in real time.
- When stop reasons involving support teams (quality, maintenance) are raised, KFactory automatically sends notifications using SMS or Microsoft Teams to responsibles. Therefore the entire support process is monitored : from the moment a notification is sent, to the moment that is received, then when the intervention is taking place and its duration.

- Data is available in real time for all managers.
- Reports are sent by email in several minutes after the shift is over, so instant visibility of the production is ensured.
- By integrating a business analytics platform, G managers have access to all data, production trends and patterns, allowing them to take the right decisions.

The following year after KFactory rollout, the measured results were impressive :
The overall performance of the production process was increased by 15%
For a part of industrial equipment the growth was even more - up to 25%
KFactory triggered major decisions at shop floor level, like replacement for three industrial presses which did not perform as required.
The data collection team was reallocated for other activities

KFactory still is rolling out new functionalities for G, adding more value for this customer in months and years to come.

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