ARTEMIS

MAGAZINE

June 2020 | No 28

ARTEMIS
Industry Association

FOREWORD

Dear participants in the ARTEMIS Community,

All forewords in all magazines in the world nowadays start with a reflection on the COVID-19 situation that has so suddenly changed the life of all the habitants of our Earth. Most of us are working from home, not sure when and how a sort of "normal" life will be come back.
Many of our companies and institutes are trying to find out whether their product portfolio can help prevent infections in direct or indirect ways and help in diagnosis and cure.

Also, in this magazine you find many references to the COVID situation and some thoughts about the post COVID era. At the same time, our community is preparing for the KDT-JU, the envisioned successor of the ECSEL-JU that should start in 2021 and continue the kind of of impact ECSEL has generated.

In a short article by Josh Grindrod you find some words on the impact of ECSEL.

Patrick Pype from NXP describes the impact of COVID-19 on his company and Paolo Azzoni from Eurotech develops his view on the Internet of Things in the post COVID era.

Ronald Dekker (Philips) and Kaspars Ozols (EDI) share their views of the ECSEL impact on health and they comment on the manufacturing culture and collaboration in Europe.

The next article describes a recent report published by ARTEMIS-IA: "From Internet of Things to System of Systems". IoT and SoS can be considered as the backbone of digitalisation, providing scalable technologies capable of managing billions of connected devices and generating potentially more than USD 3 trillion worth of revenues in the next 3-5 years. This report can be downloaded from the ARTEMIS-IA website.

Then Jerker Delsing (University of Luleå), Johannes Kristan (Bosch) and Mateusz Bonecki (DAC) discuss "ARROWHEAD TOOLS and the added value of ecosystems". They represent the worlds of academia, large enterprises and SMEs.

Finally, four influential women in our community discuss gender equality in Europe, a topic that is quite important for the European Commission. Sabine Herlitschka (infineon), Veera Koskinen (Business Finland), Elisabeth Steimetz (VDI/VDE) and Doris Vierbauch (Austrian Research Promotion Agency) give their perspectives in the context of the High Tech industry in Europe and the fact that the interest of young women in studying technology is relatively low in Europe.

I wish you an enjoyable read.
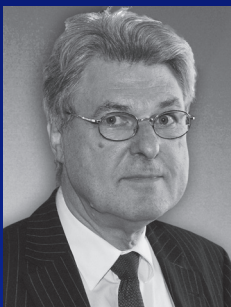
Jan Lohstroh
Secretary General ARTEMIS Industry Association

CONTENT

ECSEL

DOTTING THE 'I' OF INNOVATION TO KEEP THE WORLD TURNING

by JOSH GRINDROD

Necessity continues to be the mother of innovation. Never has this been more true than of late when our dependence on digital "high tech" was put to the test early this year. Enter a 120nm blob of grease with spikey protein stuck in it, surrounding a 30k-base strand of RNA whose only ambition in life is to make more spikey protein.

INNOVATIONS ENABLED BY ECS

This phenomenon spread suddenly and dramatically to infect around the world and slam the brakes on most of our daily business and halt much of human social and economic activity. The financial and societal consequences are huge – the "new normal" and "social distancing" are already household concepts – but thanks to electronics, digitalisation and the Internet – unthinkable without Electronic Components and Systems (ECS) – a significant number of people, including emergency services, have been able to continue providing support to many others.

In adapting quickly to the situation, key sectors, like emergency medical care, pharmacological research, transport and logistics, and manufacturing, all demonstrate the benefits of innovations in digitalisation enabled by ECS. Similarly, the world will now look to innovative technological solutions to see where they can help in healing also the socio-economic wounds left by the pandemic and build a better future. Innovation is not just about finding something "new". It's about an inextricable link between the Research at one end – looking for new things – and "the market" at the other, the sharp end where application overcomes the problems we confront.

WITH A CAPITAL "I"

The environmental and now pandemic crises have emphasised this key role for Innovation (capital "I" from now on) in creating more wellbeing for more citizens with the same or preferably fewer inputs. In addition to the more concrete technological solutions coming out of the funded projects, a key success story of ECSEL JU is the creation of the best conditions for this kind of Innovation. Through financing industrially relevant RD&I projects that are guided by European *and* National or regional socio-economic strategies and that embrace all the actors, including SMEs and academic institutes.

In the public space, put "electronics"

and "innovation" together and you get a Smartphone. But this is just a very small example of the importance of ECS: they have a long-established record as being a key enabler of Innovations across virtually all sectors. Either directly, as electronics products in their own right, or less visibly as the products that control manufacturing plants, logistics systems, cars (increasingly electric ones) and other vehicles, medical devices, and so on.

A defining characteristic of ECS applications is their extreme complexity, an aspect that is growing exponentially. The reliable operation we today take for granted is only possible due to huge volumes of past R&D, at all points along the "value chain" (these days better referred to as a "value network"), within which continued RD&I effort on ECS is an inescapable priority if society is to continue to benefit from digital technologies.

PILOTS AND LIGHTHOUSES

The socio-economic value of Innovation comes not from one specific breakthrough but from the combined effects of many interoperating ones, and the impact achieved is far greater than the "sum of the parts". This observation, in the past, led to the definition of the ARTEMIS "Pilot line" approach, which clustered work across several projects to achieve the benefits of synergy. This has continued into ECSEL JU in the form of "Lighthouse Initiatives", whose charters also extend to embracing non-technical assets such as regulatory and standardisation issues. Not only do these industry-led "LIs" add a sturdy fulcrum for the leverage that can be achieved via ECSEL JU-financed projects, they also collect and focus the results from projects in their specific field, funded by various instruments (not just ECSEL JU), and help to steer the uptake of project results. This effectively gets them ready for industrial operations to implement and deploy, thereby more quickly reaping the socio-economic benefits of their businesses, while at the same time overcoming the pitfalls that innovative ideas can otherwise encounter along that route. To date there have been three Lighthouse Initiatives called into being, focusing on Health, Mobility and

Manufacturing ("Health.E", "Mobility.E", and "Industry 4.E" respectively).

PROMISE OF A BETTER FUTURE

But back to the COVID-19 situation. At some point or another, the world will enter a post-COVID-19 phase and ECSEL JU can boast many projects whose technological developments and Innovations can become crucial in the global recovery from this pandemic and in protecting against future incidents. Like enabling "Organ-on-chip" technologies to potentially speed drug development and testing, remote patient monitoring that can potentially accelerate clinical trials. Or new electronics devices whose low electrical power consumption and intelligent energy control systems can keep our ecological footprint in check. What about cleaner and more flexible factories, clean and safe transport systems, faster and better computing devices that keep our privacy and security safe? These are all innovative results that can soon contribute to a better "post-COVID" digital society.

Thankfully, it appears that the world is managing to pull through, albeit stuttering now and then as the pandemics spits back here and there. We are taking many lessons learned in the process. One of these is that ECS and digitalisation will also play an important role in implementing the now very apparent urgencies for the future. So much so that this has become the theme of the 4th annual ECSEL JU Symposium, an online event being organised on 24 June. At this conference, leading industrialists and decision makers will discuss the importance of continued RD&I efforts in electronics and digitalisation, to assure socio-economic recovery in the post-pandemic era. To find out more, follow us on Twitter (@ECSEL_JU #ECSELJUSymposium2020) and at www.ecsel.eu.

LOCKDOWNS, LO
THE LONG TERM

GISTICS AND

THE IMPACT OF COVID-19 ON R&D

by   J O S H   G R I N D R O D

Within the first four months of the new decade, COVID-19 spread to 213 countries or territories across the globe, making it the fastest-spreading pandemic in history. While the overall trajectory remains uncertain – with much of the world having lived and worked under lockdown for weeks on end – there are also reasons to be hopeful. In this article, NXP and Philips share some of their technical and logistical innovations and what these could mean for the coronavirus and beyond.

THE NEED TO ADAPT

"At this point, we're almost 30,000 people in 30 countries," begins Patrick Pype, Director Strategic Partnerships at NXP Semiconductors. "More than 12,000 are working from home. People are working in our labs and production facilities, but we strictly follow the rules from different governments. No events, no meetings, everything done via Skype or Teams. In some cases, this is more efficient as we don't have to travel. There are pros and cons, you might say."

Starting life as a Philips subsidiary in 1953, NXP was spun-off as an independent company in 2006 and is headquartered in the Netherlands. With such a deep history in the automotive and communication infrastructure markets, Patrick is optimistic that the company can weather the storm. "We expect an impact, but we have a good position to survive this period. NXP has a policy to care for our people and to ensure that R&D projects in Europe can continue. We believe that our strength in R&D will be key to our success over the mid and long term."

"Our R&D team has solutions that are being developed for various industries that show promise in the health industry"

This largely reflects a trend across Europe: adaptation to the new situation while keeping the focus on innovations that matter in relation to both COVID-19 and the post-pandemic world. "Our R&D team has solutions that are being developed for various industries that show promise in the health industry," says Patrick. "For example, we're making air pressure sensors which were intended for automotive applications and which are now used as infrastructure for breathing installations in hospitals. Another example is a smart sensor patch which can measure the fever evolution of a patient every ten minutes. This was the result of a previous R&D project which is already commercially available on the market."

MANY BIRDS WITH ONE STONE

For NXP, however, the biggest innovation may prove to be using XAI – explainable AI- in chest X-ray screening – the oldest and most common form of medical imaging for diseases of the lungs. xAI expands on the inference and probability capabilities of machine learning by adding a more reasoned human-like decision-making approach and the additional dimension of certainty. xAI combines all the benefits of AI with an inference mechanism that is closer to how a human would respond in a situation."NXP is exploring how this could be used to deliver more confidence in the analysis of chest x-rays in the context of COVID 19" said Patrick. We're still in an early stage and are seeking partners and we hope this R&D project could someday contribute to these and other diagnostic applications."

KEEPING THE SUPPLY LINES OPEN

Beyond the R&D developments themselves, the ongoing pandemic has also created logistical nightmares: how can we ensure the production and supply of life-saving technologies when most countries are restricting movement? In Italy, where the coronavirus first took hold in Europe, Siare Engineering was asked by the government to significantly ramp up production and immediately assemble approximately 2000 respirators.

"Siare typically produces around 160 machines per month, so they were being asked to increase their production drastically," notes Patrick. "Several years ago, we introduced our pressure sensor MPX2010DP to their system, so we received an urgent request to help the company find all of the materials. Thanks to [Canadian distributor] Future Electronics and the help of the Italian army, we were able to manage an immediate delivery of pressure sensors, which enabled Siare to go ahead with production."

THE PRODUCTION CHALLENGE

Siare isn't alone in this increased demand. Philips is one of the world's leading providers of products, services and solutions to diagnose, treat and monitor COVID-19 patients, with a portfolio including invasive and non-invasive ventilators, patient monitoring and CT and ultrasound systems. Like its competitors, Philips tends not to produce its hospital ventilators in large quantities. This is part due to their complexity, with ventilation equipment containing more than one million lines of code and over 650 components. Nonetheless, they committed to doubling their production of respirators between March and May and will quadruple production by the third quarter of 2020. At a time of worldwide economic recession, they've hired dozens of new production employees to meet this demand.

"The urgency and fluidity of the situation is affecting our company, our customers and our employees around the world," explains Frans van Houten, CEO of Royal Philips. "As a company, we're continuing to focus on our triple duty of care in order to ensure the health and safety of employees, meet customer needs and guarantee business continuity. I'm proud of our employees who are intensifying, collaborating and driving this tremendous operation, including rapidly scaling up the production of much-needed products during this crisis."

Of course, this increased workload counts for nothing if these ultrasound systems, ventilators, and patient monitors fail to reach patients, particularly in high-risk areas such

as dense population centres. With the loss of approximately 90 percent of all flights between Europe and Asia, however, there has been a major shortage of cargo capacity. Philips has therefore joined forces with KLM and the Dutch government to create a special airlift between the Netherlands and China, with requests for extra capacity coming in from many other parties. By bringing the Boeing 747-400 Combi back into operation twice a week to Beijing and three times a week to Shanghai, approximately 250 tonnes of extra cargo capacity have been created per week.

"We're grateful to those who cannot stay home, both at Philips and beyond," adds Van Houten "From caregivers to postmen, catering workers and cleaners, we see you and we thank you. We hope that you take pride in the work you do to make a difference to the health and lives of those around you."

FACING THE FUTURE

In closing, Patrick has some words of advice for other R&D organisations on dealing with the current uncertainty: "You just need to continue in a different way. Content-wise, I would not make any changes to programmes unless you have solutions which can help with COVID-19. Of course, it's important that you do what you can to support hospitals, so we've also been making donations and doing fundraising. In France, for example, we've donated more than 5000 masks to local hospitals. In the Netherlands, we've given facemasks to hospitals and laptops to schools and care centres.

"For NXP, it's very important – and I think this is the key message – that we do not take actions to completely reorganise things. This is the advantage of our sector: we can all work in a remote way because we already have the programmes. We need to run them as planned because there will be a period after COVID-19 when our solutions will still be needed."
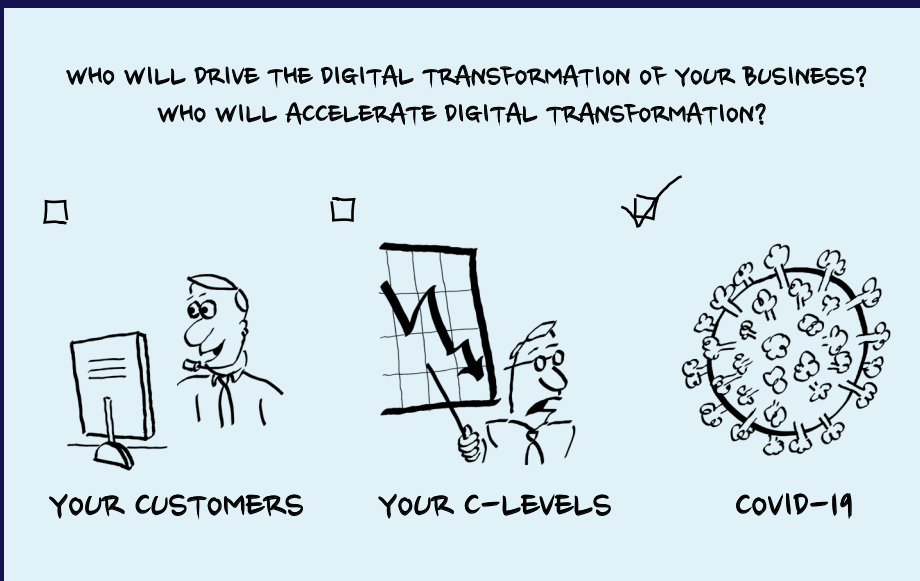
INTERNET OF THINGS IN THE POST COVID ERA

by **PAOLO AZZONI**

COVID-19 has completely changed our life, the way we work, how we interact with people, the global economy, but we have to look forward: what will we do after? Will there be an "after"? Or will we have to live together with COVID-19?

But we have also to ask ourselves what we have not done before...

In the environment where we live, a tiny planet in the universe, we share billions of tons of biomass very different from human life, including millions of virus species, some of which we don't even know of their existence. Viruses have a role in our delicate environment, and we cannot imagine completely eradicating them.

As humans, we are programmed to try to anticipate and plan the future, but an analysis of the past in a similar crisis is fundamental to avoid the repetition of previous errors. Probably, the COVID outbreak is strictly linked to the underestimation of risks that characterise our society, in almost every sector. In 1986, just after the Chernobyl disaster, Ulrich Beck published the book "Risk Society: Towards a New Modernity" ("Risikogesellschaft"), in which he highlights that the primary characterising element of modern society is its increasing tendency to create catastrophes, with dramatic impact on humans and their activities. He considers the "risk society" as the last step in the evolution of society, a step where the greater the hazard, the more the reward… Unfortunately, sooner or later, a similar approach presents the bill, a bill that all the humanity has to pay.

The Conora virus, apparently, is not a human generated disaster like Chernobyl, at least not directly: the scientific community is converging on the idea that the conjunction of ecosystem rupture, overpopulation, pollution, globalisation and frequent zoonosis indirectly contributed significantly to the Corona virus outbreak, transforming a natural phenomenon in a global disaster.

TECHNOLOGY IS PARAMOUNT

Technology has evidently a responsibility in this: consider the global transportation system and its role in the rapidity at which the virus has been spread, all over the globe. The air transport sector exposed us to a high risk and is also one of the markets that is now paying the saltiest price. Again, the risk is the point: the benefits society is accustomed to are strongly bound to an irrational and irresponsible underestimation of risks. Using a simile, if a car allows you to reach 200 km/h, it doesn't mean it is safe or clever to reach this speed: it depends on the brake system, on the power steering, etc. … and on someone that periodically checks them. The scientific community advised many times on the necessity of a deeper knowledge of pathogenic organisms, but research funding was reduced in the face of the perspective of limited profits. A short-sighted decision that is now costing us ten, hundred or maybe a thousand times over. The certainty of the possibility of new pandemics pushed the World Health Organization to define specific pandemics plans…that almost no one took

seriously. And it is clear today that you cannot improvise.

The lockdown and isolation indeed represent a temporarily improvised and inevitable measure that is impacting on global economy as much as the virus itself. Lockdown and isolation have to quickly make way for a structural recovery and to a safety and resilience plan for the future: we have to avoid the previous errors. Technology plays a fundamental role in this plan. Technology is not good or bad, it depends only in the way it is used. Technology is fundamental to the prompt detection of future pandemics, tracking and keeping them under control, ensuring the resilience of the healthcare system, transportation, agriculture, production and even the economy. The lockdown is also having the positive effect of increasing the sensitivity of the collectiveness towards all digital technologies: people have been practically forced to embrace digital technologies from home to communicate, work, maintain social relationships, monitor health, do shopping, make payments, etc.

In the ECS value chain, IoT and SoS represent technological solutions that could significantly contribute to achieving these objectives and ensuring a quick and safe recovery. Except for the initial phase of the crisis, where we assisted in a momentary reduction in demand for IoT products, in the medium-to-long terms the impact of COVID-19 on the IoT value chain will be extremely positive. Some business areas are suffering and will suffer from ongoing losses where IoT could not contribute to recovery in the short term (e.g. the global tourism industry is expected to lose around USD 80 bn in 2020), but many other areas could benefit from IoT technologies to re-start (already during the quarantine) and even experience a significant boost of pre-COVID revenues (e.g. healthcare domain, logistics, manufacturing, etc.). The huge market dimensions and the positive expected trends illustrated in the Artemis-IA whitepaper "From IoT to SoS"[1] will result in being conservative. Analysists also believe that a larger than expected market growth is not the only consequence: the pandemic will increase the digital divide, due to the opposite and contrasting behaviours

of those that will fully embrace the digital transformation and those that will remain reluctant to do it. Embracing the digital transformation and its new business models will allow a quick recovery and will ensure a leading position for the future.

A CHANGE OF PERSPECTIVE

Embracing the digital transformation doesn't mean only to adopt the state-of-the-art technologies, such as IoT, embedded artificial intelligence, hyper-connectivity, edge computing, etc., but it is much more a strategic decision, a change in the business approach, a change of perspective involving many other aspects indirectly linked to technology:

+ operational and organisational processes, linked to new business models, must be "reshaped" to take advantage from the data stream collected from remote sources, flowing, stored and processed in the IT infrastructure organisation. The internal re-organisation is typically the most difficult step in the digital transformation, impacting even on the company c-levels.
+ Many new agile business models have been introduced in the IoT domain, subscription based, asset sharing models, data monetisation models, pay per use, service offering, razor blade, etc. Financial aspects are also involved because the payment mechanisms change with these business models.
+ The digitalisation process transforms the role and positioning of the company in the value chain, changing also the relations, partnerships and alliances with the other stakeholders.
+ The digital transformation requires new internal skills and professional expertise that can be acquired in hiring new personnel or training the existing human resources (e.g. embedded engineers, computer scientists, data analysts, system administrators, etc.).
+ Globally, a cultural change, a shift towards flexibility and to a more service-oriented and IT-based production, operations, management, sales, etc. is required in the organisation.

Fig 1 — IoT global revenue share (2025-30)
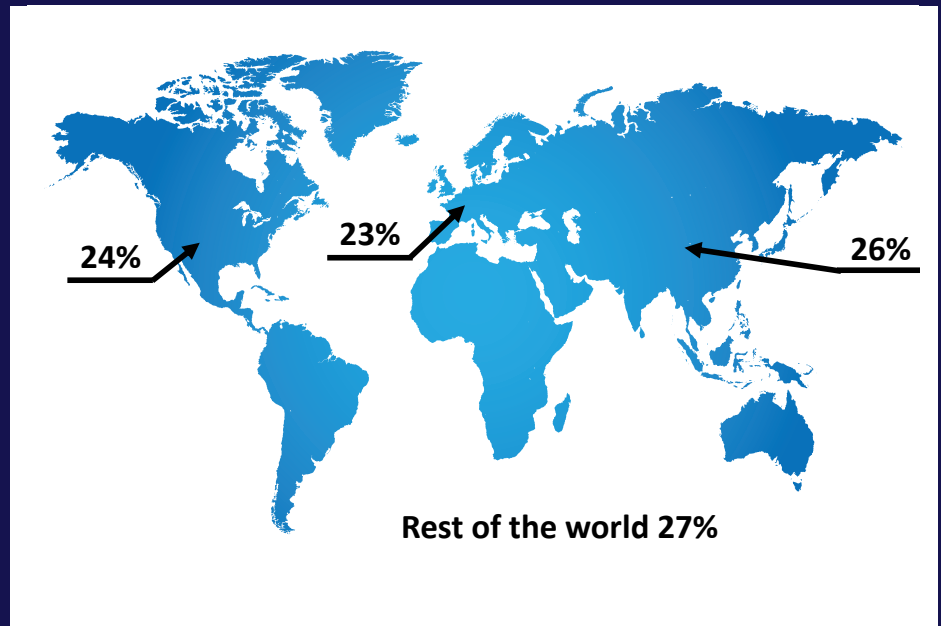
A large part of the population has been forced to adopt smart working, which is already an enabling technology per se, to ensure the continuity of work activities, the primary factor in supporting the economy. Without smart working, the freefall of the global economy would had been disastrous. But smart working requires transparency, in almost any aspect of daily activities, for the employer that needs to know employee whereabouts, conduct and health conditions, for the supply chain to track and verify the origins, status and quality of goods, for companies to ensure the trusted remote execution of decisional and operational processes, manufacturing activities, etc.

IoT devices and the IoT infrastructure also allow companies and people that are not or cannot be digitally connected to be easily reached. IoT adapters or retrofit solutions combined with the latest communication technologies also bring the IoT functionalities and benefits to rural and inaccessible areas.

NEED FOR AUTOMATION

The remote execution of working activities is just the tip of the iceberg that hides the area where IoT could experience more significant market acceleration: automation.

COVID-19 requires primarily social distancing and, in the working environment, this means a first step towards reducing the human presence in everyday activities and substituting it with automation. Automation is commonly perceived as a potential obstacle to employment but, in global crisis like a pandemic, it becomes an ally to substitute humans in dangerous tasks (e.g. in hospital) and, more importantly, it ensures the continuity of processes that would stop without a human presence. In a pandemic, automation is a key factor in keeping the economy engine going. From hospital, to administration, manufacturing, logistics, etc. the availability of robots (both intelligent agents and real robot) could ensure the resilience of the society and significantly accelerate the recovery. Significant investments are expected to characterise the automation domain, in any vertical market area: production line automation, use of drones for delivery, surveillance and monitoring, connected robot for cleaning and disinfecting, etc.

Remote execution could significantly take advantage from IoT-based augmented reality that, in conjunction with automation, allows the possibility to remotely execute complex tasks in many working areas, including production, maintenance, logistics, etc. IoT-based augmented reality could contribute to sustaining all the manual activities that require an individual.

AGILE SUPPLY CHAINS

But ensuring the continuity of processes is not enough, because processes can only run with a working supply chain, providing the required goods, whether virtual goods (information) and/or physical goods. The supply chain has been seriously affected by the pandemic due to transportation restrictions, increased lead times, reduced manufacturing capacity, unavailability of goods, staff reduction, etc[2]. According to a recent survey, more than 75% of the organisations in the selected sample experienced ruptures in the supply chain and more than the 80% "believe that their organization will experience some impact because of COVID-19 disruptions"[3]. 39% of the respondents reported a severe impact in April and 22% experienced an average revenue reduction of 16% already in February. The disruption of supply chains is clear evidence that a new strategy must be identified and IoT could inspire new solutions for supply chain diversification, real-time supply chain monitoring and business model adaptation. IoT-based manufacturing plants, inventories and goods tracking cut the geographical distances, increase the number of potential suppliers and diversify the sources, contribute to costs reduction and globally improve the resilience and the "agility" of the supply chain. Moreover, IoT allows the virtualisation of assets that is fundamental for business based on multi-channel operations to unify them under a single commercial platform independent of the specific channel. This improves business flexibility and agility, specifically during crises. Virtualisation even allows the creation of an end-to-end digital twin of the supply chain, enabling the virtual exploration of different suppliers, the assessment of risks and the identification of the best trade-offs to avoid supply chain disruption.

IoT also allows the adoption of business models that contribute to supply chain flexibility and resilience, for example adopting the procurement of large categories of goods as a service, a solution that relieves the balance sheet of these costs, transforming them into operating costs.

TRACK AND TRACE

On the consumer side, apparently the interest for IoT "traditional" applications has faded during the lockdown, while the market of connected monitoring devices for mitigating COVID-19 effects and profiling people at risk has exponentially increased and is expected to grow at this pace. This part of the IoT market is literally exploding, with any kind smart device: pendants or bracelets to ensure social distancing, smart thermometers to produce daily maps of people having fever[4], smart watches to provide constant monitoring of people's vital parameters[5], smart air conditioners, smart access controls, smart water and beverage dispensers, smart locks, … even unimaginable IoT-native buttons[6], which are battery operated and connect directly to the LTE network to send instant alarm in hospitals or sensitive places.

But the large clamour and interest raised by tracking applications is demonstrating that IoT-inspired solutions have the right time-to-operations, flexibility, geographical coverage, pervasiveness, efficiency, etc. to become reliable "first responders" in crisis and global disasters. In record time, covering 131 countries, Google has been able to release periodic reports that "use aggregated, anonymised data to chart movement trends over time by geography, across different high-level categories of places such as retail and recreation, groceries and pharmacies, parks, transit stations, workplaces, and residential"[7]. Also in this context, smart objects such as smartphones, smart watches or wristbands are helping to monitor the health of infected people and ensure they are correctly following the quarantine process: a study[8] of the data collected by wearable devices (e.g. resting heart rate and sleep duration) demonstrated that is possible to monitor and promptly discover influenza trends.

SMARTER HEALTHCARE

More generally, IoT has proven to be fundamental for the entire healthcare sector, specifically in all the countries that are experiencing a crisis in their healthcare system, with rising costs, long waiting lists and inadequate infrastructures. In

IoT has proven to be fundamental for the entire healthcare sector, specifically in all the countries that are experiencing a crisis in their healthcare system, with rising costs, long waiting lists and inadequate infrastructures.

these countries the adoption of connected healthcare is slower than expected but the current pandemic will certainly push the sector to adopt IoT-based solutions. IoT has already found its positioning in the healthcare market with a wide range of applications, telemedicine, remote imaging, patient monitoring, drug administration and delivery, medical personnel monitoring and assistance, connected ambulance, etc. The healthcare sector is expected to record significant investments in the short term, along the entire value chain, specifically for technologies that will contribute to monitoring and managing future COVID-19 outbreaks and pandemics on a large scale:

+ Telemedicine services help doctors during the pre-screening and diagnosis phases, reducing the number of phone calls to hospitals and allowing to start the intervention procedures only when strictly needed. Smart personal assistants[9] (both devices and mobile app) are currently being updated to support COVID-19 specific questions, initiating the triage at home, reducing the workload and allowing doctors to focus on patients' treatment rather than on phone calls.

+ Self-driving robots and automatic disinfection systems use high-intensity UV rays and special disinfectants to clean, disinfect and sanitise hospitals. Drones and autonomous vehicles are deployed to monitor and disinfect highly contaminated hot spots, or to deliver medical samples and quarantine material.

+ At home, in hospitals, in public spaces IoT devices provided with a touchless interface can contribute to reducing the diffusion of the virus that typically can be found on doorknobs, handles, light switches, mail, packages, etc.

+ IoT devices equipped with GPS, RFID and QR code are deployed to create virtual perimeters to define safe (or dirty) areas and control people's movements and their observance of quarantine restrictions.

+ Remote monitoring is fundamental for the creation of safe locations outside hospitals (e.g. care homes, hotels, unused buildings, etc.) where patients can safely recover, releasing the pressure on essential health services and intensive care units.

+ Remote monitoring is possible thanks to IoT connected devices specifically conceived for the healthcare sector, such as smart thermometers, blood pressure meters, smart inhalers, glucose meters, automatic drug dispensers, etc.

+ Monitoring the environmental parameters and the air pollution is also fundamental, because the relationship between environmental pollution (e.g. PM 2.5) and the impact of COVID has been demonstrated[10].

+ Eventually, the large amount of data generated by IoT devices is extremely important in monitoring and tracking community-level data to understand the global evolution of the pandemic.

Monitoring and tracking the health of passengers will be fundamental for the transportation sector that has been hard hit by the pandemic, specifically air transportation that has been reduced by 70-80% and is expecting a long period of uncertainty.

THE TRANSPORTATION CONUNDRUM

In the transportation sector, another vertical market that has been particularly hit by COVID-19 is automotive, an area that offers huge opportunities for IoT: with annual investments of around EUR 57.4 bn in research and design, the automotive sector is already Europe's largest contributor to innovation, but it is that similar investments cannot be sustained in the next 2-3 years, also considering the delicate situation of this market before the pandemic. The significant reduction of investments will certainly impact on the evolution of the automotive market, oriented towards a scenario based on fewer vehicles, extremely efficient in terms of autonomy, functionalities, emissions, sustainability and costs. According to a recent study[11], the annual sales of connected cars is experiencing and will experience a significant decrease (EUR 30-35 m in 2020 and 40 m in 2021), to gradually realign to pre-COVID estimations only from 2025. The automotive industry has been forced to an almost complete shutdown of production (around 60,000 vehicles per day), therefore any technological solution, including IoT, that could contribute to restoring the supply chain

and resuming the production is fundamental for this sector. Unfortunately, sales in the automotive market are also influenced by other direct factors such as the budgets of consumers, of businesses and governments that will be significantly reduced, with a direct impact on sales and R&D investments. The consumer's reduced budget will translate into demand for less expensive cars, provided with minimal features and fewer services such as IoT, while the reduction of R&D budgets will impact on the space available for IoT projects with respect to other projects in areas like emissions reduction and electrification. IoT projects for connected cars will certainly be delayed or even abandoned, while IoT projects supporting electrification will probably see acceleration in a second stage. Consider that in recent years the costs required for the introduction of new concepts and vehicles in the automotive market have been significantly increased. In similar conditions, the collaboration between the stakeholders of the value chain is fundamental to sharing the costs and increasing the interoperability of the developed technologies and solutions. The diffusion of connected cars based on IoT technologies will also depend on the available connectivity infrastructure, a sector that requires the presence of public investments. The 5G network will play a key role from this perspective, ensuring the network coverage required by IoT solutions provided in connected cars.

STAYING CONNECTED

Hyper-connectivity is indeed a crucial factor for recovery and resilience in future crises. During the lockdown, the global communication networks have been subject to an unprecedented real test that no one would have ever imagined. The results of this test, which almost everyone has experienced directly during lockdown and smart working, are extremely positive and encouraging: many issues have occurred, but the overall communication networks held up. Luckily, unlike common Internet applications (e.g. stream TV, teleconferences, music, etc.), IoT has been conceived to ensure optimal use of the connectivity bandwidth, requiring a small data throughput although multiplied by millions of data sources. The global amount of

data transmitted by IoT applications has not significantly increased during the pandemic and will not affect the global connectivity network, due to the efficiency of the existing IoT solutions: during lockdown, millions of existing IoT devices have been remained connected and continued to operate normally. However, the evolution of the IoT market in certain applications could encounter practical obstacles related to connectivity. For example, the healthcare sector could experience deployment issues of IoT solutions due to gaps in Internet's geographical coverage and the limited command of technology in certain categories of final users. This is particularly true for elderly people that represent the category most exposed to the COVID-19 effects and that typically do not have a good "relationship" with technology: to solve these issues, the IoT solutions must provide a sort of "plug and play" deployment and installation methods, and include also the connectivity service. Once the device is installed and connected, it is simpler to interact with the user and help him/her to correctly operate it, improving the user engagement, the quality of the service provided and of the information collected.
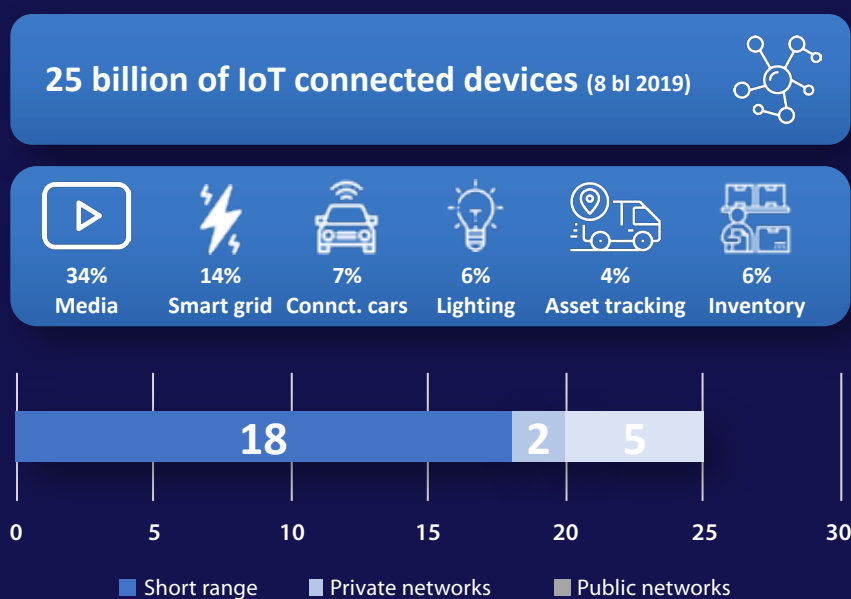
PRIVACY AND SECURITY

But more connected devices also mean more risks for security and privacy, with a potential significant reduction of the overall trust in IoT solutions. This is particularly true for the healthcare sector that significantly benefits from IoT solutions but, at the same time, is also more exposed to security and privacy risks due to the sensitivity of transmitted information. A recent study from Checkpoint Software Technologies[12] highlights a global increase of cyberattacks during the pandemic. According to the study, the leading threats identified during the last months "was phishing (55%) followed by malicious websites purporting to offer information or advice about the pandemic (32%).", but also an "Increases in malware (28%) and ransomware attacks (19%) have also been noticed." Similar results have been reported by Symantec[13]. Regarding privacy, the GDPR represents a limitation in the crisis that needs prompt reactions and technological solutions that, due to the urgency, require a reduction of privacy: the success of a tracking application that significantly contributed to containing

the virus in some countries (e.g. China and Korea) could be difficult to replicate in Europe, due to the privacy limitations introduced by the GDPR. If the price of saving hundreds of thousands of lives is a reduction of privacy, it is morally correct to pay the price. More generally, the increase of cyberattacks, the new vulnerabilities and the growth of information exposed to privacy issues will consequently increase the demand for end-to-end trust solutions, for new strict security standards and for new regulations.

END TO END

The concept of "end-to-end" brings us to consider the market of IoT platforms, which are fundamental to increasing the resilience of supply chains, asset management, production and the processes of organisations. IoT platforms have the primary role of orchestrating the entire IoT infrastructure, therefore they represent the primary "tool" to ensure the continuity of every kind of operation. Indeed, the prominent functionality of IoT platforms is remote monitoring and control, which is fundamental to reducing human interactions and thereby ensuring the continuity of operations. IoT platforms also allow the deployment and maintenance of IoT devices to be simplified and optimised: for example, provisioning services accelerate the deployment while fully automated software updates completely eliminate the necessity of a maintenance operator. A recent study[14] indicated that IoT platform revenues reached USD 55 bn in 2019 and are expected to reach USD 66 bn already in 2020, with annual growth of 20%. This part of the IoT value chain will follow the trend of the global IoT market, whereby the IoT platform is an integrated and fundamental component of IoT solutions. It will be difficult to maintain this trend in the long term, therefore platforms providers will need also to adjust their strategies in order to capitalise and consolidate this growth. For example, it will be fundamental to improve and broaden the functionalities and features offered by IoT platforms to support the integration/inclusion of legacy systems: considering the potential role of IoT solutions in the recovery phase and in future

Fig 2 — IoT connected devices (2025-30)

25 billion of IoT connected devices (8 bl 2019)

| 34% Media | 14% Smart grid | 7% Connct. cars | 6% Lighting | 4% Asset tracking | 6% Inventory |

| 18 | 2 | 5 |

■ Short range ■ Private networks ■ Public networks

Source Transforma Insights 2020

resilience, it is fundamental to maximise the number of vertical domains and related value chain that could benefit from IoT technologies. The support for legacy systems goes in this direction and opens up to IoT technologies an immense market, enabling recovery and resilience at reasonable and sustainable costs. The healthcare sector, with telemedicine, connected healthcare devices and vast non-digitalised assets that could be enabled by legacy functionalities is estimated to be a driver for the future growth of IoT platforms in the short term. Manufacturing and supply chain management will follow, influencing the growth also in the long term.

MARKET EVOLUTION

The market analysis illustrated in the whitepaper "From Internet of Things to System of Systems"[15] provides estimations that are generally confirmed by recent studies and that could evolve as an underestimation due to the global pandemic crisis that will offer new and unforeseen opportunities for all the stakeholders involved in the IoT value chain[16]. The studies remain conservative, in order to "absorb" the fluctuation of the current critical moment, with a number of connected devices estimated to reach 24-25 billion by 2030 (the previous estimations indicated 2025-2026) with a CAGR of the 11% and a predominant presence of cellular connections. The estimation of the global revenues is confirmed at USD 1.5 tr by 2030 (USD 1.1 tr by 2025), with a geographical share evenly distributed: 23% Europe, 24% North America, 26% China and 27% in the rest of the world. Figure 4 provides an estimation[16] of IoT revenues in a set of vertical domains complementary to the ones considered in the withepaper[15]: globally none of the considered verticals is expected to witness a decrease their growth in the medium/long term, while in the short term it depends on the vertical in which IoT is adopted.

To take an example, with respect to the pre-pandemic estimations, the automotive sector with connected vehicles is already experiencing a significant drop in its growth trend (from 30% to 15%) that will be confirmed in the short term. A similar trend
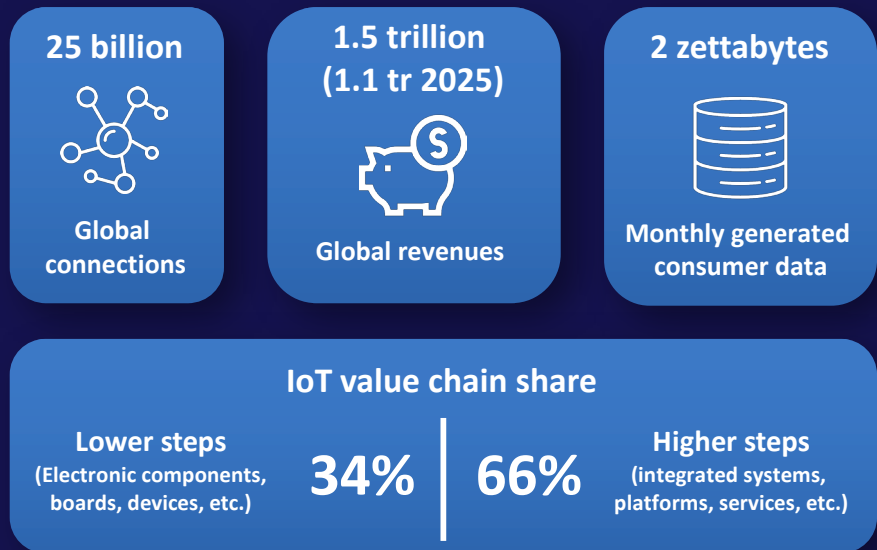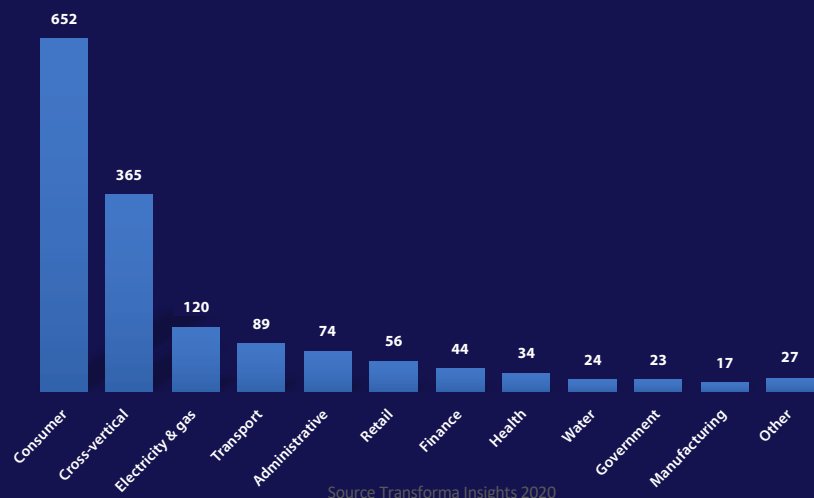
Fig 3 — IoT global estimations (2025-30)

25 billion	1.5 trillion (1.1 tr 2025)	2 zettabytes
Global connections	Global revenues	Monthly generated consumer data

IoT value chain share

| Lower steps (Electronic components, boards, devices, etc.) | 34% | 66% | Higher steps (integrated systems, platforms, services, etc.) |

Fig 4 — IoT revenue share by vertical (2025-30, billion))


Source Transforma Insights 2020

is expected for the entire transportation market, with extreme drops for air transport, for which it is very difficult to provide future predictions. Another sector that has been strongly hit is building automation, with a drop of 15% already in 2020, due to the global lockdown of business premises (both existing and in construction) and a similar trend in the reduction in revenues is expected for portable information terminals, payment systems, smart parking, smart meters (the smart grid sector is already experiencing a revenue reduction of 17%) and in general for all the IoT-based solutions that have been affected by the supply chain disruption, by a low level of production and by deployment issues due to the lockdown. All these sectors

are excepted to slowly realign to the previous estimations starting from 2021.

In the short term, a significant boost in the growth trend is expected for consumer products (specifically for health), for the healthcare sector, for manufacturing and for the supply chain automation, that is, for all the primary sectors of our society and economy that require a fast recovery, continuity and a significant transformation to improve the resilience in future crises. The pandemic has also highlighted the fundamental role of agriculture during a crisis and, supported by IoT technologies, smart and automated agriculture is expected to definitely take off in the next 2-3 years.

Fig 5 — COVID-19 effect on connected products in 2020 and short term
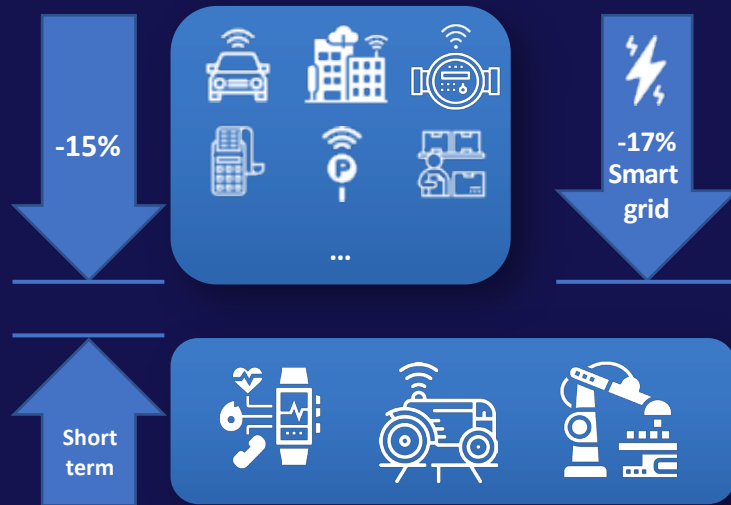
READINESS FOR RECOVERY

In this panorama, organisations are relying on the digital transformation to speed up recovery and ensure long-term growth, although the digitalisation road maps will probably be completely re-shaped to face the new challenges generated by the pandemic and to comply with potentially reduced budgets. Starting a new digital transformation project is not an easy task, because of the uncertainty of the potential return and due to the lack of familiarity with IoT technologies among many organisations. According to Gartner[17], already in 2019, 82% of interviewed CEOs have planned digitalisation initiatives to improve their business and certainly this percentage will increase due to the pressure generated by the pandemic. To confirm the value of this approach, if we consider the recession during 2008-2009, the organisations that better resisted the crisis and that were able to quickly recover continued to invest 5-7% of their IT budgets in digital transformation projects during the recession : trying to anticipate the future creates a competitive advantage that can be promptly exploited as soon as the conditions allow it, but it also lays the foundation to support and consolidate long-term growth. Currently, most organisations is still in the "triage" phase, trying to assess the situation, define budgets cuts, reduce the head count, lower operational costs, sell assets and set up contingency and recovery plans: when significant revenue drops are expected, organisations enter a sort of "conservative mode". Despite the tendency to stay conservative, in the "triage" phase it is fundamental to continue to invest in the digital transformation and avoid stopping the related projects, in order to be ready for the recovery phase. It seems unreasonable, but the lockdown and the shutdown of many operations and processes allow the organisation to find time to identify new paths to innovation and business growth. Eventually, the recovery phase will require a readiness to fulfil the restarted customer demand that, although growth can be expected to happen slowly, will benefit greatly from IoT solutions. The impact of the pandemic is and will be so serious that a return to complete normality is not expected very soon, extending the lack of budget and resources for IoT projects to the rest of 2020, but in the long term investing in the digital transformation will be fundamental to improve resilience and reduce the effects of future crises.

The direct lesson we can learn from COVID-19 pandemic is that solving immediate problems is not enough if the adopted solution doesn't prevent their presence again in the future. IoT will play an important role in containing and treating COVID-19, but it is also the right solution to monitor, prevent and control future pandemics.

[1] From Internet of Things to System of Systems - Market analysis, achievements, positioning and future vision of the ECS community on IoT and SoS, An Artemis-IA whitepaper, Paolo Azzoni, April 2020

[2] Coronavirus Alters Supply Chain Dynamics Impacting People, Products and Costs, Gartner Research, 2020/02/24.

[3] COVID-19 Survey: Impacts on Global Supply Chains, Institute for Supply Management, 2020/03/11.

[4] https://www.healthcareitnews.com/news/digital-thermometer-data-may-provide-insight-covid-19-surges

[5] https://www.cnbc.com/2020/03/18/hong-kong-uses-electronic-wristbands-to-enforce-coronavirus-quarantine.html

[6] https://www.visionstate.com/post/visionstate-ships-first-iot-buttons-for-rapid-response-to-cleaning-alerts

[7] Helping public health officials combat COVID-19, Google, 2020/04/03

[8] Harnessing wearable device data to improve state-level real-time surveillance of influenza-like illness in the USA: a population-based study, Jennifer M Radin, Nathan E Wineinger, Eric J Topol, Steven R Steinhubl, The Lancet Digital Health, 2020/01/16

[9] How Hospitals Are Using AI to Battle Covid-19, Kelley A. Wittbold , Colleen Carroll , Marco Iansiti , Haipeng Mark Zhang and Adam B. Landman, Harvard Business Review, April 03, 2020

[10] Exposure to air pollution and COVID-19 mortality in the United States: A nationwide cross-sectional study, Xiao Wu, Rachel C Nethery, M Benjamin Sabath, Danielle Braun, Francesca Dominici, Harvard T.H. Chan School of Public Health, April 2020.

[11] Forecasting IoT in a world turned upside down by Covid-19, Transforma Insights, 2020/04/07.

[12] A Perfect Storm: the Security Challenges of Coronavirus Threats and Mass Remote Working, Checkpoint Software Technologies, 2020/04/07

[13] https://symantec-enterprise-blogs.security.com/blogs/threat-intelligence/covid-19-outbreak-prompts-opportunistic-wave-malicious-email-campaigns

[14] The Internet of Things: Consumer, Industrial & Public Services 2020-2024, Juniper Research, 2020/05/05

[15] From Internet of Things to System of Systems - Market analysis, achievements, positioning and future vision of the ECS community on IoT and SoS, An Artemis-IA whitepaper, Paolo Azzoni, April 2020

[16] The IoT in 2030: Which applications account for the biggest chunk of the $1.5 trillion opportunity?, Transforma Insights, 2020/05/21

[17] Preserving Your Digital Growth Investments During Economic Uncertainty, Gartner Information Technology Research, 2020/04/08

INTERNATIONAL NETWORKS AND GROWING INNOVATION

ECSEL'S IMPACT IN LATVIA AND THE NETHERLANDS

by RONALD DEKKER AND KASPARS OZOLS

Over the course of ten calls, ECSEL Joint Undertaking has driven 64 projects with over 2100 participations and 3.4 billion euros in RDI costs. From digital healthcare to automotive data sharing, these have generated innovations that touch upon almost all aspects of daily life in Europe. But what exactly does ECSEL's impact look like and what does it mean in terms of manufacturing culture and collaboration? Two participants from opposite corners of Europe share their views.

READYING THE TECHNOLOGY

Founded in 1960 within the framework of the Latvian Academy of Sciences, the Institute of Electronics and Computer Science (EDI) is now a state research institute conducting fundamental and applied research into areas such as extremely precise event timing, remote sensing and space data processing, robotics and machine perception, signal processing and embedded intelligence, smart sensors and IoT. It's also a long-time participant in ECSEL's larger basis, having been part of the ARTEMIS programme that was merged into ECSEL in 2014.

"To cut a long story short, Latvia found success with ARTEMIS so we decided to commit to ECSEL too," explains Dr. Kaspars Ozols, Deputy Director of Development at EDI. "We already had quite a lot of partners from the ARTEMIS programme at that point and we went to a few brokerage and face-to-face meetings to find more and to start writing project proposals. At the moment, we have eight ongoing ECSEL projects, although it's a bit early to comment on the results because we've completed only one. But two more are finishing this year: I-MECH[1] and AutoDrive[2]."

For its various projects, EDI's focus has been on developing its proof-of-concept prototype systems, which are around TRL 4-5 and can be further developed into market-ready products after the project. In the I-MECH project, this means low-latency, real-time wireless sensors with a wireless charging functionality; in the AutoDrive project, it corresponds to a fail-aware, fail-safe, fail-operational vehicle-to-X communication device for cars to enable wireless communication between cars and infrastructure such as traffic lights. "ECSEL's Research and Innovation Action platform is great for this because you receive all the requirements and specifications from leading industrial companies in Europe, as well as ideas for the architecture," says Kaspars. "You can really shape the content into something which is needed in industry, which we did in both projects.

In Latvia, we have a specific programme that allows you to do the feasibility study, market analysis and commercialisation plan, supported by European structural funds.

When the experts see that there is definitely market potential, they give additional funding to bring technology to TRLs 6, 7 and 8. This makes it much more interesting for big companies and SMEs to buy and adapt it. ECSEL is perfect for us as a starting point for validating proof-of-concepts in order to enter this next phase."

A CULTURE OF INNOVATION

For EDI, the long-term goal is to foster the development of a knowledge-based economy in Latvia. From this perspective, the eight projects still in progress are already showing highly promising results: between 2011 and 2018, Latvia's innovation performance on 27 criteria rose by 17.7% of the EU average. According to the European Innovation Scoreboard, this makes Latvia the third fastest growing innovator on the continent.

"In 2015, my feeling was that most of Latvia's needs were satisfied by buying things. If something was not on the market, we just had to wait until somebody else developed it," Kaspars notes. "I knew that this needed to change, and Latvia in general thought the same. ECSEL was and still is a great instrument for creating new technology and generating this innovation. Since joining this environment, the culture of Latvia has changed somehow. Programmes have been developed and we have demonstrators and prototypes which can be commercialised. This is what has and will facilitate Latvia's rise on the scoreboard."

Critically, ECSEL's impact has the potential for a snowball effect in Latvia: a self-perpetuating cycle of funding and innovation. "Latvia isn't the worst country in Europe for expenditures on R&D, but the share of GDP going into the sciences is very low," Kaspars says. "Countries like Sweden or Germany are spending about 3% on science, but it's around 0.6% for Latvia right now. ECSEL is therefore crucial for the scientific community as we can receive additional funding or contract research projects and strategically develop ourselves, attract new employees and build up knowledge capacities. Thanks to ECSEL and our nine projects, we were able to recruit many more researchers and extend our

scientific knowledge in new research areas. I hope that our national authorities will see this and act on it too!"

THE NEXT LINK IN
THE CHAIN

Almost a thousand kilometres away, the Netherlands holds the dual title of Europe's fourth biggest innovator and its seventh fastest growing. Thanks to this established presence in international R&D, Dr. Ronald Dekker of Philips and Delft University of Technology is well-positioned to discuss longer-term impacts. "I was invited by somebody else at Philips to join the ENIAC/ECSEL project INCITE in 2013. I was not into European projects at that point – actually, I thought it was a lot of rubbish! But then I had a very good experience and really saw how it works when you bring a large group of people together."

Most crucially for Ronald, there's more to ECSEL than funding: it's also about doing things collectively that otherwise wouldn't be possible. "One way or the other, I got involved in writing a proposal for ECSEL – a call for pilot lines, the InForMed project," he continues. "This was really the umbrella to which we connected all subsequent projects. It got a lot of attention, including a demonstration in the European Parliament, and evolved into the POSITION project. Around that time, we also developed the vision of an open technology platform, which we are now advocating for in the Health.E Lighthouse, and the Moore4Medical project for this took off on 1 June 2020."

In a nutshell, INCITE is about concepts for smart catheters, InForMed is for the infrastructure to manufacture them and POSITION is about bringing technology platforms to a higher TRL: a chain of projects that build on one another for maximum impact. As a result, Philips has become one of the leading manufacturers of smart catheters for coronary applications worldwide.

"When we started INCITE, Philips was not doing smart catheters," Ronald notes. "But we had the vision that catheters would become important to us. Three years later, I arrived

at work one morning and, lo and behold, [Philips CEO] Frans van Houten announced that we had acquired Volcano, then a leading manufacturer of smart catheters. In a research organisation, they don't tell you every business move in advance. Yet through these three projects, we were able to step into this new market seamlessly. That's the thing I'm most proud of."

BEYOND THE PROJECTS

With its vast consortia – typically between 50 and 70 partners per project – it's no surprise that another big impact of ECSEL is the creation of durable networks and ecosystems. "ECSEL is like a culture dish," says Ronald. "You see all kinds of microorganisms, by which I mean collaborations that transcend the project itself. There's something more than just the technology, it's an environment in which collaborations and ecosystems can grow. Time and time again, I've seen new working relations that were not anticipated but which are very fruitful.

From InForMed, for example, we have two start-ups. One is a fast-growing company called Salvia[3], which is making an implant to treat chronic migraine. The other is BI[4]/OND, which works on organ-on-a-chip devices. Many years after InForMed, they still use its network extensively. You create an ecosystem and part of it survives or even grows. This is very satisfying to see."

Close cooperation over borders is one of ECSEL's most important ingredients as well as one of its biggest impacts. This is what allows its technological results to be disseminated to all corners of the continent and increases Europe's competitiveness on a global scale. "For me," concludes Ronald, "ECSEL is like oil in a machine – without it, the machine doesn't run. One example is how you can connect to technology suppliers and potential users. Take our technology platform for smart catheters. We hope that other catheter manufacturers are going to use it, but if we just say, 'hey, we have a nice technology platform for you', they'll close the door on us. If we can say, 'I have a technology platform that we can develop together and I can also bring in some funding', the door stays open."

" ECSEL is like oil in a machine – without it, the machine doesn't run"

[1] *I-MECH - Intelligent Motion Control Platform for Smart Mechatronic Systems (GA. 737453)* https://www.i-mech.eu/

[2] *AutoDrive - Advancing fail-aware, fail-safe, and fail-operational electronic components, systems, and architectures for highly and fully automated driving to make future mobility safer, more efficient, affordable, and end-user acceptable (GA. 737469)* https://autodrive-project.eu/

[3] https://www.salvianeuro.com

[4] https://www.gobiond.com

FROM INTERNET OF THINGS TO SYSTEM OF SYSTEMS

DRIVING THE EVOLUTION OF FUTURE MARKETS

by CHRIS HORGAN

To cite the Executive Summary of this whitepaper written by Paolo Azzoni, Research Programme Manager at EUROTECH Group and chairman of the Working Group 'From IoT to SoS', "Digital transformation is shaping our world in unprecedented ways, at a rate of change never seen before, potentially improving our daily life and our society, disrupting the traditional businesses and representing a must to secure companies' competitive edge. Digitalisation creates a link between the physical and the digital worlds and the dynamic interaction between these two worlds constitutes one of the strongest driving forces that will shape the evolution of future markets, potentially in every vertical domain."

EXPLICIT AND REAL IMPACT

This recently published whitepaper is the culmination of two years of a labour of love in which Paolo sought to concretise the major advances and real impact that ARTEMIS-IA and ECSEL projects have generated over the past decade or so. It is full of content, and the very tangible examples of initiatives and projects not only represent the huge impact of the ARTEMIS-IA and ECSEL communities over the past decade but also provide a platform for the ECS community to make explicit this very actual and real impact. In this article, it is not the intention to paraphrase the contents of the whitepaper, which can be downloaded from the ARTEMIS-IA website, but to garnish the report, as it were, with insights that inform the purpose, processes and procedure that led to the finished product. Its raison-d'être.
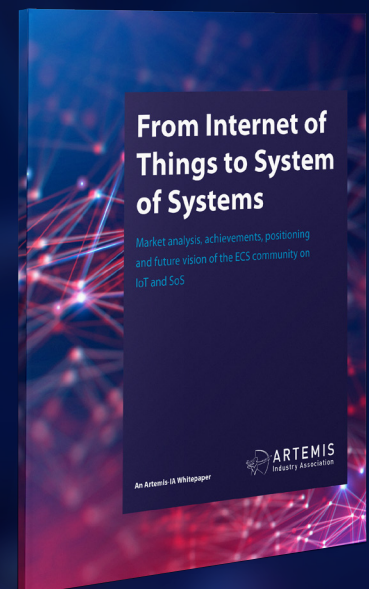
Paolo recalls the origins of the whitepaper. "I started discussing this topic with Jan Lohstroh and Laila Gide, who was then President of the ARTEMIS-IA, a few years ago when the whole IoT world in Europe appeared to be shrouded in some kind of 'fog' – there seemed to be no concrete profiling of what was being achieved by ARTEMIS and ECSEL. So I felt it

was time to let the community, European business, the political masters know what real achievements were being made by real people in real projects. To make the intangible tangible. Products with impact on the market and on society, something that has become increasingly evident over the past few years."

RELEVANCE IN A REDRAWN LANDSCAPE

To this end three actions were started up. Paolo: "We created a specific IoT working group, we completely reshaped and redefined the ARTEMIS focus areas, and we produced the whitepaper."

In the process of producing the whitepaper, the research was very inclusive and comprehensive, incorporating many sources of information, and including a review of all the documentation available along with interviews with a number of the project leaders. "We intended to position the ARTEMIS community in the international panorama," Paolo continues, "with respect to the other European initiatives and programmes focused on IoT. The more the landscape became redrawn, the more essential it was that our

From Internet of Things to System of Systems

Market analysis, achievements, positioning and future vision of the ECS community on IoT and SoS

An Artemis-IA Whitepaper

ARTEMIS Industry Association

The whitepaper "From Internet of Things to System of Systems", which can be downloaded from the ARTEMIS-IA website: https://artemis-ia.eu/publication/download/artemis-iotsos-whitepaper.pdf

IOT AND SOS

IoT and SoS can be considered as the backbone of digitalisation, providing scalable technologies capable of managing billions of connected devices and generating potentially more than USD3 trillion worth of revenues in the next 3-5 years.

The shift of computing to the edge, hyper-connectivity, artificial intelligence, security awareness and sustainability are the short-term linked trends influencing the IoT evolution.

ARTEMIS/ECSEL projects have investigated IoT at both hardware, software and system levels, in order to build solid foundations on the edge of IoT (e.g. for sensing, actuation, processing and connectivity), defining the IoT/SoS stack and providing integration solutions to create and manage the entire IoT/SoS infrastructure. One of the roles of ARTEMIS/ECSEL projects has been exactly to allow partners to reach a better understanding of IoT from many perspectives, technical, engineering, operational, vertical applications and consequently also from the business perspective.

IoT generates a radical change in the structure of the current and future economic system, transforming the linear value chain in a nonlinear value network. Any business combination in the network could potentially generates new revenue streams.

A single company is not capable to offer an all-inclusive IoT/SoS solution, sustainably covering the entire lifecycle of IoT and SoS, while an ecosystem of companies with complementary competences and businesses is a more appropriate solution. The ECSEL community must evolve towards a wider ecosystem of stakeholders really conscious of the interdisciplinarity and heterogeneity of IoT/SoS, committed to sharing and joining their forces and expertise to fully cover the future IoT and SoS value networks.

There are still significant obstacles to remove and challenges to face like safety, trust, availability of open platforms, interoperability and engineering support.

focus was kept on the demands of European industry and society. In this whitepaper we have selected 58 projects (of 107) in ten years in which so much good work has been done."

The whitepaper is the first publication in ten years to draw the entire picture, to give a voice to the achievements. "It's a backtrack assessment that is full of excellent results. It seemed like a good moment in time to get the message out there, loud and clear," Paolo says. "To demonstrate that our message of impactful work is backed up by real achievements that are getting through to the market and are having an actual and growing impact in business and society."

The analysis clearly highlighted that the ECSEL community has all the ingredients (technology, business models, managerial schemes, operational rules) to create IoT/ SoS solutions to go into a global market. This study is an opportunity to underline ECSEL members' contribution to IoT in the light of other European initiatives in the same domain.

"However," adds Jean-Luc di Paola-Galloni, ARTEMIS-IA President, "there are still significant obstacles to remove and challenges to face like safety, trust, availability of open platforms, interoperability and engineering support. The market study (particularly the trends), the assessment of the achievements and of the investments of previous projects allow us to clarify where we must invest in research and innovation, where we need to remove the barriers and provide solutions that speed-up the IoT uptake."

SPRINGBOARD FOR THE FUTURE

"So, this backtrack assessment serves a very important purpose. It gives us a check point where we can become aware of where we are now in time, of what impact we have been able to create. Then the logical next question is: where do we go from here? Awareness of where we stand today means that we can start planning the future. We have incorporated market studies and investment research because we want to know if we are heading in the right direction. In conjunction, the SRA, with all its technical details, will point us in a forward-looking direction. In this way, the SRA and the whitepaper should be regarded as complementary documents. The one provides a springboard for the other."

The whitepaper will appeal to a wide audience, from policymakers and funding institutions to the whole ECS community and, very importantly, the landing strip – the companies that are the beneficiaries of the results of these impactful projects. "Companies," Paolo emphasises, "can be the real beneficiaries when they are able to take advantage of IoT and System of Systems. Here I'm looking at the potential value chains that could be created in the future. The first stakeholders in the chain to monetise IoT have been the semiconductor companies, but other stakeholders are following and will quickly follow, from IoT device manufacturers, to IoT/ SoS platform providers and to application developers, etc. But there is a large set of non IoT-based sub-value chains that could switch to/adopt IoT, and the nature of the current

COVID-19 pandemic is exercising a push in this direction. In many cases, it is making this switch mandatory. IoT has the potential to automate and control many processes that have so far been human-centric."

OPPORTUNITIES ABOUND

Given the dramatic and unavoidable changes in the economy and society of post-COVID 19 era (see the article on page 10 by Paolo in this issue), IoT/SoS will have an accelerated importance that will require valid research, implementation and control. "Opportunities abound," Paolo states. "The whitepaper offers education, information and signposts to plot the future. Also the policymakers and decision-makers, like the European Commission and Member States, who are tasked with assessing the impact of the research that they fund. It gives them a reference tool to do this on the basis of real, tangible results. The bottom line is that if you look at the estimated investments – 700 million euros – this is modest when compared to the excellent and often brilliant results achieved by the ARTEMIS and ECSEL communities."

"In short," concludes Jean-Luc, "this study should bring a substantial pillar within the battle for European digital sovereignty. It brings an essential brick to consider the future of the key digital technologies not only to support semi-conductors' innovations as stand-alone, but to have an ECS approach on a true eco-system based on the importance of the strategic market value in the future."

ARROWHEAD TOOLS AND THE ADDED VALUE OF ECOSYSTEMS

NETWORKS AND COLLABORATION IN EUROPE

by **JERKER DELSING JOHANNES KRISTAN AND MATEUSZ BONECKI**

What do Arrowhead Tools, ARTEMIS Industry Association and ECSEL Joint Undertaking all have in common? As ecosystems for innovation, these bring together key players from all sectors of the value chain and provide the environments in which Europe's next technological breakthroughs can occur. Using Arrowhead Tools as a framework, three participants from the worlds of academia, large enterprises and SMEs share their thoughts on the added value of such set-ups.

A FOUNDATION OF TRUST

With a budget of 90 million euros and 80 participants, Arrowhead Tools is Europe's largest project for industrial automation and digitisation solutions. ARTEMIS vice-president and project coordinator Jerker Delsing takes a moment to outline how this enormous ecosystem came to be. "The Arrowhead project started in 2013 and went until 2017, during which the Arrowhead Framework was launched as an open-source project for creating interoperability. Arrowhead Tools builds on the results of Productive4.0, with a one-year overlap, and has been extremely productive."

Interoperability is a vital foundation for modern industrial ecosystems: if every organisation focuses on its own heterogeneous or legacy systems, collaboration and continuity will always be harder to maintain. "Right now, we're creating long-term governance for technology like this," explains Jerker. "The Arrowhead Framework turned open source in 2016 and things moved to Github about a year and a half ago, providing a certain professionalism in terms of code and documentation. This means that more solid trust can be built. We're now in a position where the open-source element is becoming part of Eclipse, which has a very clear strategy on how a successful open-source project can build on active ecosystems."

The professionalisation of an ecosystem also means the creation of long-term governance, a vital ingredient in ensuring impact beyond the end of an initial project. Take Linux, for example, which gathered interest in the late nineties. "If you look at Linux today, who is supporting them?" Jerker asks. "It's all the big players. All other Unix versions are dead but Linux is one of the two major operating systems worldwide. This is what happens when you create a stable and agreed-upon way of further developing and maintaining a piece of software."

Long-term success as an ecosystem also means striking the perfect balance between fundamental and applied research. In Arrowhead Tools, for instance, 30 participants come from academia. As a professor at Luleå University of Technology (LTU) in Sweden, Jerker naturally recognises the importance of work at lower TRLs. "From an academic viewpoint, the motivation for us to work with industry is very clear: industry houses the problems which we can generalise and come up with solutions for. Where there's an openness in the sharing of results, there's an atmosphere which is super creative. This creates motivation for faculty like me and my students here at LTU as we feel like we really contribute to the competitiveness of Europe."

Another benefit for universities is the circular nature of networks and the tendency for results to be fed back into academia as the basis for new course content. This has been

the case for ECSEL project outcomes and LTU's Computer Science curricula, while the book *IoT Automation: Arrowhead Framework* was published in 2017 and is now used as a base material for automation courses at several universities. In Jerker's view, this is the positive outcome of being an attractive partner.

"Universities always seek to exchange information with others, but many academics are focused on just publishing their papers and hoping somebody cites them. That's one way of getting recognition, but another is getting industry to want to cooperate with you. Big companies don't care where we are; they care if we have the competencies and if students are coming out of here with a modern way of thinking. This builds up the reputation of the university and is why we're asked to lead these very large initiatives. Again, it's all about creating trust."

THE FUTURE IS OPEN SOURCE

"Academia develops promising ideas," agrees Johannes Kristan. "On the other hand, you have the real world, where those ideas have to be applied. Projects like Arrowhead Tools are really good for bringing these two worlds together. We can pass on our constraints, such as how to actually operate a system on a shop floor. You have to put a lot more into a technology stack than just the features that are publishable in academia. All sides need to work on better solutions."

Johannes is a Senior Expert at Bosch.IO, one of the two Robert Bosch GmbH subsidiaries within Arrowhead Tools. There, he works on underlying open-source technologies to enable the creation of services and solutions for other Bosch branches and external partners in different domains as part of the commercial Bosch IoT Suite. "Our idea," Johannes explains, "is to use the experience and domain knowledge of Arrowhead partners to improve the Eclipse IoT stack for industrial automation use-cases. As part of that, we're the task leader involved in combining the Eclipse IoT stack with the Arrowhead Framework."

Regarding the experience so far, he's quick to point out that ecosystems are what you make of them – you need to put something in to get something out. "Jerker is doing a good job in 'herding' all of these many participants towards building a platform, but you also need to actively address issues yourself! You need to be aware that it's not always easy to know who's involved, so use everything a project gives you. Speak to as many people as you can and try to build up your network inside the community."

The advantage, of course, is that these internal networks provide a good impression of the problems and objectives of manufacturers, such as which technology they're looking for. One example is the desire for data to remain on-site instead of travelling to an external cloud and being stored and processed on infrastructure which is not under the full control of the manufacturer. This is provided by the Arrowhead Framework. Johannes: "We also believe that building open-source software is the way to go, and we as a company need a clear and strict framework to do that. Part of this is an open-source license and processes to ensure that projects comply with this license. The Eclipse Foundation is providing this legal framework."

In other words, open source is an enabler for building up ecosystems, but it needs a strong legal framework if it is to be used securely by companies. Openness helps to generate trust among manufacturers as they can examine the code and even audit it, which is not as easy or perhaps even impossible for closed-source software. Open-source software also offers

possibilities for long-term support as this can be done within this community rather than being bound to a specific supplier. Bosch.IO is also keenly aware of the value that smaller enterprises bring to the table, having enjoyed fruitful discussions with Polish SME DAC on broader topics in the automation domain. "The exchange of ideas is one thing and the other is finding out what can be integrated into a common platform, which means making those SMEs aware that there is a platform such as the Eclipse IoT Stack. For many of them, this is an opportunity to get into the right communities. This is good for us as bigger and more vibrant communities produce better ideas and funnel their efforts into a commonly-accepted platform," says Johannes.

"We are internationally-oriented. For the future, we therefore hope that European collaboration can build up common technologies and not only rely on offerings from other markets. Again, it's nice to have an ecosystem like Arrowhead so we don't end up developing ten small solutions that only address a fraction of the market when we could join forces to create large, reliable platforms that can compete globally. It's important for us to stress that open source is the way to collaborate on an international level. It really makes it easy for companies to generate solid, competitive offerings from inside Europe."

VALUE MOVES DOWNSTREAM

What, then, do SMEs make of these extensive collaborations across borders? Mateusz Bonecki, Chief Innovation Officer at DAC, first takes a step back. "Before we enter into a discussion of the Arrowhead ecosystem, we must grasp its scale. Let's look at three members of our consortium: Infineon, STMicroelectronics and Philips. In 2018, these three groups corresponded to 10-13% of the total EU turnover in the manufacturing of computer, electronic and optical products. Projects like Arrowhead Tools or Productive4.0 are truly ecosystemic because their eventual impact on industry is defined in terms of macroeconomics."

Although this figure suggests domination by larger players, SMEs hold a crucial

and perhaps underrated role. In 2018, for instance, the added value share of SMEs in the European non-financial sector was estimated at 20-40% for computer and electronics manufacturing and as much as 40-60% for computer programming. "SMEs' contributions to the high-tech industry are significant. However, they generate more value in the software sector than in electronics production," explains Mateusz. Software applications are concentrated mostly in the later stages of the electronic systems value chain, which the 2019 ARTEMIS/ Advancy report *Embedded Intelligence: Trends and Challenges* suggests will be the fastest-growing segment this decade. "We see large enterprises like BMW acquiring start-ups that provide software applications for navigation, carpooling and so on. They're getting ready to embrace opportunities emerging at the software-hardware frontier."

This is also an opportunity for SMEs. Mateusz: "Their role will be to provide applications that generate additional revenue streams on top of original equipment sales, such as connected cars, CT scanners or even shop floor equipment." By simplifying SME access to manufacturing equipment capabilities, Arrowhead paves the way for the development of such extra functionalities. "Think of a small company specialised in AI. Through dedicated services, developers can now retrieve data, train machine learning algorithms and ultimately optimise the performance of manufacturing equipment. In this way, the Arrowhead ecosystem could transform into a market of smart services for industry."

For DAC, which focuses on solutions for the digital industry, involvement in Arrowhead's ecosystem began with data applications for embedded intelligent systems which the company had developed in Productive4.0 – a project which saw the Fourth Industrial Revolution in terms of the integration of digital production, supply networks and project lifecycle management. Arrowhead Tools seemed like a great opportunity for DAC to enable the cooperation of industrial frameworks and legacy systems along the value chain.

Notably, one in every three partners in Arrowhead is a small or medium-sized

company working on IT solutions for sectors as diverse as mining, food processing, energy and – of course – manufacturing. In some cases, SMEs deliver solutions to more traditional industries. In Mateusz's view, this is the perfect illustration of their dual role in Industry 4.0 as a whole: both high-tech solution suppliers and adopters undergoing the process of industrial digitisation. "Take, for example, the idea of setting up a new corporate R&D unit to develop digital twin technology. Such a change takes time and entails some overhead. But somewhere, there might be a group of engineers or start-uppers who are working on applicable technology and are capable of delivering an early prototype in a relatively short time and at a lower cost. They can either be acquired by a large enterprise or market the product themselves, which I find extremely beneficial."

This support runs both ways. While companies like Bosch or Siemens drive digitisation and can invest in R&D or new software stacks when faced with legacy issues, many smaller enterprises – especially in mid-tech production sectors – struggle to adapt to Industry 4.0 technology. "To support manufacturing SMEs in the integration of their IT and OT with innovative technologies like IIoT, smart sensors or AI, interoperability and flexibility are needed. This is the promise of Arrowhead," Mateusz concludes.

"The Arrowhead ecosystem is dynamic. Just as dynamic is the IT market, so Arrowhead interacts, learns and explores new opportunities. Last month, for example, the Productive Intelligence consortium (led by Infineon) applied for funding in an ECSEL call to strengthen the European economy through AI applications for the manufacturing industry. We welcomed many new partners because new objectives always require new competencies. But we also reached for proven solutions. This time, Arrowhead was called upon to help in the development of edge AI. Every time we meet, we gain new perspectives."

ROLE MODELS, QUOTAS AND EARLY ENCOURAGEMENT

by **SABINE HERLITSCHKA, VEERA KOSKINEN, ELISABETH STEIMETZ AND DORIS VIERBAUCH**

FOUR PERSPECTIVES ON GENDER EQUALITY IN EUROPE

Where does Europe stand on gender equality in science and technology today? What can still be done to improve this situation? And what does equality even mean? For this issue of the ARTEMIS Magazine, four representatives from Infineon Technologies Austria, VDI/VDE Innovation + Technik GmbH, the Austrian Research Promotion Agency (FFG) and Business Finland came together for a dialogue on these issues and more.

THE MEANING OF GENDER EQUALITY

According to the United Nations' Sustainable Development Goals, "gender equality is not only a fundamental human right, but a necessary foundation for a peaceful, prosperous and sustainable world."[1] The practicalities, however, are subject to a great deal of discussion.

"To me, gender equality is about everybody having the same possibilities to access education, equal pay, etc.," begins Doris Vierbauch, FFG Senior Expert and Chair of the Public Authority Board of ECSEL. "Of course, it's also about the protection of women against violence and discrimination. Today, the country and social class in which you grow up, still determines the chances you have in life and whether you will probably suffer from inequalities. There has been a lot of progress in the last decades in Europe, but we still haven't reached gender equality. Experience shows that it is not enough to have nice papers and brochures about gender equality. Theory and reality, unfortunately, are often far apart. Initiatives such as the 'Equal Pay Day' are therefore very important to raise the awareness."

As the CEO of Infineon Technologies Austria and chair of the ECSEL Governing Board, Sabine Herlitschka first takes the opportunity to thank ARTEMIS for reporting on this issue. "However, I think having four women talk about gender equality is not the right approach. Gender equality is not a women's support programme or an issue only women have to discuss. To me, gender equality means that as a society and as companies, we understand that diversity is a huge source of opportunities and competitiveness. We will have achieved something when occasions/events on gender equality gather much stronger men's interest because they are eager to search for more gender diversity."

"I think that gender equality will have been reached when there's no discussion of it anymore – when we just have equal rights, opportunities and salaries and the role of women is no longer having to step back when you have children," adds Elisabeth Steimetz, director of EPoSS and a member of VDI/VDE. "We have laws and rules in place in Europe, but we have not reached gender equality yet.
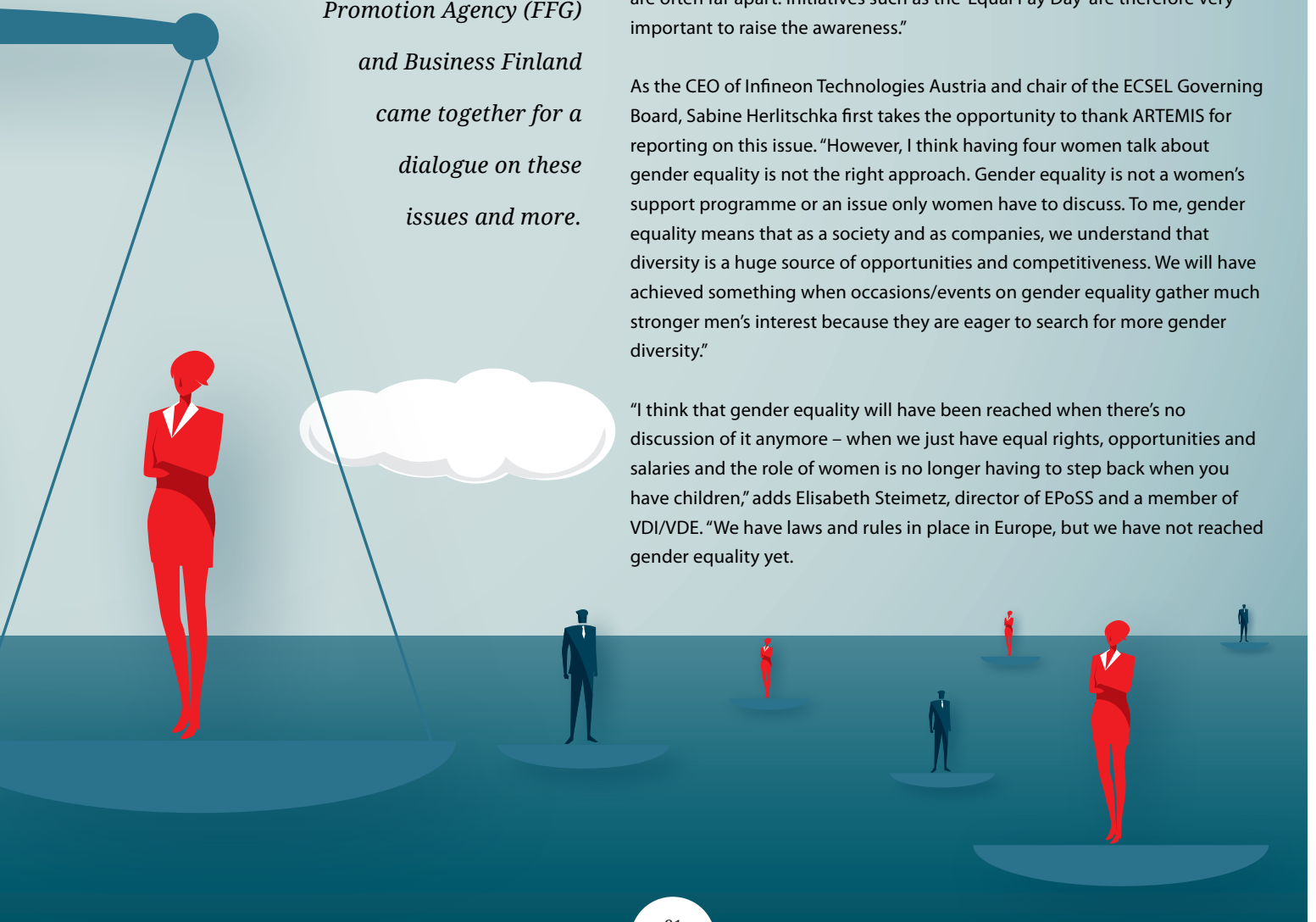
Elisabeth Steimetz

Doris Vierbauch

Sabine Herlitschka

"It's not only the absence of discrimination but also positive encouragement," says Veera Koskinen of Business Finland. "To provide equal opportunities in education and careers, we need to work on the rigid social structure in which girls are pushed towards certain interests and professions and boys towards others. They need to be encouraged equally. If you extend it further, it's about traits that are typically viewed as feminine. Men should be able to share these traits and express these emotions."

100 YEARS OF MAJOR CHANGES

Sabine kicks off the main discussion with a positive reminder. "2020 is the 100-year anniversary of women being able to vote and study in Austria. Today, we have significantly lower hurdles in terms of formal framework conditions. I think it's important to remind us that a lot has improved over the last century, formally speaking. We should not always focus *exclusively* on the limitations. It's about the best opportunities we've ever had nowadays."

"Of course, the informal settings are also important. We do still have a very traditional societal model and difficulties with childcare institutions, among other things. Nevertheless, I think that our role as

individuals (as well as a community) is to encourage women, not to get passive and wait for all the conditions to change. It's about taking your life into your hands and making your opportunities real."

"Until 1975, women in Austria had to ask their husbands if they are allowed to take on a job. Like Sabine said, we are still a very traditional society," Doris notes. "But in my experience, the situation has improved a lot over the last 20 years and gender equality gets more attention than in the past. There was a time in my life when I felt I had to work harder than men in order to reach my goals, such as a certain position, a salary level or whatever. It was not always easy for a young female academic in a male-dominated area. Some people were even surprised that I had the same expectations and demands as men. What experience also proves is that one of the most important things with regard to gender equality is to constantly work on that topic. If we stop, we might lose what we've reached so far. It's like doing push-ups. It's hard work, it's a pain, but you get good results in the end."

Having previously worked in industry for 13 years, Elisabeth Steimetz provides a comparable example from her own career. "When I was travelling a lot in Japan and

Korea 20 years ago, I faced huge difficulties. I was once at a conference dinner as an invited speaker and one of the professors said to me: 'What are you doing here? Don't you have a husband taking care of you?' This is something you might experience working in science and industry, where people are not expecting too many women, but a lot has changed in Asia and Europe since then."

"I remember my first job very well," agrees Sabine. "It was the mid-eighties and the head of HR of that company told me very frankly – without any concern whatsoever – that of course you earn less than your male colleagues. In today's discussion, this might sound bizarre. Such explicit behaviour is not possible anymore; nowadays, we have laws prohibiting this. Organisations in Europe are challenged to demonstrate the fair treatment of women."

For Veera, the youngest participant in the dialogue, the effects of these societal changes are already visible. "I can't say that I've had these challenges or that I've ever been treated as a representative for women in my career. I'm very lucky in that sense. When we had EFECS last year, I was the organiser here in Finland. I knew that the environment would be quite male-dominated and I was

Veera Koshinen

a bit nervous as I'm used to more 50-50 environments. But I actually noticed how welcoming the community is. Not once in those three days was I treated differently because of my gender. The community is open to women, we just need more women to welcome in."

THE TRICKY QUESTION OF QUOTAS

In the question of how to practically involve more women in communities like ARTEMIS, three themes emerge: effective role models, concrete targets and the use of quotes. Regarding the former, Elisabeth points to the tiny minority of female students in technical domains in Europe. "This has nothing to do with the interests of women in science and technology but rather with the way children are still brought up today. We can't change that through laws but only by setting examples. It's important that you have female leaders showing that it's possible to be successful and still have a family, for example."

"I think you're completely right," says Doris, "and there is also the challenge of informal networks in which men simply have more experience because they've been doing it

for a long time. As they often have better networks, men are able to use information gained in advance. In 2002, the percentage of women working in R&D in Austria's corporate electronic sector was at 12.9 %; it increased to 17.2 % in 2017. This is actually a sector in which the female share is far below average, which demonstrates that women have a great deal of catching up do. It might also explain why we do not have the networks that men have – not yet, at least."

Elisabeth agrees. "It may have something to do with man-to-man relationships. Even if qualified women apply for an executive position, a man will still often be selected if there are no quotas in place. They would of course not tell you that there was a male candidate in their network who they had to promote; they will find another very good reason for their selection. I've experienced that myself."

"Building on what you just said, Elisabeth, a difference compared to a few years ago is that such selection processes are being challenged for a higher transparency level," Sabine adds. "We do have a legal framework that allows for closer looks at why a man has been hired over a woman. In many cases, women have to be preferred in the case of equal qualifications. The people who do these selection processes now have to justify their decisions. Equal pay for equal work is still an issue but companies and politicians alike are also being called upon to create and further develop transparency here. We at Infineon Austria are committed to gender equality in our pay and have a uniform salary scheme for men and women, which is ensured by regular monitoring."

For Veera, quotas are one obvious solution to both the comparative lack of women in the field and the difficulty in progressing past biased interviews. "Pretty much everybody knows that Finland has the youngest female prime minister and a female-led coalition. We've had quotas since the eighties so there's a long tradition of equality, but it's a complex issue. In the engineering and technology field, we have to use a 40-60 quota in public bodies and seminars.

Of course, none of us want to be invited somewhere or appreciated because of our

gender instead of our achievements. But for us to actually have true equality, we first have to make the inequality visible and actively seek out female professionals to give speeches. Maybe it sometimes feels like we're there to fill the room, but if we reach gender equality, we won't need quotas – the most competent candidate will be hired every time."

Despite having a female CEO, Infineon Technologies Austria currently has a 18.4% female workforce and a 7.1% share of women in management positions. "Companies are used to work based on Performance Indicators, so we have set a target to achieve 20% women in leadership positions. It's understood as target, not a quota, which is an important difference. Using this target allows for measurement. At the same time, I do not shy away from quotas, although they do not seem 'elegant' – they simply work. As long as there are not better instruments to achieve a higher share of women in supervisory boards, for example, they are the right approach. Quotas create attention and open doors, but then every person – man or woman – has to perform, with or without quotas," Sabine explains.

"Considering the fact, that only 8% of students finishing electrical engineering degrees are female, you can guess how difficult it is to get more women involved. At Infineon, we use every opportunity to demonstrate how exciting and promising this career path is with numerous initiatives, including our bilingual day-care centre with a focus on technology, science and internationality, 'Girls' Day' for elementary school and 'Women's Day' for female students."

THE NEXT STEPS FORWARD

Throughout the dialogue, it was clear that both individual and structural changes are needed if gender equality is to be fully embraced within Europe. The participants therefore rounded up discussions with a look at what they can do on a personal level. "I'm currently the chair of the ECS-SRA team and there are more than 50 people in the core team and the chapter leader team for the next major update. I was the only woman," Elisabeth notes. "I managed to get one young

lady supporting us but it really is a challenge to get more women involved. It's an open call, so I will keep on advertising. We have to encourage women to network better in order to play a bigger role. When it comes to organising events, we should also think about having more women as invited speakers and on panels."

"I work for a company that is obliged to increase equal opportunities for women and men in their business careers," continues Doris. "We have a gender anchor group which is responsible for all topics related to gender and gender mainstreaming within the company, including (for example) providing advice on the implementation of gender-specific criteria for the evaluation process of our calls: if a group of people is affected by research or is at the centre of research, this has to be taken into consideration by an R&D consortium during the design of the project.

"The composition of a project team is also evaluated with regard to the gender balance. For example, are there women in a consortium? Do these women have important roles in a project? There is a reward if the participation of women exceeds the 'sector average' but also punishment if the efforts are sub-standard. We also have various funding programmes dedicated to increasing gender equality, like the FEMtech Programme, Laura Bassi and w-fForte. These support female students or companies that are interested in the employment of women in technical professions, for instance. Other examples are the support of female researchers or women that want to be active in digitisation via with trainings and networking events."

Sabine: "Typically, I refuse to join events or discussions where only women are talking about gender equality. The basic idea is that the more diversity I bring to my organisation, the greater the potential is for the best

ideas and approaches. Quite a number of studies prove this. So far, at least in many European countries, we have not yet taken full advantage of the enormous potential of women in the labour market."

"I'm trying to be more visible to girls and young women who are thinking about their careers and to throw out this challenge to my female colleagues," says Veera in closing. "Right now is the perfect time for a change as we're in the middle of the Fourth Industrial Revolution. If Europe wants to stay at the forefront, we need to have more than half of the population available. With every revolution, there are new ways of arranging things. Maybe some of the professions that are female-led will come to the front of research and development. Who knows what will happen?"

[1] https://www.un.org/sustainabledevelopment/gender-equality/

digital conference

WEDNESDAY
24
JUNE 2020

ECSEL JU SYMPOSIUM

Key Digital Technologies enabling European economic recovery

ECSEL JU

ARTEMIS MAGAZINE

June 2020 | No 28

Lockdowns, logistics and the long term
page 6

Role models, quotas and early
encouragement
page 30

EDITORIAL INFORMATION

ARTEMIS Industry Association strives for a leading position of Europe in Embedded Intelligence