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D.T1.1.4 “Digital Technologies, societal challenges and entrepreneurship in Alpine Space”

WP n°:	T1: The digital revolution to support AS innovation and growth
Task n°:	**A.T1.1. Digital Innovation to meet Alpine societal challenges and strengthen the modernization of the AS industry**
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1. Executive Summary

Within the SMART SPACE project, the activity AT1.1 is aimed to set the scene. It identifies main elements to strengthen the Industry 4.0 processes by SMEs in the AS. Particularly, specific themes, e.g. the alpine peculiarities, innovation processes, social challenges identified in the AS eco-system to meet Industry 4.0’s challenges, create employments and growth.

The Report D.T1.1.4 “Digital Technologies, societal challenges and entrepreneurship in Alpine Space” sums up inputs from previous tasks to identify specific innovation paths able to connect alpine challenges, societal innovation, smart technologies, entrepreneurship and investments.

2. List of contents

3. Applied concept and approach

A detailed analysis and collection of contribution has been made to draft an AS SWOT analysis and to focus the digital solution that can face the typical challenges that Alpine Space is encompassing. This analytic work was done in cooperative way by the SMART SPACE consortium.

Suggestions about specific innovation paths, able to connect alpine challenges, societal innovation, smart technologies, entrepreneurship and investments, have been built upon the analytical work.

4. The AS societal challenges and SWOT

The AS is facing a series of societal challenges. SMART SPACE has focused these challenges considering mainly the EUSALP Strategy and the Alpine Digital Agenda (2014). These challenges are listed below.

- **CHALLENGE 1) Economic globalisation**[1] requires the AS to host a competitive & innovative economic pattern made of successful businesses, interesting job market, even maintaining enterprise dimension from micro to SME and traditional sectors such as textile, mechanical, chemical, agriculture, livestock, tourism.
- **CHALLENGE 2) Demographic trends**[1], characterized particularly by the combined effects of low population density, ageing and new migration models
- **CHALLENGE 3) Climate change**[1] (AS is particularly vulnerable to) and its effects on the environment, biodiversity and on the living conditions of its inhabitants. ICT to manage climate change, environmental data, risks and increase community resilience
- **CHALLENGE 4) Energy challenge**[1] consisting in managing and meeting demand sustainably, securely and affordably
- **CHALLENGE 5) Mobility and transport challenge**[1]. AS is a transit region, with challenging transport conditions, connected with seasonality and weather conditions.
- **CHALLENGE 6) Digital Divide Challenge**[2]The unavailability of (ultra) broadband connections is a source of great inequality, both for business and for citizens in AS.

[1] Eusalp Eu Strategy, http://www.alpine-region.eu/eusalp-eu-strategy-alpine-region
[2] The Alpine Digital Agenda, 2014, www.alpconv.org/en/publications/alpine/Documents/Agenda_Digitale.pdf

STRENGHTS	**WEAKNESSES**
• Location at the very center of Europe, boosts on a reliable and extensive transport network, compared with the global level. • Strong industrial & manufacturing pattern, with industrial culture, in most of regions (some are focused on tourism, culture & services). The servitization of economy impacted but manufacturing is still a leading sector, for GDP and job offer • High R&D expenditure, if compared with the global level, but not sufficient and increasable • Several RTD players are spread across regions and countries, both Universities and research centres with strong capacity. Good quality of the public and private research system, often gathered into a stable regional system of research and innovation. Anyway the technology transfer to SMEs is often lagging behind • Several training institutions: high-end universities, research institutes and vocational training centres • AS Regions ranges from "Moderate Innovators" to "Strong Innovators", according to the Eu Innovation Scoreboard. It refers to traditional innovation indicators (patenting, scientific publications, …), but other indicators are lower • Specialized clusters are widespread, crucial for innovation and digitalization process • Innovative SMEs and large enterprises are often leaders in their fields and included in high innovation competitive at regional & local level & sustainable economic cycles • Tourism is a global "basic sector", developed in all of the AS regions • High overall education level, especially in metropolis and larger cities, compared with the global level • Labour markets caters the needs of traditional industries • High quality public and social services are available and high quality of life attracts students • Several public policies and governmental initiatives / instruments to promote innovation, both at national and regional level, including fundings (S3s, ERDF ROPs), information platform and events, …) • Very rich natural and cultural heritage, exploitable as a production input (tourism) • Renewable energy is available to be exploited • "Ecosystem" of innovative, globally leading SMEs in the field of energy efficiency and renewable energy sources do exist	• Very heterogeneous area, significant intra-regional & inter-regional & social disparities in innovation, funding opportunities, ICT and services of general interest. Despite geographical proximity and large commonality of needs, cross-border language and cultures are different • Spatially fragmented local markets • Progressive depopulation of some decentralized rural and alpine areas: strong migration due to poor infrastructure endowment. Poverty niches, especially in declining rural areas, areas with seasonal occupation and "displacement zones" • Very fragmented economical pattern. SMEs represents a large part of business. Mostly micro to small, they face challenges such as undercapitalization; limited investment capacity in Innovation, R&D, renewal of obsolescent machinery, low capability to meet global market challenges, … • In some areas, tourism favours economic "monocultures"; high dependability of economy on tourism and consequent "environmental pressure" • Insufficient R&D expenditure for innovation leap in traditional sectors and technology transfer • Limited inter-Alpine research & innovation cooperation • Limited R&D on topics of specific Alpine importance • Mismatch between RTD performers research results & the economic pattern take-up, awareness, openness. Limited applied research results capitalisation, visibility, awareness, uptake, commercialization, exploitation, transfer into industrial value-added processes, due to inadequate links research / industry. Gap between topics in the research agenda and the economic sectors/priorities agenda • Under-dimensioned employment in the digital sector and skill shortage as for digitalization experts: gap between curricula offered by training institutions and market demand. Frequent mismatch between training curricula offered by training institutions/universities and labour market requirements. Poor lifelong-learning attitude • SMEs suffer from their low attitude to cooperate among each other • Companies don't recognise digitalization technologies as means towards economic growth. Sort of reluctance/resistance and shortage or ineffective information services. • Digitalisation enabling technologies aren't strong & widespread enough, such as high-speed low-cost bandwidth (digital divide rural, alpine, decentralized areas), Cloud Computing services, … • Existing information and accompanying services are under-exploited • Labour markets are heavily dependent on commuting, especially the peripheral areas on cars commuting • Some parts of population have lower digital and e-content skills • Complex institutional context: multilayer territorial governance, mix of national governance system, overlapping of competences or centralization of decision processes in the capital cities • High environmental sensitivity, general pressure due to human activities (land-take, air pollution, …). Often energy-demanding industry and energy-intensive mobility patterns • Digital divide: ICT infrastructures are not sufficient in some region (eg: Italy, Austria, …), even if always excellent presence of infrastructure / connections in metropolitan areas •

OPPORTUNITIES • Strategic positioning at the heart of Europe, easily accessible from most EU poles & on a wider international scale • Economic globalisation can be a chance for high-quality, high added-value sectors arises • Mobile highly skilled workers could be attracted, due to the high standard of living • Scope for ICT applications, products and services is very large • Socio-demographic trends open new economic fields/markets related to social services & quality of life • General modernization and pressure to innovate (e.g. building, power stations, drive technology, sustainable logistics, …) can open new markets • Global processes like climate change (e.g. on water and energy supply) urge for sustainability. There are business opportunities related to sustainability, (e.g.: consulting and engineering in energy efficiency, natural hazard defences, risk management, services for ageing society, new tourism products, …) can open new markets • All developments expected generate opportunities for the educational system • Good presence of RTD organizations, expertise, competences, funds and instruments. Research priorities need to be oriented consistently with market trends and TT services enforced • Governmental support for investment in R&D in digitalization do exist. It needs to be oriented consistently with market trends • Innovation can help industry develop resource-efficient processes and new recycling technologies, reducing environmental impact /footprint • Awareness raising measures to overcome reluctance to/ fear of digitalization • Prevailing % of SMEs can be an opportunity in term of flexibility, focus to niche markets, customer oriented productions • High environmental sensitivity, general pressure due to human activities (land-take, air pollution, …) and energy-demanding industry and energy-intensive mobility patterns can open new markets • Chance of cooperation between high-tech start-ups and traditional sectors • Digitalization makes possible to access services and job opportunities even in non-urban areas	**THREATS** • The increasing global competition: competitive markets (e.g. in Asia) or laxer administrative, environmental and labour market constraints • Risk of losing competitiveness in front of new global competitors especially taking in account the lack of an Alpine specific approach and capitalisation • Fragmented governance systems and administrative discordance can reduce the potential for transnational exploitation of the Alpine Space strengths and opportunities • Innovative developments in the energy sector are dependent on public support in the initial phase. Public funds often do not match to renewable energy potentials • The knowledge transfer into the heterogeneous and small-structured business sectors requires a regionally-adapted approach • Medium sized cities near metropolises would be the "winners", rural areas the "losers" • Some areas are affected by brain drain from rural areas and consequent depopulation • Shortage of digital professionals and skills • Recruitment issue related to the skill gap in the digital economy. • Cultural reluctance to open SME capital to 3rd party capital & cooperation • Smaller businesses lacking resources for implementing new technologies will lag behind • High cost of building broad-band infrastructure in a mountains and rural areas, where no ROI is guaranteed • Offer of R&D and training keeps on being fragmented • Bureaucratic procedures in public funding are not tailored to micro and SME needs: this impairs digitalization processes • Market demands for individualized products: so businesses must be able to handle complexity • Fear of job market evolution and job loss due to digitalization increase mistrust and reluctance

5. Digital solutions facing AS challenges

SMART SPACE is proposing a series of ICT /digital /smart solutions, contributing to enable the AS to host a competitive & innovative economic pattern made of successful businesses, interesting job market, even maintaining enterprise dimension from micro to SME and traditional sectors such as textile, mechanical, chemical, agriculture, livestock, tourism. These solutions are mapped on the pivotal social challenges and included in the following “CHALLENGES/SOLUTIONS MATRIX”.

AS SOCIETAL CHALLENGES	**ICT /DIGITAL /SMART SOLUTIONS CONTRIBUTING TO FACE THE ALPINE SPACE CHALLENGES**					
CHALLENGE 1) The economic globalisation	**INTERNET OF THINGS**	**BIG DATA**	**CLOUD COMPUTING**	**E-COMMERCE**	**MOOC**	
	PLATFORMS	**SYSTEM INTEGRATION**	**ADDITIVE MANUFACTURING**	**SIMULATION**		
CHALLENGE 2) Demographic trends	**DIGITAL HEALTH**	**PERSONAL SERVICES**	**SYSTEM INTEGRATION**	**DIGITAL SERVICE PLATFORMS**	**ROBOTICS**	
CHALLENGE 3) Climate change	**IOT & SENSOR NETWORKS, DRONES & TO MONITOR ENVIRONMENT**	**IOT & SENSOR NETWORKS, DRONES TO MONITOR BIODIVERSITY**	**CLOUD COMPUTING TO MANAGE DATA & SUPPORT DECISION PROCESS**	**BIG DATA**		
CHALLENGE 4) The Energy challenge	**SMART GRIDs**	**ICT-BASED SOLUTIONS & USER INTERFACES**	**INTERNET OF THINGS**	**CLOUD COMPUTING**	**BIG DATA**	**SIMULATION**
CHALLENGE 5) The Transport & Mobility challenge	**INTELLIGENT TRANSPORT SYSTEM/ SMART, GREEN AND INTEGRATED TRANSPORT**	**COMPUTATIONAL TECHNOLOGIES**	**DIGITAL ACCESS TO PUBLIC SERVICES REDUCES THE MOBILITY NEED OF AS INHABITANTS**	**ARTIFICIAL INTELLIGENCE**	**MOBILITY PLATFORMS**	
CHALLENGE 6) The Digital Divide Challenge	**SATELLITE INTERNET ACCESS**	**HETEROGENEOUS NETWORK**	**PUBLIC POLICY FOR BROADBAND IN DECENTRALIZED AREAS**			

5.1 Societal Challenge 1) The economic globalization

According to the EUSALP EU Strategy[3], the economic globalization requires the AS to host a competitive & innovative economic pattern, made of successful businesses, interesting job market, even maintaining enterprise dimension from micro to SME and traditional sectors such as textile, mechanical, chemical, agriculture, livestock, tourism. Several ICT /digital /smart solutions can contribute to face this challenge. In general terms, a key idea is that the **DIGITAL ACCESS TO SERVICES & OPPORTUNITIES FOR BUSINESSES**, such as public services, training, cooperation along the supply chain, access to digital market for supply & sell, …) is a competitive factor that gives equal opportunities for businesses, even located in AS and in decentralized, rural areas.

The so-called **INTERNET OF THINGS (IOT)** paradigm is the internetworking of physical devices, also referred to as "connected devices" and "smart devices", vehicles, buildings, and other items, embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data. The IOT allows objects to be sensed (with sensors) and/or controlled remotely (by actuators) across existing network infrastructure. The IOT allows **objects** along the production chain to be connected into a **cyber-physical system**, to be **sensed** and **monitored** (by sensors) and/or **controlled** remotely (by actuators) across existing network infrastructure. The potential of IOT is improving manufacturing process, increasing product quality & traceability, increasing job safety, reducing defectiveness. The IOT paradigm requires acceptable answer time from device to device and reliable security solutions and focus more on services than on objects ownership. A couple of interesting cases are the Piemonte **SDP (Smart Data Platform/ Smart Data Net)** and the **EasyIoT** in Slovenia, where the government is providing enabling tools for businesses and local PAs, in order to fasten adoption and innovation impact. The first one is a platform to gather and make available open data, coming from sensors of different type widespread around the region, while the second is a reliable and cheap platform with a suite of general purpose services.

In some details, **EasyIoT**[4] is a secure, reliable and cheap platform for Internet of Things for home and business usage. The system is designed for user, which need advanced a wide range of services, such as, for example alarm system, remote plant irrigation system, solar cell charger control, SMS controlled heater, door opener, hydroponic system or even automation process control system. All these services can easily build on EasyIoT framework. The solution can build smart things, collect their data and help the world understand the data generated by thousands of sensors widely distributed. A community

[3] Eusalp Eu Strategy, http://www.alpine-region.eu/eusalp-eu-strategy-alpine-region
[4] www.Iotlab7.com, http://iot-playground.com

has developed around the platform and several interesting projects have been developed on the community site iot-playground.com.

SMART DATA NET[5] is an open-data platform, that allows to share and aggregate information produced by different services while creating new applications and smarted and sustainable communities. The flow of data is generated by Internet of Things devices, distributed all over the regional area of Piemonte (such as cameras, traffic sensors, weather stations) and Internet of people (such as tweets, or smartphones' signals). It is a system interconnecting objects and people and aiming to improve the knowledge and analysis of life events within complex environments. The technological pillar of the ecosystem is represented by YUCCA, an open source platform oriented to the acquisition, sharing and reuse of data resulting both from real Time and on-demand applications.

With respect to the economic globalisation challenge, another enabling paradigm is the so-called **CLOUD COMPUTING**, that makes possible ubiquitous, on-demand access to shared & configurable computing resources, beside the exploitation of a wide computation and storage potential that is among distributed server farms, conned by a connectivity infrastructure.

The third pillar, together with IOT and cloud computing is **BIG DATA**, including large or complex data sets, made of advanced data analytics methods, that extract value from data. The running trend sees data sets growing rapidly - in part because they are increasingly gathered by cheap and numerous information-sensing mobile devices, aerial (remote sensing), software logs, cameras, microphones, radio-frequency identification (RFID) readers and wireless sensor networks. In productive contexts, the BIG DATA potential can be used in predictive manufacturing, as part of a cyber-physical system, to unravel uncertainties (such as inconsistent component performance and availability), toward near-zero downtime and transparency.

SYSTEM INTEGRATION is a good way, with regard to economic globalisation, to maintain the competitiveness of a company: in fact, it improves customer relations, reduces administrative effort, increases flexibility, boosts the acceleration of processes. The production of the future has to guarantee flexible processes by means of automation and connectivity, which are adjusted to the demands of the customers. Thereby the quality assurance can be perfected, the administration effort reduced and the time frame from the incoming order to delivery minimised. The precondition for this purpose is the possibility to retrieve information online and in real-time. A fast information flow with all participants is ensured by a flexible information hub, which connects the diverse data and processes it for as well the employees as the decision makers. Due to the digital flow the right information is available at the right time and place. Direct communication with the leading system facilitates a large part of the operations. For example, it makes sure, that only approved orders are carried out in the planned sequence. Additionally, it is visible at once, where an

[5] https://www.smartdatanet.it

order is located, if it can be accomplished on schedule, if logistics have to be provided and when maintenance is required. Moreover, the consistent acquisition of components, including all relevant process data, enables consistent backtracking. While in the past complex processes, using mainly human work capacity, were very time-consuming in administration, error-prone and hence very expensive, an automatic process connects all required departments from both the company and customers and suppliers without system or media disruption. The advantages are several, starting from a drastic reduction of administrative efforts on customer and supplier side, and including an enormous increase of flexibility and speed in switching or changing the production, a reduction of the stocks (implying fixed capitals) and the chance of producing exact quantities on demand (just-in-time). To these advantages, others can be added, such as the reduction of error and defects (via improving the interfaces between departments), excellent and environmentally friendly resource management (linked to the on-demand production) and drastic reduction of the costs for error corrections and reworking by automatic, fully electronic quality control of every component and documentation; intelligent fault prevention.

System integration can be applied on every production branch and there is a wide demand for large data set analysis in very diversified sectors, which is due to the growing use of ICT and cloud services. A practice trying to answer this need is NET.PLEXOR[6] from Slovenia. It is a set of tools for analysis and visualization of large networks and data sets in real-time. The tool is intended for the purpose of data collection, management and visualization of data in different sectors, addressed to the large crowd of users (providers of content and services, market regulators, researchers, etc.) Domains of application are wide, ranging from communications, to energy and transport networks, health systems, logistics systems, environmental monitoring, the financial sector, social networks, marketing research, online shopping.

Also **SIMULATION TECHNOLOGIES** can provide advantages: in fact, they can enable shorter development times, while **ONLINE CONFIGURATORS** and **COLLABORATIVE AND E-COMMERCE PLATFORMS** can contribute to customized products, increases proximity to customers, who become a competitivity factor by providing their feedback and increasing product customization.

On the other hand, **ADDITIVE MANUFACTURING TECHNOLOGY** can improve competitivity since they enable rapid prototyping at lower costs while reducing resource consumption. An interesting AS case is represented by **Qubit3D**[7] is a joint project, deriving from the synergy between Fly-Image Technologies, a Swiss company specialized in mechatronics, and Politologica Inkjet Printing, a spin-off company of the Politecnico di Torino. The project aims to create a 3D Printing Network through the aggregation and coordination of Print Centers.

[6] http://www.abelium.eu
[7] www.qubit3d.com

The Print Centers are provided with technology, training and assistance, in order to make them fully operational in delivering 3D Printing Services and meet individually their own local market demand, but also a wider market in cooperation with other Partner Centers (nowadays they are 30 in Northern Italy). The two proposing companies have developed and tested the technology and own it. and the expertise to use it to face market needs. The proposal was made available to Centers of Digital printing (already experienced in 2D printing services) and to MBE Centers (already used to operating in a network as logistic operators). The goal was to become the main 3D printing player in Northern Italy by 2018, with a business model totally based on the technology the company has developed internally and fully owns. The market is with no doubt growing fast and a flexible answer is a competitive advantage. The chosen approach was aggregating professional press centers through technology sharing and skills. The created network is made of 300 machines, 90 skilled operators, with a production capacity of over 1000 objects per day and a widespread presence. This approach enables the network to respond to the new needs of the more traditional local customers (such as architects, designers, advertisers, students) and, through a shared collaborative job, to the emerging "just-in- time" and "0 km" market, that requires flexible production in terms of customization, quantity and cost reduction in comparison with the massive industrial production.

Moreover, some main enabling preconditions need to be mentioned, both “hard”, such as **HIGH SPEED INTERNET** and **CYBERSECURITY**, and “soft”, such as **SKILLS & COMPETENCES**.

First of all, a pivotal enabling technology is represented by the **HIGH SPEED INTERNET**, that allows companies to have access to big data ad data mining technologies and to contribute to the economic development, even if businesses are not based in urban and fully served areas. Secondly, **CYBERSECURITY** must be assured. An interesting case is the cybersecurity platform provided by Lyon Metropole, where one of the first “collective” in Europe dedicated to the cybersecurity of industrial and urban systems has been created. The Metropole of Lyon has teamed up with leading names in the industry, SMEs and start-ups to promote this theme. This consortium brings together equipment manufacturers, including automation companies (Siemens, Schneider, Alstom, Sorhea), solution companies (Sentryo, ESI Group, Cybersprotect, Stormshield), integrators (Automation and Industry, EKIUM, Assystem, Axians, Actemium), global cybersecurity actors (ATOS, Thales), a CESTI (CEA Leti), and operators of industrial and urban systems. The security of industrial and urban systems concerns industrial Internet, intelligent building, transport and energy networks as well as industrial sites and processes. It is a highly strategic issue for businesses, individuals and territories. The diagnosis on the security sector, carried out by the Observatoire Partenariale Lyonnais en Economie (Opale[8]), highlighted the specificity of the Metropole de Lyon: its

[8] http://www.opale-lyon.com

unprecedented position on the security of industrial and urban systems. A particularity confirmed by the exchanges with the actors of the territory.

To be carefully considered also the so-called the "soft" components or preconditions, such as **SKILLS AND COMPETENCES OF MANAGERS, WORKERS, DECISION MAKERS**. Traditional training approaches or computer–mediated approaches should be integrated to increase and keep updated the workers' skills. Among these, **MOOC (**Open and Massive Online Courses) can be an interesting tool, boosting the potential of distance learning and leading workers to interact on a distance basis as a crossing approach to training, cooperating, working. MOOC are an open type of distance learning capable of accommodating a very large number of participants. Course participants are geographically dispersed and communicate via the Internet. An interesting platform for MOOC is provided by a EU project named EMMA[9], providing a system for the delivery of free, open, online courses in multiple languages from different European universities.

5.1. Societal Challenge 2) Demographic trends

A challenge particularly relevant for the AS is represented by demographic trends, characterized particularly by the combined effects of low population density, ageing and new migration models, as pointed out by the EUSALP EU Strategy[10]. To counteract demographic trends, the quality of living in rural areas has to be assured and living there organised as attractive as possible. There are various approaches for the different spheres of life. With the help of digitalisation and new technologies health care and nursing services, the living situation, work, education, services, energy supply and mobility can be improved considerably and additionally designed worthwhile.

As in the previous challenge, a key idea is the **fair & equal digital access to services & opportunities**, such as public services, health services, training & school, job opportunities…). In fact, the Alpine Convention underlines "the principle of the maintenance and modernization of the existing settlements, implemented according to the specific characteristics of each site. The principles then emphasize the importance of maintaining

[9] The European Multiple MOOC Aggregator called EMMA for short, is a 30-month pilot action supported by the European Union. It aims to showcase excellence in innovative teaching methodologies and learning approaches through the large-scale piloting of MOOCs on different subjects. EMMA provides a system for the delivery of free, open, online courses in multiple languages from different European universities to help preserve Europe's rich cultural, educational and linguistic heritage and to promote real cross-cultural and multilingual learning. See https://platform.europeanmoocs.eu.

[10] Eusalp Eu Strategy, http://www.alpine-region.eu/eusalp-eu-strategy-alpine-region.

and developing decentralized primary health care and education services also in remote areas. This also applies to leisure activities and cultural programs, whose importance is emphasized not only for tourists, but also for local residents. Finally, the principle of facilitating access of the Alpine population to modern communication technology is underlined[11] as an enabling condition.”

Medical treatment, for instance, can be supplemented with online communication with the doctor to spare long drives. That way even tele-diagnoses are possible. Furthermore, smartphones can be used to gather and forward patient data to the doctor on a daily basis. Besides, it can help the user keeping track of needed medication. Platforms also provide the opportunity to strengthen the public spirit and to encourage social interactions. This way neighbourly help, regional online bartering and trading, involvement in local politics or simply information exchange can be offered and coordinated easily. Furthermore, digitalisation enables not only working from home, but offers also new means to provide services and thereby improves the supply situation of the demanders. Thus regional platforms following the example set by websites like myhammer.de can be established. There the required manual services have to be described and a qualified provider can be found quickly. By using such means there are positive effects for the providers, too. For example, an increased number of orders in the proximity or the possibility to partially choose and schedule the tasks. This concept can be transferred to other business segments and contributes to a continuous availability of services for the inhabitants of an area.

Several ICT /digital /smart solutions can contribute to face this challenge. First of all, the range of **DIGITAL HEALTH SOLUTIONS** need to be recalled, where the term E-HEALTH does not only refer to condition of illnesses but also relates to prevention and to a complete state of physical, mental and social well-being and connects with the provision of **DIGITALIZED HOME SERVICES**: in fact, the population aging and the push towards the home hospitalization are supported by the increased availability of low cost digital equipment for households and home.
An interesting case is **PEDIATRE-ONLINE**[12], a teleconsulting platform made available in Alsace by a start-up. As in several AS decentralised areas, the number of physicians and specialists as pediatrician has more and more decreased in Alsace and especially in rural areas and e-health solutions can be crucial to ensure access to medical services for all the population. Development of PEDIATRE-ONLINE is a start-up created by Dr. Pfersdorff, paediatrician in Strasbourg and launched in September 2016. The teleconference is similar to what paediatrician does regularly in the office when a patient calls. Paediatricians (about 30 involved in the initiative) listen to the person, and can then judge whether the situation

[11] “Demographic changes in the alps. Report on the state of the Alps”. ALPINE CONVENTION. Alpine Signals – Special Edition 5, 2015
[12] http://www.pediatre-online.fr

can be resolved remotely or whether a physical consultation is necessary. Sending photos or videos is a great help. This service is a real relief for parents who can now have the same quality of advice regardless of their location. By being in contact with a specialist via chat or telephone, at a very reasonable cost, they don't have to travel to the emergency room with their child. This tool also makes it possible to secure existing practices because some doctors paediatricians respond to requests from patients in an unsecured environment (no secure messaging, ...). Facilitating the cooperation among health professionals is a complementary approach chosen by the Slovenian national initiative named **E-TRIAGE**[13]**,** providing information support for the triage process in health centres and hospitals: it is used to reduce clinical risk in cases of the large number of patients where medical staff cannot do real-time treatment of all patients.

Secondly, the range of **SOLUTION TO ACCESS ONLINE PUBLIC SERVICES** can contribute facing the demographic challenge in the AS. An interesting case is the DIGITAL PLATFORM AUSTRIA[14]**:** Austria has been the EU leader in eGovernment for years. The Austrian administration offers numerous services on the Internet, which, for example, makes it possible to make applications largely independent of time and place or to communicate electronically with the administration. Another interesting practice is Open Data Portal Baden-Württemberg[15], the e-Government platform for citizens, companies and administrations in Baden-Württemberg active since 2003 and renewed in 2016. E-government stands for the use of the electronic media - especially the Internet - to manage administrative processes electronically. The task of e-government is to realize economic, holistic and, as far as possible, media-free automation solutions within the administration and between the administration and the citizen / company using the means of information and communication technology. Where administrative procedures cannot be carried out electronically for legal reasons, information should be offered to prepare or facilitate the progress of the authority, whether personally or electronically.

Enabling technologies and devices are partly common to the previous challenge: in fact, on one hand, **SENSOR NETWORKS and IOT DEVICES** enable to collect data and to monitor physical conditions of people and are, in their turn, enabling HW and SW for digital health, training and leisure services. In the meantime, while, on the other hands, **BIG DATA** and **CLOUD COMPUTING** enable data storage, retrieval, computation and digital access to services & opportunities.

From a different perspective, **WEB-BASED APPLICATIONS, DIGITAL SERVICE PLATFORMS, USER INTERFACES,** are integrating part of the demographic challenge answer, since they

[13] https://zvem.ezdrav.si/domov
[14] http://www.digital.austria.gv.at
[15] https://www.service-bw.de/

facilitate the interaction among people, between people and specialists (health professionals, training professionals, entertainment professionals, …) and the access to information and digital resources. Services can be accessed and offered from any place. Moreover, **DIGITAL ACTIVITY EXCHANGE PLATFORMS and SOCIAL MEDIA PLATFORMS** enable the inhabitants of a certain area to swap ideas on hobbies / activities, to organize trips and help people to form interest groups.

A relevant target group for fair & equal digital access to services and opportunities is represented by the elderly. An interesting case in Lombardia[16], where a project carried out by Consorzio Intellimech and other partners has the objective to improve the quality of life in the elderly population, increase the well-being of citizens, assist and motivate them to maintain autonomy and health. To achieve this result, the project aimed to develop and test an integration platform for the collection and sharing of personal data, powered by sensors and devices, connected to a centralized system of information processing. Through the processing of these data sets software applications that can perform specific functions and communicate with citizens through mobile devices (smart phones, tablets, smart TV) have been developed. The goal is to monitor physical condition, guide and promote healthier lifestyles. A series of specific applications that meet different needs in different areas of life and relationships of senior citizens have been developed. The first requirement has been to motivate and assist the citizen in undertaking physical activity in controlled conditions, to maintain the state of health, both in house and outdoor. Through automatic systems for data acquisition and processing the user has been given active support in the management of nutrition, to improve the state of health even in people with limited autonomy. Another series of integrated software applications, with personal and environmental sensors, have been developed to give emotional support in stress managing. In addition, to improve the current management of individual drug therapy, largely present in aging, an infrastructure to support diagnosis, treatment and medical care using integrated management of personal medical information has been built.

To be mentioned as well **SIMBIOZA**[17], a Slovenian nation-wide campaign of computer and Internet education initiative, to enable elderly to make the most of computers and the Internet. It has connected more than 15,000 elderlies and 9,000 young people across Slovenia in three years and has developed a model of computer workshops for the elderly, where they do learn the basics of computer use from young people. The workshops were

[16] The life expectancy in Italy has risen from 70 years in the ‘60s to more than 81 today, being more than 84 years for women. This is one of the highest life expectancies in the world and derives from the medical progress of the last fifty years and probably healthier lifestyle habits, such as the Mediterranean diet. More than 12 million people in Italy are over 65. This growing number of senior citizens, however, increases the number of people suffering from pathological conditions, with low quality of life, limited autonomy and high social costs for medical care and assistance.

[17] http://www.simbioza.eu

free and were based on intergenerational cooperation and knowledge transfer from young people to the elderly.

5.2. Societal Challenge 3: Climate trends

Climate change is the third main challenge for AS, that is particularly vulnerable to its effects on the environment, biodiversity and on the inhabitants’ living conditions.

ICT solutions can be really helpful to manage climate change, environmental data and risks, to increase community resilience and help to cope with the aggravating consequences. In particular, **IOT, SENSOR NETWORKS and DRONES** are suitable to monitor environment phenomena (such as landslides, rivers, glaciers, avalanches, …) and possible emergency. Data streams (such as, weather data, air quality, water streams, ice and soil movements, …) are made available to observers and professionals, are stored, interpreted, compared with historical series and eventually converted into alarms during crisis. **CLOUD COMPUTING** is pivotal to manage data and support decision process, both as for long term climate change management and for sudden crisis. **BIG DATA** enable to manage effectively the quantitative explosion of data and to analyse them.

In some details, continuous and widespread gathering of weather data is the basis of all following processes like modelling, analysis, monitoring or predictions in climate research, environmental planning or danger management. The data includes air temperature, accumulated precipitation, water balance, snow height and temperature, solar radiation and duration of sunshine. With this information frequency analyses, extreme value statistics or even energy optimisations can be obtained. Also the agricultural sector depends on the weather, whereby exact predictions of e.g. weather alerts and the actuality of the accessible data are highly significant. **SIMULATION SWs** are often applied to the collected data to enrich the decision process.

On platforms like the of the **GERMAN METEOROLOGICAL SERVICE** (**DWD**[18]) or the Piemonte regional platform **SMARTDATANET**[19] large amounts of data are collected, stored, classified, compared with historical data series. Part of the gathered data is available to anyone, part is addressed to experts, both as free open data, and as paying services. As for **DWD**, besides a direct connection via Regional Meteorological Data Communications Network (RMDCN), there are also other ways how an end-user can receive the desired information, for example per SMS-services or satellite connection. In some details, the **SMARTDATANET** allows to

[18] http://www.dwd.de/EN/Home/home_node.html
[19] https://www.smartdatanet.it/presentation.html

share and aggregate information produced by different services to create new applications, creating more intelligent and sustainable communities. The data flows are generated by “IOT sensors” (such as cameras, traffic sensors, weather stations) and Internet of people (such as tweets, or smartphones' signals). The various components are gathered into a system interconnecting objects and people and aiming to improve the knowledge and analysis of lives within complex environments. The technological pillar of the ecosystem is represented by YUCCA, an open source platform oriented to the acquisition, sharing and reuse of data resulting both from Real Time and on-demand applications.

An interesting practice of **REMOTE SENSING** and **MONITORING** related to Climate Change is registered in Piemonte, where CSP in cooperation with the Società Metereologica Piemontese has started the project METEO2850[20]. A monitoring station is located at 2850 mt above s.l. at the Ciardoney Glacier in the Parco Nazionale del Gran Paradiso: it consists of a weather control stations powered by a co-generation system and connected to an experimental broadband network, that transmit daily data and video streaming (through a live webcam) about the glacier environmental conditions for some hours every day.

Also **SATELLITE VISION**, characterized by multi-scale and temporal dimensions, offers optimal capacities to observe how our territories are developing. Land consumption through urbanization, connectivity of green infrastructure, or the potential impacts of agricultural practices on biodiversity are some of the quantifiable landscape dynamics, that can be measured though satellite data.

A relevant case is represented by **SERTIT[21],** a laboratory of the University of Strasbourg in Alsace, that uses satellites to monitor environment, biodiversity and to evaluate human impact on environment SERTIT has huge knowledge on big data analysis, data mining. Created with the launch of SPOT-1, the first French EO satellite, SERTIT helps space serve the Earth producing geo-information from space imagery. As a regional, national and European operator, it responds to society’s needs offering solutions in risk management, land planning, natural resource management, the environment and sustainable development. SERTIT intervenes in emergencies thanks to its world renowned rapid mapping service. This service responds to information needs in risk and crisis management during disasters. It is notably involved in the European Copernicus Emergency Management Service Rapid Mapping and the International Charter “Space and Major Disasters”.

Moreover, **SPACE SOLUTIONS and SATELLITE REMOTE SENSING** have proven to be a reliable and effective instrument in forestry surveillance, management and monitoring, complementary to other traditionally used methods, to manage mountain territory in Alpine Space and especially forests (remote sensing is becoming a decisive tool for foresters enabling them to have a clearer view and better knowledge, for the greater benefit of our

[20] http://nimbus.csp.it
[21] http://sertit.u-strasbg.fr

forests and the timber industry as a whole).
In Slovenia, Space Remote Sensing is used to monitor droughts and freshwater wetlands. The Centre of excellence **SPACE.SI** focuses on the application of tools for managing the drought consequences, on increasing drought preparedness and reduce the drought consequences. an interactive system has been Developed through the use of micro and nano-satellites, to provide an effective early warning of the drought danger. **WETMAN**[22] project work on the protection and management of freshwater wetlands in Slovenia, both as for emergence of non-native species and monitoring of level of the ground water.

5.3. Societal Challenge 4) Energy management

A further challenge for the AS is related with energy management, consisting in managing and meeting demand sustainably, securely and affordably.

Digital solutions and approaches useful to face the challenge ranges from **SMART GRIDS**, to **REMOTE CONTROL** and **DATA ANALYTICS** to **ICT-BASED INTERFACES** to increase consumers’ energy aware habits and to manage the demand side. General purpose technologies, such as **IOT, SENSOR NETWORKS, BIG DATA and CLOUD**, as in the previous challenges, allows to collect data, store, process energy-related data and to support decision in this domain. In some details, IOT and sensor networks provide information in the Cloud, concerning the state of energy availability and needs, cloud accommodate in a common space all the data and information useful for decision-making, while big data offers new opportunities for information exploration, knowledge and evaluation, trend and prospective analysis on energies and their uses.

Some interesting cases of **INTEGRATED ENERGY MANAGEMENT SYSTEMS** have been developed in SMART SPACE partner regions.

The project **SIDE** (Energy Management Systems based on climate input) is related to the monitoring and control of domestic energy consumption, leveraging on the technologies related to data collection, dispatching of data to a server and web-based access to data. SIDE) has developed an innovative system for building energy management, that allows the development and management of new zero-energy building and the requalification of existing building. The project aimed at controlling the hygro-thermal comfort of a building and at managing accordingly the heating/cooling system in order to maintain the ideal conform level inside the building and minimize the heating/cooling total cost. The hygro-

[22] http://www.wetman.si

thermal comfort depends on the following parameters: air temperature, air humidity, luminous intensity, noise level, indoor air quality, Thus, this system takes into account both internal and external parameters. The core of the system is represented by a “black box” that is installed inside the building and is responsible of the building management. This black box collects all the data gathered from monitoring the building conditions and defines the actions needed to maintain the system under control. New and old information are elaborated trough predictive algorithms in order to define the future state of the system and put in place corrective actions. The project has developed a web-based platform that, leveraging on the exchange of data with the “black box” installed inside the building, works both at digital and real level through the remote control. This web-based platform has three main functionalities: diagnosis, control and supervision. Thus, based on the data gathered and the analysis of these data, the active elements of the building are automatically set up in order to ensure high performance according to the intended use of the building.

To face the energy challenge, smart solutions for monitoring and optimization of energy consumption are urgently needed. Monitoring software products constantly combine building and measurement data, which are consequently used not only for monitoring, but also for performance analysis and eventual performance optimisation to enhance an efficient energy management. Therefore, monitoring systems can also be integrated in already existing buildings.

Products as **MONISOFT**[23] by Rosenheim University of Applied Sciences, guarantee that building data is always processed in the same, standardised manner independent from the used building management system to make comparisons possible. Another important feature of such software is the visualisation of the gathered data to facilitate energy management. Information on a certain area, measurement point characteristics, data quality or individual user preferences are included to automatically generate detailed analyses. Also with the help of graphic illustrations the user is able to detect malfunctions very quickly or compare the results with average values. For further analyses conditions and dependences can be set, such as regular working hours or air conditioning. Especially in combination with the utilisation of renewable energies, smart grids help to ensure a sufficient and continuous energy supply for an entire area. Renewable energies are especially convenient for the alpine space to cover the security of supply and are simultaneously economic and sustainable. Smart electricity meters in combination with a smart grid is the next step to an intelligent power supply system. Smart meters measure the energy demand of every consumer and deliver important information about consumption patterns and prognoses about energy demands to the connected electricity grid. This way it is possible to coordinate demand and supply.

Renewable energy plants are only able to deliver a certain amount of energy at the same time. The **AÜW**, an electricity distributor in the Allgäu region, shows how these different

[23] http://www.fh-rosenheim.de/forschung-entwicklung/kompetenzfelder-und-projekte/energietechnik-und-energieeffizienz/monisoft-20

decentral plants can be joined in a virtual power system. It observes and controls energy consumption and production as well as transport and dispersion to the consumers. Due to this intelligent network an energy balance can be achieved and maintained. Additionally, energy conscious consumption and sustainable acting can be encouraged, for example by providing and promoting online advisers or calculators on the subject.

As for **SMART GRIDs**, including operational and energy measure devices, smart appliances, renewable energy resources and energy efficiency resources, to control and optimize production & distribution of electricity.

ICT-BASED SOLUTIONS & **INTERFACES** can help increasing consumers’ awareness on energy consumption and energy efficient behaviours and to make efficient energy consumption and competitiveness factor of manufacturing enterprises. The **THE4BEES**[24] EU project, funded by the Alpine Space Programme, aims to make a group of users and managers aware of the energy consumptions of the buildings (both public or private buildings) they manage or make use of and suggests them practices to carry out more energy-efficient behaviors. Sensors, digital interfaces and a mix of IOT solutions, large data and clouds are the technological components, experimented in social houses, schools, alpine huts, public buildings, coworking spaces.

5.4. Societal Challenge 5) The transport & mobility challenge

As stated by the EUSALP Strategy, AS is a transit region, with challenging transport conditions, connected with seasonality. There is a strong need to minimize transport environmental impact (and its impact to the Climate change) while exploiting business opportunity of transport & logistics. According to the Transport Protocol of the Alpine Convention, the AS need to “pursue a sustainable transport policy which will reduce the negative effects of and risks posed by intra-Alpine and transalpine transport to a level which is not harmful to people, flora and fauna and their environments and habitats; inter alia, by transferring an increasing amount of transport, especially freight transport, to the railways, in particular by creating appropriate infrastructures and incentives in line with market principle”.

The introduction of **ITS-INTELLIGENT TRANSPORT SYSTEM** solutions and approaches, the focus on **SMART, GREEN AND INTEGRATED TRANSPORT**, including according to the EU Directive 2010/40/EU (7 July 2010) infrastructure and sensors, interfaces, vehicles and nomadic users, for traffic and mobility management can significantly help to face the mobility

[24] http://www.alpine-space.eu/projects/thefourbees/en/home

challenge for AS. On one hand, **COMPUTATIONAL TECHNOLOGIES**, such as **CLOUD COMPUTING** to store and process data can help to manage transport towards sustainability e efficiency. On the other **REMOTE SENSING TECHNOLOGIES and IOT** enable monitoring and managing road and vehicles. Main solutions range from **WIRELESS COMMUNICATIONS**, needed to connect fixed and mobile items and allow data exchange, to **SENSING TECHNOLOGIES**, such as **WIRELESS SENSOR NETWORKS** and **IOT**, to collect data and include the so-called “actuators”. Moreover, **ARTIFICIAL INTELLIGENCE** offering problem solving methods for high logical or algorithmic complexity issues are particularly useful in the Intelligent Transport System domain.

Since the transport and mobility challenge in the Alpine Space is, in comparison to urban areas, a real issue, it is important to boost TRANSPORT PLATFORMS. They can be used as well by individual persons as by companies for their goods traffic. One of the best-known possibilities are CARSHARING SERVICES. The concept is usually very simple: after registering at the provider, the user can search for available vehicles nearby, make advanced bookings or directly use vehicles at any time. A well-developed infrastructure (including charging stations if car-sharing is combined with electric mobility) with enough pick-up points is essential as much as the information infrastructure that allows to benefit of the available vehicles. This is a good opportunity to reduce the environmental impact and make mobility more sustainable, both for inhabitants and for tourists. A couple of interesting cases of mobility-as-a-service offer are in Southern Germany: EE-TOUR[25] in Allgäu and ECARSHARING by E-WALD[26] in the Bavarian Forest. CARPOOLING is similar, whereas travellers have to organize and take agreements among themselves, often via online-communities. Also MULTIMODAL TRANSPORT (consisting in performing the transport with at least two different means) and DRT-Demand Responsive Transport for passengers cannot do without digital enabling solutions and by TRANSPORT PLATFORMS.

An interesting case is represented by **FRESHMILE**[27], a start-up SME located in Alsace that has developed electric mobility solutions**.** It has developed a new business named “Charging service operator for electric vehicles” for individuals and professionals, providing real-time multi-device information (such as power, connector type, availability, prices, directions and navigation) about charging infrastructures, via web, IOS and Android app.

The initiative named **RIDE**[28], in Lombardia and other regions in Northern Italy, addresses a specific target of travelers and commuters represented by University students. In fact, RIDE is a college carpooling platform to bring together the supply and demand of steps to and from the university. The idea is to put together two actors, the drivers and passengers

[25] http://www.ee-tour.de
[26] https://e-wald.eu

[27] www.freshmilecharge.com
[28] Fondazione per lo sviluppo sostenibile, 2016. "1^ RAPPORTO NAZIONALE 2016. LA SHARING MOBILITY IN ITALIA: NUMERI, FATTI E POTENZIALITA'", www.fondazionesvilupposostenibile.org

students. Ride gives the opportunity to reach the university in less time and at a reasonable price. Direct customers and users of the service are therefore college students but two other categories of non-direct customers will benefit from the advantages of using the service. On the one hand it will be an added advantage for the benefit of society: the use of the car will be optimized leading to having a green city by reducing the cars in circulation and increasing parking available. On the other hand, whereas the costs for the university transportation impact up to a maximum of 27% (as Ministry of Education) on the total cost to attend college, the university will offer an additional service to its students in order to reduce the costs and time to attend to it. A method to increase the accessibility and hence its usability.

OPTIMOD'LYON[29] is an integrated innovation platform on urban mobility and public-private cooperation on ITS in urban areas. It aims to collect, centralize and process all data on urban mobility on a single platform and to create innovative services, that will facilitate travel and the lives of users. Based on ITS technologies, this project reduces personal car use by offering credible alternatives and thus facilitate the urban travel of both individuals and professional freight.

5.5. Societal Challenge 6) The Digital Divide Challenge

The last societal challenge is referred to a typically enabling condition for digitalisation and Industry 4.0, represented by connectivity. According to many sources, including the ALPINE DIGITAL AGENDA[30] and the European Parliament Briefing "Bridging the digital divide in the EU[31]", the unavailability of broadband connections is a source of great inequality, both for business and for citizens in AS. IN fact "The unavailability of broadband connections is a disadvantage for many business operators since being able to use the services of modern technologies is a key factor for promoting their businesses. Such technologies are an economic boon for those who can use them, but the source of greater inequality for those who cannot. The issues identified relate in particular to the lack of an internet connection sufficiently widespread to also reach the small mountain settlements, preventing users from having a line – not even necessarily broadband – for offering their accommodation and catering services and to sell local products. Just having an internet connection, even without broadband, would enable the mountain huts to provide a range of basic services to improve the offer to customers.[32]".
This strongly affects alpine areas, not interesting in term of return of investments for commercial operators. This reduced accessibility to services in comparison with urban areas is linked with most of the challenges we have listed in this document, in particular with

[29] http://www.optimodlyon.com
[30] "http://www.alpconv.org/en/publications/alpine/Documents/Agenda_Digitale.pdf?AspxAutoDetectCookieSupport=1.
[31] http://www.europarl.europa.eu/RegData/etudes/BRIE/2015/573884/EPRS_BRI(2015)573884_EN.pdf
[32] ALPINE DIGITAL AGENDA, 2014, page 28

demographic and transport challenges: according to the MOR€CO project[33], economic and demographic dynamics in Alpine Space lead to extensions of peri-urban areas, to splitting of the territory, splitting of transport services and to enormous increase of private traffic. This is highly problematic because of the strictly limited space for settlement development in Alpine Space.

Innovative technological solutions, policies and business models for connectivity can contribute to face this challenge. Main relevant solutions are represented by the **HIGH SPEED INTERNET** (stated that access to new generation fiber optic communication networks is important to ensure the balanced development of territories in the European Union and to enhance the competitiveness of businesses), by **SATELLITE INTERNET ACCESS** and **HETEROGENEOUS NETWORKS.**

The Alsace case is an interesting case of technology/ public policy approach: in fact, noting that the very high rate of coverage of the Alsatian territory cannot be achieved by private operators alone (limited to dense urban areas: Eurométropole de Strasbourg, Mulhouse Alsace Agglomération, Communauté d'Agglomération de Colmar, communes of Haguenau, Saint-Louis, Sélestat and Siltzheim), the regional authority resolutely carried the **Very High speed internet (VHSI) Project**, together with the local authorities of Haut Rhin and Bas Rhin. This ambitious objective was translated on 30 March 2012 by the adoption of the **Territorial Master Plan for Digital Development (SDTAN)**, which aims to define an operational framework to be reached in terms of digital coverage of the region, to encourage the deployment oVHSI, in addition to investments by private operators, to lay down guidelines on the public actions to be taken to avoid the digital divide. Digital development has been a strategic objective for the Alsace Regional council for several years in terms of regional development, notably with the creation in 2004 of the Alsace Connexia broadband network. The implementation of the high speed internet will result in a unique technology for all the communes of Alsace where the Region will allow the implementation of fiber optics to the inhabitant / company (FTTH). Thus, thanks to a symmetrical and guaranteed flow of at least 100 Mbit / s, inhabitants and companies will gain access to new digital spaces, teleworking, cloud computing, new home automation services (surveillance, assistance to people ...), As well as high-definition television, video-on-demand or online games. This optical fiber is also essential for the advent of mobile THD (4G network), to connect the different antennas together. Faced with the risk of a digital divide, the European Investment Bank (EIB) has decided to support the “Plan France Very High Speed Internet” program. By 2022, more than 370,000 households, public facilities and businesses, mainly located in rural areas, will be connected to fiber optics throughout Alsace. In Alsace, EIB financing is part of the Investment Plan for Europe ("Juncker Plan"), which aims to boost investment and stimulate growth and creation, Jobs in the territories.

[33] http://www.moreco-project.eu

In Baden Wurttemberg, the action **BROADBAND OFFENSIVE 4.0 - FAST INTERNET FOR BADEN-WÜRTTEMBERG** has focused on broadband as enabling condition for companies. This market-driven broadband expansion works primarily where this is economically feasible for companies. Especially in communities with low population density and centrality of settlements, a private-sector approach is often not worthwhile. In cases where a company does not want to guarantee broadband coverage, the public sector can act as a supplement. That is why we have already developed a digital strategy for 2012 in Baden-Württemberg. In the field of broadband expansion, Baden-Württemberg is focusing on the development of next generation municipal networks (NGA networks). This includes high-speed networks. It is especially advantageous if individual municipalities (for example, even circular) are involved in broadband expansion and jointly promote the establishment and expansion of such NGA networks. The broadband initiative is a partnership process in dialogue with all actors in the country. The economy, municipalities, counties, associations and telecommunication companies work together with the state government on a sustainable broadband infrastructure that is technologically viable. One of the results of this collaboration is the New Media clearance point in the rural area. As a voluntary interdisciplinary federation of municipalities, the Ministry of Finance and Economics, the Ministry of Agriculture and Rural Affairs, the Ministry of Finance and the Economy, the Academy of Rural Areas, the Media Villages Working Group, the regional office for communications and the foundation Chair Furtwangen as well as and the municipalities in the country. There will be a widespread need for mobile and wired networks providing high bandwidths. The goal is to achieve a reliable transmission rate and network coverage. Mobile telephony supplements the circuit-based supply. The country supports the development of municipal high-speed and high-speed networks with financial support. These next-generation networks are mostly based on fiber and are designed as FTTB (Fiber To The Building) networks. In a first step, the municipality is connected to the fiber-optic backbone network. The backbone networks extend across a county and have at least two point-of-presence (POP) points per municipality. At the same time, connection points to the neighboring backbone networks are defined. Broadband networks differ in how far the fiber optic cable reaches the customer. With FTTC (Fiber To The Curb), the fiber reaches a cable junction point in the municipality via a transfer point. The signals then reach the apartments via copper leads. These networks are called high-speed networks (FTTC networks). When the community gradually relocates the fiber to the building, one speaks of top speed networks, FTTB (Fiber To The Building).

The term **HETEROGENEOUS NETWORK** is used in wireless networks using different access technologies (e.g. providing a service through a wireless LAN and able to maintain the service when switching to a cellular network). Heterogeneous networks combine and integrate different access technologies, depending on the area features and morphology, on connectivity needs, boosting existing infrastructures (both TLC and other infrastructures). As

stated in the Alpine Digital Agenda, “optical fiber transmission represents a solution that has obvious limitations for implementing in mountainous areas where the construction of physical infrastructures (suitable ducts, infrastructure of concentration, etc.) is difficult (if not impossible) logistically and certainly extremely expensive. It is therefore necessary to evaluate different technologies that are better suitable to solve the problem in these areas, such as using HUB and SPOKE architecture which would enable the foothill areas to be reached by the high-capacity "Backbone" optic-fiber such as HUB in which to concentrate the Datacenter resources for the provision of services, and to identify an adequate number of SPOKE to be placed at high altitudes to be connected to the HUB by high-capacity wireless technologies (WIMAX, high-capacity Radio Links, the satellite technologies DVBS2,4G, BuNGee, etc.) and traffic compression systems (WaaS, etc.) combined with Content Delivery Network solutions that bring the requested content closer to the end user and use intelligent routing capabilities (iWan).The creation of an integrated network, as described, combined with the delivery of services based on SOA philosophies (Service Oriented Application) that inherently enhance the capabilities, are the challenge to reduce the digital divide in alpine areas[34]” HETNET (formerly called HPWNet) is an experimental ultrawide-band wireless network developed by CSP in Piemonte since 2005. The project started with two aims: to develop a wireless backbone in the urban area of Turin, to be used for the rapid activation of wireless nodes in the city and as a point of departure for extensions towards neighboring municipalities. Today, HETNET is based on 15 sites in the urban area of Turin and involves over 30 backbone nodes widespread throughout the Piemonte area (NW Italy). Link length ranges between 500m and 80km: HETNET enables the deep analysis of the wireless devices behavior, in a real scenario, interacting with other active networks and several interferences. HETNET is not only an experimental network and it is used on a daily basis by several ongoing research projects and pilot projects. Its network architecture, particularly flexible and integrated with other optic fiber network in the regional area, can be used both as a backbone of contribution, and as an access network. HETNET is made available and considered of great importance for experimental connectivity and prototypal services in areas / locations not yet covered by broadband provided by commercial TELCO operators. This is very relevant in a region where over 40% is mountain / alpine area and over 30% is hill, where digital divide is still a problem. One essential HETNET strength is its modularity: on one hand it integrates with other networks already present in the area (included DMR network), and on the other, it makes possible to modify the basic infrastructure and extend the network, not only by adding connections to new destinations, but also by increasing the available throughput on single links by aggregating several wireless connections. In view of this, it will be possible to extend the network to respond to the need of integrating new points, but only when an existing connection approaches to saturation and it becomes necessary to increase its capacity. This simplifies the network

[34] ALPINE DIGITAL AGENDA, 2014 page 21

planning stage and at the same time means the system can respond rapidly to the requirements and operative needs of the users.

6. Temporary conclusions: suggested innovation paths

From the described analyses, it is possible derive some synthetic suggestion of innovation paths able to connect alpine challenges, societal innovation, smart technologies, entrepreneurship and investments.

In general terms, the digitalisation and industry 4.0 paradigm "solutions" listed in the challenge-solution matrix (Internet of Things & sensor networks, big data, cloud computing, e-commerce, MOOC, system integration, additive manufacturing, simulation, robotics, drones user interfaces, smart grids, …) need to be fully exploited. They can have disruptive effects only if they are part of an organisational and cultural renewal in the company. Otherwise they will be counter-productive and self-defeating, with negative impact on productivity and generating mistrust and resistance in workers. This means the full understanding of their potential, the customised implementation into the specific productive context, production plant, production chain, work organisation, procedure, …

Again in general terms, AS businesses need to face the economic globalisation through high-quality, high added-value sectors, niche products. And digitalisation can make the difference in this, if properly implemented.

Innovation path 1: Attract population & fight brain drain

Mobile highly skilled workers could be attracted or retained from leaving, due to the high standard of living of the AS. In fact, digitalization makes possible to access services and job opportunities even in non-urban areas. Digitalisation can help facing the challenge of transport system.

Innovation path 2: Widen awareness and change mind-setting about digitalisation

Digitalisation and industry 4.0 paradigm and "solutions" (as listed in the matrix) can be exploited as a factor for flexibility, productivity, competitiveness, provided that businesses are open to organisational change and consequently to technological change. The innovation paths should aim at digitalising industrial and businesses culture and mind set involving all levels, from workers to managers, to intermediaries. Fight reluctance and resistance to digitalisation of managers and workers. In particular, as for workers, the awareness of potential should be clarified (loss of traditional jobs will imply new digitally-skilled jobs and

there is chance for re-training, up-skilling and requalification of possible redundant workers) and obviously the promise of new jobs must be kept.

Innovation path 3: Customised digitalisation paths for business and digitalisation professionals

There is a need to develop customised digitalisation paths (and to specialize professionals able to kick off and implement this paths), including

- digitalisation need diagnosis for businesses
- reorganisation of production processes including the needed digital "solutions" (as listed in the matrix)
- training (and also re-training, up-skilling, requalification) and motivation of human capital
- revise market positioning
- exploit savings (energy, rough materials, reduction of faulty and waste) while reducing environmental impact

The paths need to be specialized per sector and the life-long learning approach is embedded, considering the fast obsolescence and innovation trend that is typical of ICT and digital solutions.

Innovation path 4: Feed, develop, exploit the training market

Training is, on one hand, an absolute need to exploit the digitalisation potential and, on the other hand, a market in itself, potentially creating jobs.

- specializing digital professionals and workers, fully skilled with reference to potential of on-the-edge technological trends (as listed in the matrix)
- specializing intermediaries (support agencies and players helping business in chamber of commerce, clusters, incubators, ...) in the above mentioned digitalisation paths for businesses with reference to organisational changes, potential of on-the-edge technological trends (as listed in the matrix)