vienna business agency

A service offered by the City of Vienna

Internet of Things

Technology Report

Europäische Union Investitionen in Wachstum & Beschäftigung. Österreich.

Contents

Foto: Wirtschaftsagentur Wien/David Bohmann

Introduction

Dear Readers,

Vienna is one of the five largest ICT metropolises in Europe. Around 5,800 ICT firms generate about 20 billion Euros annually. The 8,900 national and international ICT companies in the "Vienna Region" (Vienna, Lower Austria and Burgenland) are responsible for two thirds of the total turnover of the ICT sector in Austria.

According to various studies, Vienna scores especially strongly in innovative power, comprehensive support for start-ups, and a strong focus on sustainability. Vienna also occupies the top positions in multiple "Smart City" rankings. The city is also appealing due to its research- and technology-friendly climate, its geographical and cultural vicinity to the growth markets in the East, the high quality of its infrastructure and education system, and last but not least the best quality of life worldwide.

In order to make optimal use of this location's potential, the Vienna Business Agency functions as an information and cooperation platform for Viennese technology developers. It networks enterprises with development partners and leading economic, scientific and municipal administrative customers, and supports the Viennese enterprises with targeted monetary funding and a variety of consulting and service offerings.

Support in this area is also provided by the technology platform of the Vienna Business Agency. At technologieplattform.wirtschaftsagentur.at, Vienna businesses and institutions from the field of technology can present their innovative products, services and prototypes as well as their research expertise, and find development partners and pilot customers.

This report provides an overview of the various trends and developments in the field of Internet of Things (IoT) as well as a selection of companies from Vienna who are active in IoT sector.

Your Vienna Business Agency team

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Definition

Digitization is becoming the megatrend of our time. In particular, the boom in the Internet of Things (IoT) sector, for example in form of portable wearables and new technologies for networked smart homes, is regarded as one of the biggest innovation drivers of the coming decade. The Internet of Things enables the development of new digital services and business models using intelligent, networked end devices and machines. This symbiosis is the key to massive future growth in developed markets. According to market research company Gartner, 2017 sets a milestone in this development - for the first time, in this year more networked "things" were available worldwide than there are people on our planet.[1] According to IDC, this figure is expected to increase more than tenfold by 2025 with 80 billion networked devices.[2]

In the future, new market segments - such as the Industrial Internet of Things (IIoT), Ambient Assisted Living (AAL) and Connected Cars - will establish themselves in the broad field of the Internet of Things. In this respect, the IoT market is huge and has the potential to generate numerous other innovations in the coming years. By 2020 alone, Gartner market observers expect IoT-related services worth 263 billion US Dollar worldwide. The economic benefits of the Internet of Things are thus available to established companies of all sizes, the manufacturing industry and start-ups. The concept of developing new services based on sensor data will also generate innovations in the field of app development and thus turn software developers into "architects of a digital future". IoT will open up new revenue streams for companies by monetizing data, improving efficiency and potentially leading to more sustainability by helping us save resources with new solutions.

In Austria, the numerous possibilities of the Internet of Things have already been taken advantage of in some areas. According to the study, two thirds of national companies would recognize the potential for change of the Internet of Things, but they are still willing to invest only 2% of their turnover in new technologies. There is also still a great deal of uncertainty with regard to other technology drivers such as Big Data as well as Cloud and Security - the main question here is which building blocks need to be coordinated in order to fully exploit the potential. The human factor should also not be forgotten - both in terms of socio-political and legal factors (data protection) and in terms of whether certain technologies are safe for humans and the environment. What the currently discussed emerging technologies have in common, however, is that they can dramatically change our lives.

[1] van der Meulen. 2017. https://www.gartner.com/newsroom/id/3598917

[2] Kanellos. 2016. https://www.forbes.com/sites/michaelkanellos/2016/03/03/152000-smart-devices-every-minute-in-2025-idc-outlines-the-future-of-smart-things/#14099a2e4b63

Internet of Things in Vienna

The strategic orientation of the City of Vienna with regard to projects and activities in the field of information and communication technology is laid down in the Digital Agenda Vienna, which was adopted for the first time in 2014. In this agenda, Vienna deals openly, actively but also critically with current digitalization trends and places a high value on an active participation culture by inviting the citizens to submit their proposals within the framework of an "idea forum". Accordingly, the Digital Agenda Vienna was developed with the aim of continuously further developing itself in coordination with the population, business, science and various other institutions. This approach is important inasmuch as the Emerging Technologies sector in particular is constantly and dynamically developing and needs to respond to this situation.

The "Internet of Things" strategy - as part of the Digital Agenda of the City of Vienna - follows this approach by placing people at the center of digital transformation. It also provides a comprehensive overview of selected activities of the City of Vienna in the field of IoT - from air quality measurements to IoT in the field of road conditions or in the field of autonomous driving. The "Vienna Principles" were also discussed as leitmotifs for the Internet of Things, and an evaluation matrix for IoT was created.

The IoT implementation projects in Vienna which are currently underway include WAALTeR, the "Vienna AAL TestRegion" (The acronym AAL refers to Ambient Assisted Living). In this context, the project aims to promote technology support in the everyday lives of senior citizens in Vienna. Among other things, fall detection in the interior and the measurement of blood pressure and blood sugar data will be tested. As another Viennese IoT project, Smarter Together has set itself the goal of implementing a data platform. Based on IoT building data & environmental data, the FIWARE-based platform will be used for various Smart-City projects in areas such as energy, buildings and mobility. The project creates an urban infrastructure for data collection and data exchange between public and private partners.

Especially in the area of the Internet of Things a clear dynamic is visible and especially for a Smart City like Vienna this proves to be a special challenge. The following example illustrates the efforts of the City of Vienna to use IoT also in the course of urban development. The City of Vienna and the Central Institute for Meteorology and Geodynamics (ZAMG) will equip around 1,200 traffic lights with around 10,000 weather and environmental sensors over the next few years. Among other things, these sensors and Big Data Analytics will be used to detect heat islands or enable intelligent traffic flow control.[3]

[3] ZAMG. 2018.
https://www.zamg.ac.at/cms/de/aktuell/news/201einternet-of-things201c-in-der-stadt-wien-ermoeglicht-neue-intelligente-klima-und-verkehrssteuerungssysteme

In this context, the city explicitly wishes to address the areas of privacy and data protection. In all these developments, Vienna as a location benefits in principle from its central function: important corporate customers, such as mobile network operators, banks and advertising agencies, are based in Vienna and a pool of well-trained employees is available. Particular mention should also be made of the fact that the IT industry is already one of the most important branches of the city's economy and that its added value is four times higher than that of tourism.[4]

3.1 Initiatives, funding, networks, institutions, associations

Vienna offers a wide range of initiatives, grants, networks, institutions and associations active in the field of IoT. The independent, non-profit association IoT Austria - The Austrian Internet of Things Network offers users, developers and organisations a platform for exchange on various technical and social IoT-related topics. The tasks of the association also include the regular holding of networking meetings and the organisation of major events in Vienna.

The Vienna Development Hub in the weXelerate Start-up center will provide further economic impetus for the city in the IoT sector in the coming years. Every year weXelerate supports 100 selected start-ups from all over Europe. In particular, start-ups from the technology fields Blockchain, IoT, Big Data, Mobility, AR/VR, Cyber Security and AI & Robotics are included in the program.[6] As a hardware coworking space with electronics production, the Factory Hub Vienna also acts as an interface between idea and production. The technical equipment and infrastructure provided enables start-ups and technicians to go into production with small series early in the development phase. The Factory Hub thus adds an important aspect to the current range of start-up hubs and incubators.

SECTOR	POTENTIAL MARKET VOLUME
Home	200 - 350 billion
Office	70 - 150 billion
Factories	1.2 - 3.7 trillion
Retail Environments	0.4 - 1.2 billion
Worksites	160 - 930 billion
Health and Fitness	0.17 - 1.6 trillion
Logistics	560 - 850 billion
Cities	0.93 - 1.7 billion
Vehicles	210 - 740 billion

Figure 1: Potential global growth in IoT until 2025, by sectors [5]

[4] Stepanek. 2016. https://futurezone.at/b2b/oesterreichs-it-markt-waechst-doppelt-so-schnell-wie-die-gesamtwirtschaft/191.251.015

[5] McKinsey. 2015. The Internet of Things – Mapping the value beyond the Hype, https://www.mckinsey.com/~/media/mckinsey/business%20functions/mckinsey%20digital/our%20insights/the%20internet%20of%20things%20the%20value%20of%20digitizing%20the%20physical%20world/the-internet-of-things-mapping-the-value-beyond-the-hype.ashx

[6] Roither. 2017. https://www.testregion-digitrans.at/news-presse/detail/news/welcome-to-the-future-palfinger-eroeffnet-in-w/

3.2 Initiatives of the City of Vienna

The platform smartdata.wien, which is based on the open standard FIWARE, is intended to serve a wide range of Smart City projects in areas such as energy, buildings and mobility. The platform offers opportunities to demonstrate the potential of FIWARE and to create an urban infrastructure for data collection and data exchange between the public and private sectors.

As an open standard and open source solution, FIWARE prevents the formation of silos (incompatible IoT solutions) and enables autonomous urban data management with great potential for expansion. The FIWARE Foundation actively supports initiatives that use its standard - the focus here is especially on Smart City and agriculture. FIWARE thus enables a new generation of more intelligent applications that use extensive real-time context information.

Communicating "computational thinking" and practical media competence at an early stage is an essential component of future-oriented education in the city. The "Smart Kids Vienna" project is therefore creating a new type of school education together with IT partner companies, the Vienna Education Server and ICT Austria. Teachers, for example, can invite IT experts from well-known companies directly to their class to conduct a topic-specific workshop and thus promote the IT / IoT competence of their students.[7]

DigitalCity.Wien is a joint initiative of the private sector and the City of Vienna administration to develop Vienna into one of the leading digital hotspots in Europe and to position and market it as such both internally and externally. The team of DigitalCity.Wien and all supporters work in close cooperation on the most important topics of information technology, which are of essential importance for the Smart City Vienna.[8]

3.3 Education and research

A problem in the ICT sector in general, but especially in the area of IoT, is and remains a shortage of skilled workers. This aspect is also confirmed in a recent study from 2018 on the entrepreneur's view of the Internet of Things: 34% of respondents cite the shortage of skilled workers as one of the greatest obstacles to the use of IoT. According to estimates, up to 3,000 specialists are likely to be lacking throughout Austria and in the ICT sector.[9] Nevertheless, many applicants often fail due to the very high degree of specialisation often demanded by entrepreneurs. Although some universities of applied sciences and the Vienna University of Technology offer specialised initial and continuing training courses, developments in the IoT sector are very dynamic and make it difficult to create appropriate training courses. In recent years, numerous modules and courses of study have been established in the Viennese university landscape, counteracting this trend and offering a sound knowledge base for IoT-oriented specialists. These include courses that deal with new forms of interaction between humans and computers, such as tangible computing or virtual and augmented reality. The master's program in Media Informatics[10] at the TU Vienna focuses on this subject area by integrating computer science, media theory, design science and psychology. The FH Technikum Wien also offers two training programs in the subject area: the bachelor's program "Smart Home & Assistive Technologies" and the master's program "Embedded Systems".

[7] http://www.smartkids.wien/home/

[8] Digital City Wien Team. 2017. https://digitalcity.wien/category/mission/

[9] Stepanek. 2016. https://futurezone.at/b2b/oesterreichs-it-markt-waechst-doppelt-so-schnell-wie-die-gesamtwirtschaft/191.251.015

[10] TU Wien. Fakultät für Informatik. http://www.informatik.tuwien.ac.at/studium/angebot/master/medieninformatik

In addition, the TU Vienna offers a master's program in "Embedded Systems" and a master's program in "Software Engineering & Internet Computing", which deals with software development for distributed systems and mobile computing.

With ELVIS (Embedded Lab Vienna for IoT & Security)[11] the FH Campus Wien has founded an IoT Security Lab that explicitly deals with the current challenges in the field of IoT security. ELVIS not only offers the infrastructure to deal with the Internet of Things under security-critical aspects, it also offers the basis to react quickly to current trends and to integrate them immediately into the education of the students. The practice-oriented teaching in the IoT-Security area is thus established and interdisciplinarity between the study courses is promoted.

Numerous non-university training courses are also offered. The Future Network CERT offers certificates for requirements engineering and professional software architecture, which contribute to a significant optimization of the development process.[12] TÜV Austria Akademie also offers modules, e.g. on IT and data security.

Project volumes in the IoT sector are currently still relatively low at national level due to the early stage of technological development. In most cases, IT departments even lack an IoT budget or mandate to create market-ready IoT concepts without the support and knowledge of external service providers.[13] A large number of IoT-related projects have set themselves the goal of addressing the lack of privacy and security aspects in the field by developing new technologies. These include the EU projects SCOTT (Secure COnnected Trustable Things) and SerIoT (Secure and Safe Internet of Things). The Austrian Federal Chancellery (BKA) is also involved as a user in a number of research projects within the framework of the KIRAS security research program. As part of KIRAS, the IoThreats project is also addressing the increasing vulnerability of a large number of systems in the area of Smart Home & Internet of Things. The Austrian Institute of Technology (AIT), together with the MA22, is involved in collaboration scenarios along IoT-based value chains. The "SymbIOTe" project is funded by the European Platform Initiative (EPI) through the EU Horizon 2020 Program and aims to bring together manufacturers of platforms and mobile apps, sensor networks, and end users.

Numerous research projects are also explicitly concerned with the consumer side and thus contribute to outlining the further trend with regard to the smart home market. The majority of these research projects have long predicted the success of networked devices.[14] According to Strategy Analytics' Smart Home Strategy Report, more and more people want to live in a smart home. The possibility of networking smartphones and tablets with the systems of the smart home is seen as a major advantage in this respect.[15]

[11] Kompetenzzentrum für IT-Security, FH Campus Wien. 2018. https://www.elvis.science/

[12] Future Network Cert. 2017. http://www.future-network-cert.at/de/zertifitkate/

[13] König et al. 2017:7

[14] Weiler 2014

[15] Arnold. 2012. http://www.energie-und-technik.de/automatisierung/news/article/90516/0/Smart_Home_24-Mrd-Dollar-Markt_bis_2017/

3.4 Activities & Events

Vienna traditionally has the reputation of being an international conference city. The Internet of Things area also offers a comparatively wide range of events that promote networking among national and international stakeholders. The annual IoT Forum (Succus) is one of the leading conferences in the field of Internet of Things and was held for the sixth time in Vienna in 2018. In recent years, the Red Hat Forum has also established itself as a magnet for stakeholders in the IoT field and aims every year to help numerous companies overcome their business challenges and coordinate their IT and business strategies.

The Austrian Standards IoT Congress took place for the second time in 2018 and has meanwhile established itself as an important meeting point for stakeholders interested in interface and synchronization topics. The congress focuses on IoT standardization issues. Successful application examples and new business models from top-class industry representatives round off the conference program. Furthermore, the conference "Digitization: IoT and Data Science" explicitly addressed the question of how companies and organisations can successfully implement data analysis and automation.

4

The Future of IoT / Current Trends

The nationwide implementation of the Narrowband IoT (NB IoT) and LTE-M standards is clearly on the advance and, as the most promising protocols between hardware and IoT platforms, will provide a further innovation boost. The IoT market will also benefit in the long run from the implementation of the next 5G generation of mobile communications, as real-time applications will actually become ”real-time” due to greatly reduced latency times. 5G also provides clear cost reduction, standardized transmission and longer battery life.

YEAR	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
NUMBER OF CONNECTED IOT -DEVICES (IN BILLION)	15.41	17.68	20.35	23.14	26.66	30.73	35.82	42.62	51.11	62.12	75.44

Figure 2: Connected IoT devices globally, 2015 to 2025 (in billion) [16]

4.1 Examples of current Trends

The Internet of Things offers the potential for greater transparency, more accurate analytics and increased capacity for automation. However, implementing these aspects also presents a number of new challenges. Companies use Location Based Services (LBS) to support navigation. LBS also helps organisations improve visibility and control, optimize efficiency, facilitate automation, and support the organisation and decryption of the data stream generated by IoT devices.[17] The need for greater location accuracy supports the introduction of the dual frequency in the mass market. This, in turn, will offer further opportunities for app developers and further reduce the gap between the professional and mass market.[18] New paradigms for product development also lead to products increasingly becoming services. One of these paradigms is ”Software as a Service” (SaaS). SaaS offers a multitude of possibilities, opportunities but also challenges - such as enormously high demands on the IT infrastructure and only slowly growing acceptance on the part of customers.

[16] https://www.statista.com/statistics/471264/iot-number-of-connected-devices-worldwide/

[17] Proietti. 2018. https://www.iotevolutionworld.com/smart-transport/articles/437441-how-location-based-services-increase-visibility-automation-iot.htm

[18] EGSA. https://www.anac.pt/SiteCollectionDocuments/Eventos/2017/04_Portugal%20workshop_LBS_v1.pdf

4.2 New business models as opportunity & challenge

An essential aspect - namely the change of existing ways of thinking and business models - is often neglected in the context of the rapidly developing IoT market. In particular, the aspect that physical products and digital services are merged into hybrid services on the Internet of Things is reason enough to think about alternative concepts. There is no doubt that the Internet of Things will have a massive impact on society and the economy and will fundamentally change existing business models in the long term. Companies that want to be successful on the Internet of Things must therefore develop a profitable business application scenario from a technical solution in a timely manner, whereby technology serves only as a means to an end and often generates no direct profit for providers (with the exception of IT service providers). With regard to current trends such as LBS or SaaS, it is agreed that in the future, competition will no longer be won on production of IoT devices, but but in digital services.[19]

The IoT market also offers start-ups good chances of success in the B2B sector. In particular, new governance structures in the affected companies are in demand. The speed of technological adaptations is also decisive for the success of a company, especially in the rapidly developing area of the Internet of Things. The benefit of developing new business models for the IoT sector is viewed internationally as quite diverse. Switzerland, for example, sees greater benefits in the development of new business models than Germany, whereas Germany attaches greater importance to the development of innovative products and cost reduction.[20]

4.3 Data-based business models & IoT Security

The trend for services to gain importance is likely to continue and increasingly require business models that focus on the customer and collect data. In order to better understand customers and better meet their needs, it is also important to ensure that this data is adequately protected and secured. In this context, there is a particular need to build trust in new technologies that extend beyond the primary application area to other social and emotional areas. It is therefore necessary to improve individual understanding and awareness of the potential benefits or risks of using IoT services, particularly in terms of privacy, autonomy, identity and social inclusion.

According to a recent study by Ernst and Young, IT security is actually seen as the central issue in business models based on IoT and Industry 4.0.[21] Ensuring the security of IoT & Industry 4.0 systems is seen as a particular challenge due to the numerous attack surfaces. Both machine builders and entrepreneurs benefit from this by increasingly acting as service providers. In this context, industrial analytics solutions that enable the sale of machine and plant availability are an innovative business model. Blockchain-based business models are also considered to have great potential, as the underlying cryptographic technology has already been attested for

[19] Dax. 2017. https://www.ksv.at/artikel-internet-der-dinge

[20] Ernst & Young. 2017. https://www.ey.com/Publication/vwLUAssets/ey-studie-ueber-iot-und-industrie-4-0/$FILE/ey-studie-ueber-iot-und-industrie-4-0.pdf

[21] Ernst & Young. 2017. https://www.ey.com/Publication/vwLUAssets/ey-studie-ueber-iot-und-industrie-4-0/$FILE/ey-studie-ueber-iot-und-industrie-4-0.pdf

several years to be able to create networks that are as secure as possible.[22]

A survey conducted by the WKÖ's Information and Consulting (BSIC) division among the national IT decision-makers underlines the assumption that current business models in the IoT sector will be subject to vehement change in the coming years. 90% of the nearly 200 people surveyed assume that digitisation will change the business model of their company, 64% expect that they will be a digital company in five years' time. In addition to the greatest risk - geopolitical changes - they also face data protection (cyber security) and the need to invest in new technologies - such as the Internet of Things.

Another major problem is that not all products can be combined with the services of other providers. The fact that numerous, largely proprietary platforms and applications exist in parallel is one of the biggest hurdles to the rapid adaptation of the Internet of Things. In this respect, machine-to-machine communication is mentioned by numerous companies as another major challenge.[23]

Cloud computing in particular has become increasingly important for innovative business models in recent years. Since products are linked to the IoT and visible online throughout their entire lifecycle, great opportunities are opening up, especially in the areas of production and supply chain management. "As a service" offerings will also gain in importance, which will provide products and services across industries, newly bundled and tailor-made globally.[24]

[22] Iot4Industry. 2018. 55
http://technik-medien.at/wp-content/uploads/2018/03/IoT-1-18-1-gesamt-kl.pdf

[23] Ernst & Young. 2017.
https://www.ey.com/Publication/vwLUAssets/ey-studie-ueber-iot-und-industrie-4-0/$FILE/ey-studie-ueber-iot-und-industrie-4-0.pdf

[24] Accenture. 2015.
https://www.accenture.com/at-de/company-newsroom-internet-der-dinge-sorgt-fur-wachstumsschub

The market for IoT / Market trends / Market development / Current figures in the industry

With regard to market development and trends in the Internet of Things sector, the question arises whether one can even speak of a market as such in the case of the Internet of Things. Rather, the Internet of Things is made up of various market components (e.g. medicine, smart energy, etc.) that can be seen as potential areas of application for IoT technologies. The possible applications of IoT are therefore manifold and illustrate the complexity of the topic. In 2017 alone, sales in the world's five largest smart home markets increased significantly. This trend is also increasing in Austria - with annual sales of 162.7 million Euro.[25]

5.1 International

In international comparison, the USA are among the pioneers with regard to the implementation of the Internet of Things. The overwhelming majority of participants (52%) in the VDE Trend Report 2016 confirms this generally accepted view. Asia follows in second place, with 29% rating it as a pioneer and 50% as well positioned. Korea and Japan, in particular, achieved good results. Europe is at the bottom of the trio of industrial continents.[26]

At the European level, the European Commission in particular is involved as a central actor in the further development of the Internet of Things. The main driver within the Commission is the Directorate-General Information Society and Media with the responsible Directorates D (Network and Communication Technologies) and G (Components and Subsystems). In a recent study, the European Commission interviewed experts on the development potential of the ICT sector and the obstacles to its realisation. The Internet of Things was cited – alongside the cloud and mobile broadband – as a key technological driver. The resulting trends - a change in supply chains and the establishment of new business models, innovation ecosystems and interaction relationships – call for new education and training opportunities to develop a sufficiently developed understanding of the importance of ICT in Europe.

The European IT Observatory (eito) predicts that the European IoT market would double to almost 250 billion Euros between 2016 and 2019. The most important factors for this development are in particular (i) network technologies (e.g. mobile broadband, NFC, cloud computing...), (ii) the development of standards, (iii) new offers as well as the stimulation of demand through marketing and (iv) the influence of politics on certain use cases.[27]

[25] (i) USA mit 13,97 Mrd. €, (ii) China mit 3,44 Mrd. €, (iii) Deutschland mit 1,80 Mrd. €, (iv) Großbritannien mit 1,75 Mrd. € sowie (v) Japan mit 1,79 Mrd. € - Koramis 2017

[26] VDE Presse. 2016. https://www.vde.com/de/presse/pressemitteilungen/vde-studie-internet-der-dinge

[27] eito. 2016. https://www.eito.com/press/Press-Releases-2016/IoT-Markt-verdoppelt-sich-bis-2019

YEAR	2016	2017	2018	2019	2020
REVENUE (IN BILLION US DOLLAR)	157.05	195.68	249.2	330.76	457.29

Figure 3: Size of the global IoT market, 2016 – 2020 in billion US Dollar[28]

The Italian IoT market alone has grown by 30% from 2014 to 2015, and with a total value of 2 billion Euro is considered to be one of the most promising future markets in the country. Overall, the European market, with a 40% share of the global market, can be described as established and advanced.[29] The IDC expects the European market to expand at annual rates of around 20% between 2013 and 2020.[30] German-speaking countries are also investing more in the potential of IoT. According to Ernst & Young, especially in Switzerland new business models with the potential to have a lasting impact on the market are being consistently pursued, whereas in Germany there is still a strong focus on production, the reduction of production costs and the development of new innovative products.[31]

5.2 Austria

In 2016, the Austrian ICT market grew twice as fast as the economy as a whole. The national cloud market is growing relatively strongly, but still at a low level. Especially in comparison to many other European countries, cloud usage in Austria is still restrained. In the media, this circumstance is even described as "cloud scepticism" widespread in Austria.[32] In particular, the low level of the "Software as a Service" (SaaS) segment, which grew strongly by 31.7% to 216 million Euros, is still below average by international standards.[33] In order for the Austrian Business Sector to benefit from the Internet of Things, it is necessary on the one hand to have female entrepreneurs who recognize the opportunity of this technological revolution, and on the other hand to have well-educated people who are up to the challenges of an evolutionary and disruptive market. According to an A1 study from 2018, two thirds of companies recognize the potential for change of the Internet of Things in Austria, but overall it can be stated that "Austria and its companies are not yet sufficiently prepared for this".[34] From an entrepreneurial point of view, Austria even scored "average to below average" in an international comparison. In this respect, the results are an indication that further investment in IoT is needed in order to exploit the full development potential and create economic impulses.

[28] https://www.statista.com/statistics/764051/iot-market-size-worldwide/

[29] SURE. 2017. https://www.sureuniversal.com/the-top-countries-adopting-iot-and-what-that-means-for-you/

[30] EU Kommission. 2014. http://publications.europa.eu/resource/genpub/PUB_KK0215315ENN.1.1

[31] Ernst & Young. 2017. https://www.ey.com/Publication/vwLUAssets/ey-studie-ueber-iot-und-industrie-4-0/$FILE/ey-studie-ueber-iot-und-industrie-4-0.pdf

[32] trend.at. 2017. https://www.trend.at/branchen/digital/it-branche-fachkraeftemangel-cloud-skepsis-8069937

[33] Hainschink. 2017. https://www.it-press.at/presseaussendung/IKT_20170407_IKT0001/fachkraeftemangel-und-cloud-skepsis-bremsen-oesterreichs-ikt-branche-anhang

[34] A1. 2018. https://newsroom.a1.net/news-a1-studie-zwei-drittel-der-unternehmen-erkennen-das-veraenderungspotential-des-internet-of-things-in-oesterreich?id=70529&menueid=12658&l=deutsch

In Austria, an important milestone for the further (national) development and dissemination of IoT was reached in June 2018. Since that time, an NB-IoT (Narrowband IoT) network has been available in Austria, which should contribute significantly to making cities (e.g. in the area of parking space management or the use of intelligent lighting and charging stations) smart through machine-to-machine applications. NB-IoT is especially suitable for applications that regularly send and receive small amounts of data (usually only a few kilobytes are transmitted in most IoT applications).[35]

5.3 Growth driver Internet of things: National market development & forecast

The majority of Austrian companies (64%) believe that IoT is a current – and future – technology with different applications in all domains. Given the current trends in the Austrian market and the slightly positive economic situation, the IoT market is expected to grow both in terms of market volume and in terms of the number of companies using this technology.[36] The strong struggle for market share is reflected in particular in pricing policies, which in turn have an impact on compatibility and standards. In some cases, there is protectionism in this respect, as certain IoT devices are not compatible with others on the market. Some companies, on the other hand, are trying to establish themselves in smaller market segments, e.g. Tapkey, which is trying to stand out from its competitors in the manufacture of its Bluetooth and NFC door locks, particularly by focusing on security aspects.

97% of the participants in an Accenture study on the future of the Internet of Things are convinced that the Industrial Internet of Things (IIoT) will create jobs in the future. There is also broad agreement that industry models need to be rethought and operational structures redesigned. The ”added value” that can be gained from collected data will require both new financing models and security standards in order to be able to offer further pay-per-use services and service-oriented services in the future. It is also clear that digitization will continue to progress rapidly: A1 expects 80 million devices to be connected to the Internet in Austria alone by 2020. 5G will enable short latency periods and further advance this development.

[35] Felser. 2018. https://www.monitor.at/storyid/article/t-mobile-hat-sein-iot-netz-fertig/

[36] König et al. 2017

5.4 Vienna

In recent years, the ICT industry has become one of the most important economic factors in the city of Vienna. The further expansion of the ICT sector - together with all important players - is therefore an important item on the agenda of the City of Vienna, including the implementation of pilot projects in cooperation with innovative companies and start-ups. Last but not least, the information from sensors can also be used to expand the city's Open Data offering, from which numerous business ideas have already emerged.

There are clear differences between the employed persons in the ICT core occupations in terms of regional distribution. A large proportion of ICT occupations are located in urban centres. Almost half of the academic ICT occupations are located in regions with a high population density. In a comparison of federal states, Vienna dominates, with almost three-quarters of all academic IT specialists concentrated in the federal states of Vienna (36%), Lower Austria (20%) and Upper Austria (16%).[37]

With its IoT operating system nymea, the start-up guh is regarded as a success story in Vienna and illustrates the innovation potential in this country. As an open source IoT operating system, nymea offers the possibility to connect a multitude of different devices from different manufacturers. This is primarily intended to prevent countless connectivity solutions from being built for products. In addition, nymea also makes a significant contribution to IoT security by making (often less mature) proprietary developments obsolete.

Another Austrian success story is LineMetrics, founded in 2012, which uses Internet of Things technologies to establish a modern business model in the B2B market. The unique overall concept will for the first time provide automated access to information that was previously reserved for large companies, especially for small and medium-sized enterprises. The importance of sensors for new business models, especially services that rely on sensors, can also be seen in the millions of downloads of the fitness app Runtastic.

[37] AMS. 2015. http://www.forschungsnetzwerk.at/downloadpub/AMS_report_112.pdf

6

Plans and challenges at EU level

Since 2014 at the latest, security experts have agreed that the spread of the Internet of Things also entails considerable threats.[38] As a result, there are increasing questions about (i) where IoT security takes place and (ii) who is responsible for it. A broad awareness of this seems to have emerged recently - sometimes through the striking demonstration of how vulnerable IoT networks really are (e.g. by providing testbeds used by hackers for attacks; e.g. Sophos at CeBIT).[39]

Many IoT device manufacturers currently regard the security aspect as a challenge where liability, risks and high costs accumulate. Therefore, the industry needs to understand the very real problems of OEMs who have difficulty implementing even the most basic IoT security standards. In practice, this means that IoT security solutions should be affordable and ready to go. If required, additional layers of security can be added based on a changing threat landscape. A complete and scalable security solution that covers the device and the cloud service is likely to be most effective in this sense. This allows OEMs to reduce costs and time to market, while services can minimize the deployment, customization and maintenance of on-site devices.

The "IoT and Cloud Research and Innovation Strategy for Europe" responds to the need for political framework conditions to stimulate further growth of the IoT market. IoT is also part of the Digital Single Market Strategy of the European Commission. The specific challenges with regard to the development of a European IoT market are formulated in the Staff-Working Document "Advancing the Internet of Things in Europe".

[38] Kassner. 2014.
https://www.techrepublic.com/article/why-experts-are-nervous-about-the-internet-of-things/

[39] Futurezone. 2017.
https://futurezone.at/digital-life/smartes-geisterhaus-zeigt-gefahren-des-internet-of-things/253.261.616

Services of the Business Agency in Vienna

The Vienna Business Agency offers companies in Vienna a ”360° service”. This includes support and advice, workshops and further coaching for start-ups, assistance in the search for business or office space, contacts to potential partners in the technology scene or the creative industries. The Vienna Business Agency also positions Austria‘s capital in the international business environment, assists international companies settling in Vienna and is the first point of contact for expats arriving in Vienna.

The Vienna Business Agency offers funding opportunities for IoT projects in various funding programs. Research and development projects (R&D projects) are promoted in the framework of special calls in the research program. The Innovation program supports companies that develop new or significantly improved products, services and processes or carry out organisational innovations. For the preparation of large projects with several (international) partners, the R&D Cooperation Initiation program is an ideal choice. Internationalisation promotes companies that open up new markets.

Since 2008, the Vienna Business Agency has organised the Vienna Research Festival, which aims to show a broad Viennese audience what is being researched and developed in Vienna together with Vienna universities, universities of applied sciences, companies and non-university research institutions. Over 69,000 Viennese people have been welcomed to research festivals over the past ten years. More than 140 companies, universities, private and university of applied sciences institutes have already taken advantage of these events to present their research projects and innovative products to an interested public and to make contact with potential customers.

Companies from Vienna

Companies IoT

The following table provides a non-exhaustive alphabetical overview of companies from Vienna that are active in the IoT sector.
The technology platform of the Vienna Business Agency also offers an overview of Viennese technology companies.

Company	Since	MA	Description	References	Contact	Website	E-Mail
Adaptivia GmbH	2008	1 - 50	Adaptivia GmbH is the result of years of research in the field of ubiquitous and pervasive computing and was included in the INiTS incubator in May 2006 due to its outstanding potential. In 2007, the founder was awarded a prize for the best business idea (within the framework of the European Semantic Technology Conference). In 2008, the development of the product WiseWater began, a project sponsored and awarded by ZIT. In the same year, Adaptivia received the Vienna Future Prize for this project. The research in the area of infrastructure-less positioning (project "GoodSense"), which was intensified in 2009, was published in a scientific journal in 2010.	Adaptivia offers consulting and engineering services in the following areas: Embedded Systems Wireless Network Protocols Integration of sense and control systems Research (Internet of Things)	Adaptivia GmbH Franz-Josefs-Kai 51 1010 Vienna	www.adaptivia.com	office@adaptivia.com
Avalaris / Ameba Consult	1980	14	With a focus on system integration, Avalaris offers forward-looking implementations of convergent and system integrative projects in order to combine all areas into a harmonious whole. In the area of IoT, we are involved in the development and implementation of energy-autonomous sensor technology paired with LPWAN (LoRaWan) for use in the (construction) service sector, medical sector, production sector, industry as well as trade and logistics. Open Source, Open Hardware, Open Standards and Open Data are our top priorities.	Avalaris has customers like Voestalpine, Electrovac, Österreichischer Bundesverlag, Kiepe Electric, Skinfit International, Elk Fertighaus, Fujitsu Ltd.	Avalaris / Ameba Consult Josefstädterstraße 72/2/2 1080 Vienna	www.avalaris.com & www.ameba-consult.com	office@avalaris.com
DerAutomat Harrer GmbH & Co KG	2012	11	We create retail robots at the POS based on our own software in combination with an innovative hardware basis, thus enabling the exchange of goods in the future. Today, we offer customer-specific solutions for applications in retail, industry and logistics. Through 100% digitization (cloud-based) and connection to existing systems, 24/7 shopping with the shopping experience of a web shop, digital payment and fully automated ERP integration are possible.	First automatic dispenser for running shoes (Adidas) First digital storage container for construction sites (ENGIE) Vöslauer "Running Station" with the advertising award 2017 was won Further customers or test positions: Turmöl, Semperit, Welser Profil, Magna, Hilti, BP, voestalpine, Dallmayr, Kwizda, various pharmacies, Flink, Airbus, Porsche Design Marco, Busatis, Herber Chemosan, Wilson, Hämmerle, Castrol, Asfinag, Nike, Raiffeisen Vorarlberg, Card Complete, etc.	DerAutomat Harrer GmbH & Co KG Kaiserstrasse 91 1070 Vienna	derautomat.com	info@derautomat.com

Companies IoT

Company	Since	MA	Description	References	Contact	Website	E-Mail
E-Necker	2015	1	E-Necker offers Smart Home planning and installations based on KNX. The KNX building bus system has had all IoT features since the beginning of the technology. KNX devices can be seen as physical objects that are clearly identifiable and exchange data. One of the features of the decentralised bus system is that the devices are compatible with each other and communicate directly with each other. This ensures high system availability, for example.	KNX consulting, KNX integration, KNX fault analysis including troubleshooting for problematic KNX installations Project management and construction management KNX Training KNX basic course KNX advanced course KNX-trainer course	E-Necker Brigittenauer Lände 156-158/5/23 1200 Vienna	www.e-necker.at	office@e-necker.at
Fittrack GmbH	2015	12	Fittrack develops sensor technologies that easily connect to existing fitness equipment so members can automatically so members can automatically track their fitness training. Our app guides users through their training, gives feedback in real time and individually optimizes their fitness training. Through our operator platform, we provide valuable data on the training preferences of training members and optimize commercial gyms and medical facilities.	Fittrack installations can be found in the DACH region as well as in Spain and Chicago with customers such as Jumpers Fitness, Cleverfit, John Harris and the Impuls Health Centre.	Fittrack GmbH Guntherstaße 13/7-8 1150 Vienna	www.fittrack.io	office@fittrack.io
INTEGIUS Systems GmbH	2008	4	INTEGIUS Systems GmbH, headquartered in Vienna, is a smart home specialist for demanding, comfort oriented premium customers. As a full-range supplier, INTEGIUS supplies a reliable, long-term proven Smart Home solution that can be wired to a standard electrical wiring system without unsafe radio transmission and without additional construction work. The result is a fully-fledged Smart Home solution that is extremely easy for the end customer to operate (building and media technology) and can be expanded modularly at any time.	INTEGIUS Systems GmbH is an expert for digital industrialization using software-cast end-2-end business solutions. From 2007 to 2018, the INTEGIUS system was used to implement numerous projects for private luxury customers throughout Europe. In 2018 INTEGIUS also launched an OEM product, which enables OEM customers (e.g. building equipment suppliers, hardware manufacturers) as well as installers to deliver turnkey solutions in high quality to the end customer.	INTEGIUS Systems GmbH Gutheil-Schoder-Gasse 10 1100 Vienna	www.integius.com	office@integius.com
in-u! OG websolutions	2009	2	in-u! develops applications for the optimization of business processes. Our portfolio covers the entire field of the Internet and digital communication and information exchange between people and machines. From websites, individual solutions and smartphone apps to complex total solutions for the Internet of Things. Since 2014, we have also been developing hardware prototypes and small series from IoT Devices exactly according to the requirements of our customers for the entry of companies into the "Internet of Things".	Ohmm GmbH: NFC access control and automation of studios including app and backend for verification and billing of prepaid customers.	in-u! OG websolutions Kurzbauergasse 4/2 1020 Vienna	https://in-u.at	office@in-u.at
LOOP21 Mobile Net GmbH	2008	50	The company LOOP21 Mobile Net GmbH has its headquarters in Vienna. LOOP21 develops solutions based on WLAN networks. With 50 employees at its locations in Vienna, Innsbruck, Düsseldorf and Palo Alto, the WLAN specialist now manages more than 2000 telecommunications systems in 18 different countries. Numerous ski resorts, amusement parks, stadiums, shopping centers, retailers, events or even cities have already been equipped with the WLAN solutions of LOOP21. Services in the areas of infrastructure, customer engagement, data analytics and mobility 4.0 are implemented internationally with the hotspot software developed in-house. Customer terminals and sensors are located via WLAN. LOOP21 offers an instrument for optimal customer communication and loyalty, indoor positioning, customer flow analysis and POS marketing on the one hand, and adapted industry solutions with data analysis on the other.	ÖBB Infrastruktur, Europa-Park, Doppelmayr, Caritas, kabelplus, Stadt Wien, Corio, Silvretta Montafon, Bergbahnen Sölden	LOOP21 Mobile Net GmbH Hirschstettner Straße 19 1220 Vienna	www.loop21.net	office@loop21.net

Companies IoT

Company	Since	MA	Description	References	Contact	Website	E-Mail
LOYTEC electronics GmbH	1999	59	LOYTEC electronics GmbH is today one of the leading European suppliers of intelligent network infrastructure products and automation solutions for building automation. LOYTEC relies exclusively on open and standardized communication protocols. Since April 2016, LOYTEC has been part of the Delta Group, a leading solution provider for energy and heat management, and operates within the group as a competence center for the building automation division. LOYTEC develops, manufactures and sells router and gateway solutions, embedded automation servers and I/O controllers, the L-ROC room automation system, DALI lighting controls, the LIOB-AIR VAV system and graphical user interfaces in the form of touch panels or via PCs.	Schneider Electric Buildings, Siemens, Honeywell, Newron System, Neuberger Gebäudeautomations GmbH, Johnson Controls and around 2,500 other companies worldwide.	LOYTEC electronics GmbH Blumengasse 35 1170 Vienna	www.loytec.com	info@loytec.com
m-smartsolutions GmbH	2016	2 - 5	The control of Smart Home functions must always be easy for the user to understand and intuitive to operate. With the M-Smart solution, you get a clearly structured and concise user interface that concentrates on the essential functions in order to control your components easily and intuitively via touch panel, smartphone or tablet. The user-centred visualization of the necessary control functions and the self-explanatory operating concept of M-Smart create confidence and a high degree of user-friendliness for young and old.	R6 Vienna: Penthouse apartment MB72 Lower Austria: Smart Home Retrofit of a weekend home FH18: Smart Home Retrofitting of a penthouse apartment B22: Luxury roof extension on an old building UW59 Lower Austria: Reprogramming KNX-Bus	m-smartsolutions GmbH Garnisiongasse 3/3A 1090 Vienna	www.m-smart.eu	office@m-smart.eu
nymea.io [guh GmbH]	2016	13	nymea.io supports the development and operation of intelligent products through a series of edge-oriented solutions. nymea also allows the monetization of IoT products through innovative, logical product combinations. The solutions are based on a professionally maintained M2M stack and a good OTA infrastructure. Products based on nymea benefit from an APP / API store, continuous security and usability updates and the extensibility of local applications.	www.smartwithmaveo.com.	guh GmbH Leitermayergasse 25 1170 Vienna	www.nymea.io	office@nymea.io
Riddle & Code GmbH	2016	20	RIDDLE & CODE is Europe's leading provider of Blockchain-based end-to-end solutions. The hardware and software systems developed by RIDDLE & CODE enable companies to respond efficiently to challenges in the areas of machine identity, product origin and supply chain management. Founded in Vienna in 2016, RIDDLE & CODE has already successfully collaborated with international companies and received prestigious awards for its technology.	Deloitte, IOTA, IPDB (Inter-Planetary Database), MOBI, WIEN Energie, Trusted IoT Alliance, EDP, Deutsche Telekom	Riddle & Code GmbH Thomas-Klestil-Platz 13 ORBI TOWER, 10th floor 1030 Vienna	www.riddleandcode.com	office@riddleandcode.com
SELSYS Software Solutions GmbH	2006	30	SELSYS Software Solutions GmbH is a renowned engineering partner of industry and research and specializes in the field of computer engineering, which means the development of hardware-related software applications in industrial environments. The primary business purpose is the provision of software development services for medium-sized companies and corporations with branches in Austria. SELSYS offers high quality solutions in the field of technical informatics for railway control, transport systems and telematics, telecommunication, object protection as well as development of mobile applications.	Software development with focus on "computer engineering". Areas of activity: Real Time, Fault Tolerant & Embedded Systems, Hardware related software development, Software development for telecommunication systems, Project management of complex software projects, JAVA technologies.	SELSYS Software Solutions GmbH Neulinggasse 29 1030 Vienna	www.selsys.com	info@selsys.com

Companies IoT

Company	Since	MA	Description	References	Contact	Website	E-Mail
Sensor Network Services GmbH	2018	10	SENS (Sensor Network Services GmbH) is an Austrian IoT joint venture between Kapsch BusinessCom, Microtronics and ORS comm. Based on the LoRaWAN radio standard, the company offers customized network services and enables resource-saving and cost-effective data transmission solutions. Customer-specific IoT complete solutions are implemented from a single source, e.g. in the areas of tracking, metering, public infrastructure and site and building management.	SENS carried out a reference project in the IoT area with the ÖBB Business Competence Center in the area of digitized switch setting. Together with the water meter manufacturer Bernhard und Söhne, a LoRaWAN supply system was installed in the IZ NÖ-Süd and the water consumption measurement was digitized. Further projects were carried out in the areas of customer satisfaction measurement with the City of Graz and in the area of tracking in Vorarlberg.	Sensor Network Services GmbH Storchengasse 1 1150 Vienna	www.sens.at	make@sens.at
Smile-IT	2015	1	Smile-IT is a small consulting company with focus on Cloud Computing, IoT, Digitization. Clients are supported by innovative approaches in the use and implementation of new technologies. The company itself works technology-independently. The focus is on IT and software architecture using innovative technologies and approaches as well as consulting on strategic issues in these areas.	IoT Strategy of the City of Vienna Cyber-physical System-of-Systems Reference Architecture for an International Industry 4.0 Company Innovative framework for integrated mobility for an internationally active Austrian technology provider	Smile-IT Barnabitengasse 9a/21 1060 Vienna	http://www.smile-it.at	thom@smile-it.at
Tec-Innovation GmbH	2014	9	Tec-Innovation is the inventor of the Walkassist. It is an intelligent shoe that recognizes obstacles. This shoe is designed to simplify the everyday life of visually impaired, mobile handicapped or elderly people as well as to make the job of security organisations easier. The warning system built into the shoe has distance sensors. This means that the shoe, using ultrasound and camera technology, detects obstacles during movement and warns the user of them. If obstacles are detected, the warning system gives the user an ideal, pre-selected feedback. This can be done acoustically, haptically (vibration) or visually.	Close cooperation exists with the following companies: GEA Waldviertler-Schuhe: Support in the production of prototypes - Shoe manufacturer SOLES2WALK: support in the production of prototypes - sole producer INiTS - Innovation into Business: Support in areas like financing, office, network, etc. etc. Konica Minolta: Contacts, Finance & Marketing Support BDO Austria: Tax consulting and accounting	Tec-Innovation GmbH Zachgasse 1 1220 Vienna	tec-innovation.com	office@tec-innovation.com
Theobroma Systems Design und Consulting GmbH	2006	11 - 50	Theobroma Systems manufactures, develops and sells hardware and software system solutions for the robotics, home automation and AI industries. Furthermore, the company has specialized in safety-critical applications. In their own system and communication modules, the combined expertise in software and hardware, from porting and expansion from operating systems through the development of complete solutions to compiler development.	To Theobroma Systems customers count beside international large corporations and medium-sized enterprises especially also well-known semi-conductor manufacturers. The company supports all worldwide customer projects from its development and production site in Vienna. The main markets are in the EU and in the USA.	Theobroma Systems und Consulting GmbH Seestadtstraße 27 1220 Vienna	www.theobroma-systems.com	inquiries@theobroma-systems.com
ToolSense GmbH	2017	15	ToolSense develops an IoT industry standard for networking mobile, energy and cost-critical construction and cleaning machines, thus creating added value for users and manufacturers.	Metabo, STIHL	ToolSense GmbH Höchstädtplatz 6 1200 Vienna	www.toolsense.io	office@toolsense.io
TTTech Computertechnik AG	1998	450	TTTech Industrial is a leading provider of real-time communication and open computing platforms for the Internet of Things (IoT) and Industry 4.0. Through product platforms that combine traditional automation functionalities with secure access to IT services and deterministic connectivity, TTTech shows effective ways to anchor IoT in industrial systems. TTTech Industrial is part of TTTech Computertechnik AG, a cross-sector provider of safety controllers and real-time networks.	Nerve is an open computing platform for Industrial IoT and Industrial 4.0 applications. Nerve provides efficient resource virtualization, secure data connectivity, open interoperability and modern, centralized management. These features allow industrial automation companies (e.g., machine builders, system integrators, and plant owners) to reduce costs while adding value through flexible production, smart maintenance, and shorter time-to-market.	TTTech Computertechnik AG Schönbrunner Straße 7 1040 Vienna	www.tttech.com	office@tttech.com

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¬	Big Data	¬	FinTech
¬	City Logistics	¬	Internet of Things
¬	Cloud Computing	¬	IT-Security
¬	E-Commerce	¬	Mobile Computing
¬	E-Government	¬	Smart Production
¬	E-Health	¬	Urbane Energieinnovationen
¬	Enterprise Software	¬	User Centered Design
¬	Entertainment Computing	¬	Visual Computing

The digital versions can be found at https://viennabusinessagency.at/technology/technology-location-vienna/

At technologieplattform.wirtschaftsagentur.at Viennese can present their innovative products, services and prototypes as well as their research experience to enterprises and institutions in the technology sector and find development partners and pilot customers.

The present activities of the Vienna Business Agency in this cooperation agreement are part of the IC3 project. Information and networking are co-funded by the European Fund for regional development as part of the "IC3 Innovation by Co-Operation, Co-Creation and Community Building" project.
Additional information on the IWB/EFRE funding Programme

Europäische Union Investitionen in Wachstum & Beschäftigung. Österreich.

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