Einstein Center Digital Future -

Berlin on its way to become a digital(ization) capital

Background – Berlin Digitalization Agenda

In June 2015 the Governing Mayor of Berlin and the President of the Technische Universität Berlin launched the Berlin Digitalization Alliance, a working group in which representatives of the enterprises, Berlin administration, and academia elaborated the Berlin digitalization roadmap. During five months of intensive discussions the alliance developed several strategic programs and published the Berlin 10 point digitalization agenda in December 2015. The presented programs range from establishing the 5G network, promotion of SMEs, foundation of a CityLab to the establishment of 30 new IT professorships in Berlin, as part of the the Einstein Center Digital Future (ECDF).

Creation of the ECDF

Following the release of the Berlin Digitalization Agenda, all of Berlin's universities, the Charité University-Medical Center, in cooperation with 8 research institutions and 2 universities of applied sciences teamed up under the coordination of TU Berlin in an unprecedented effort to prepare for the establishment of the ECDF. Representatives from all the participating institutions came together on a regular basis, discussed how each partner could contribute their competencies best to the proposal and developed the scientific program for the center. Subsequently, the partners approached local, national and international companies and enterprises in order to raise funds for the establishment of the center. The overwhelming interest and involvement of the non-university partners, which has been never seen before in previous projects, reflects the significance and demand for digitalization related research and development. 3 months after the starting the proposal the partners had mobilized funds for the establishment of more than 40 new professorships from companies, research institutes and federal ministries. Nevertheless, fundraising is ongoing and the availability of funding for 50 professorships at the time of the center's kickoff (in April 2017) seems reasonable. The proposal for the ECDF was submitted to the *Einstein-Foundation Berlin*[1] (ESB) that, after rigorous scientific review, in September 2016 approved the establishment ECDF.

ECDF Public-Private-Partnership Model

The result of the initiative is a substantial financial program to foster the development of digitalization in Berlin, deploy smart city solutions, create the necessary frameworks for the further growth of the digital industry, and to involve as many citizens as possible in the digital future. For this purpose, the private-public partnership will support the research by bringing the best minds to Berlin and, thus, to interconnect the existing cluster of excellent research located at the universities and research institutes.

In order to address these challenges, the ECDF adopts an innovative structure, going beyond already-known research structures; it implements – for first time on this large scale – a private / public partnership (PPP) between 20+ industry corporations, governmental organizations, and other sponsors, and all four Berlin universities, the Charité university medical center, and 10 associated partners from the scientific community in Berlin. This is a unique Berlin-wide working and research environment for the ECDF, since digitalization research needs real-world data, computer infrastructures, users, situations, and applications.

The funding model of the ECDF is leading the way, combining contributions from companies, non-university research institutions and the state government. $^1/_3$ of the budget is contributed from companies, $^1/_5$ from research institutes, and the remaining almost ½ from the state of Berlin (cf. figure 1).

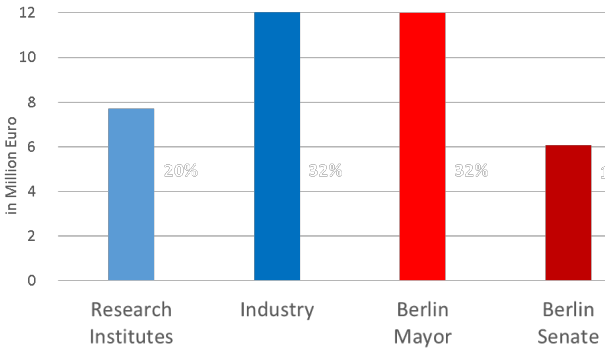

Figure 1. ECDF Funding Sources

[1] Similar to the DFG (German Research Foundation) on national level, the ESB aims to promote science and research of top international caliber in Berlin and to establish the city as a center of scientific excellence and an independent scientific commission of the highest standard selects projects for funding.

ECDF Institutions

The ECDF applicant institutions are the Berlin universities, Technische Universität Berlin, Freie Universität Berlin, Humboldt-Universität zu Berlin, Universität der Künste Berlin[2] and the Charité Universitätsmedizin Berlin[3]. Further partners are the supporting research institutes are the Berlin Institute of Health, Max Delbrück Center for Molecular Medicine, German Aerospace Center (DLR), the Fraunhofer Institutes FOKUS, Heinrich-Hertz-Institute, and Institute for Reliability and Microintegration, German National Metrology Institute (PTB), and Zuse Institute Berlin, and the participating universities of applied sciences: Beuth University of Applied Sciences and Hochschule für Technik und Wirtschaft.

Figure 2. Geographic location of the ECDF and the partnering institutions

Scientific Goals

The ECDF will pursue the following scientific goals

- Cutting-edge research of interdisciplinary methods, systems, and processes that merge knowledge from different disciplines, thus exploiting the benefits of data-driven infrastructures in order to enable, develop, and deploy applications and systems for the solution of problems of the digital everyday life
- Support of interdisciplinary and application-driven research in digitalization for a broad spectrum of the core and innovation areas including, but not limited to, *Digital Infrastructure, Methods and Algorithms*, *Digital Industry and Services*, *Digital Humanities and Society*, and *Digital Health* (cf. Fig. 3)
- Education and promotion of excellent early-career researchers, in particular, at the level of assistant professor
- Transferring the research results to industry, education, and society and thus increasing the awareness for the digital age
- Lessening the implications of the demographic digital divide
- Strengthening the network with leading scientist worldwide and opening opportunities for the conducting of research in ECDF

ECDF Research Areas

The ECDF research will focus in one core area and three innovation areas as described below. The research in the core area will lead to both the development and deployment of infrastructures and experimental setups and to theoretical foundations and conceptual solutions for the application domains. We expect to transfer our scientific research to the selected applications, industrial practice and contribute to societal development. Thus, the new professors at the ECDF will focus on interdisciplinary projects.

The core area – Digital Infrastructure, Methods and Algorithms

Digitalization requires a powerful and reliable infrastructure for connectivity, for service deployment, innovative platforms for application development and information processing as well as services to control and optimize a specific process or object. Besides the technical dimensions, a conceptualization of digital infrastructures as sociotechnical networks requires collective action and governance from different stakeholders. Recent developments such as 5G, software-defined networks, cyber-physical systems, cloud and fog computing, big-data engines and others, describe important technology artefacts. The major challenge, however, is in interconnecting the currently isolated technologies into a global system, being able to serve billions of sensors, handling Exabytes of data, and providing responses within pre-defined, low latency boundaries. Thus, the infrastructure goes far beyond the traditional mobile and wireless connectivity: people with their networked devices, vehicles, buildings, traffic infrastructure, lights, and sensors produce data continuously, which have to be collected and processed. Moreover, the reconfigurable nature of digital infrastructures allows the straightforward addition of new capabilities and features to a product, a service or a tool after it was designed, produced, and even deployed. Research and development of sophisticated methods, algorithms, and platforms are therefore the key elements on the roadmap for a digital future.

Methods and algorithms for near real-time acquisition and analysis of data make up the core of data-driven research and services. The traditional research approach to connecting theory with experimental measurements adopts the idea of detecting patterns in large,

[2] Berlin University of Arts

[3] Charité – Berlin University Medical Center

unstructured data sets. In particular, methods and algorithms for machine learning, semantic data-analysis and interpretation as well as segmentation and evaluation of video and audio data have been a focus of research for many years. Novel, scalable algorithms and systems were developed around the world with Berlin being one of the most visible research clusters. Currently, the noted methods are transferred and applied to a large spectrum of sciences, e.g., material sciences, medicine, and physics, but also in digital humanities, environmental sciences and the engineering of future production and logistics. The feedback from the application areas will lead to a continuous evolution and optimization of the algorithms for data management and deep learning. Finally, distributed security is one of the major prerequisites for the deployment and acceptance of digital technologies and therefore addressed from at least three different viewpoints: physical, distributed, and mobile.

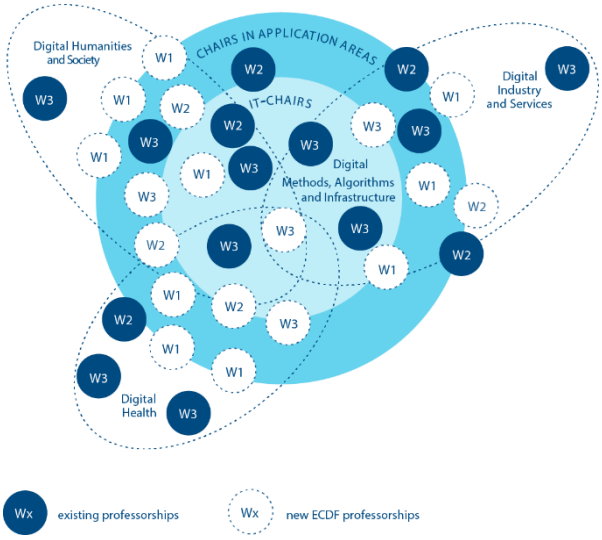

Figure 3. Core and Innovation Areas of the ECDF (depicted professorships are for illustration purposes only and do not reflect the actual number of respective new or existing professorships)

Innovation Area Digital Humanities and Society

Digitalization eliminates the traditional borders between public and private spheres, between reporters and citizen journalism, between life at home and at work to name a few. Digitalization creates a wide, virtual stage for discussion and for shaping the democracy offering a chance for everyone to participate and to be heard. At the same time, digitalization raises additional and challenging legal issues, both with regard to regulatory questions and to private-law issues. These developments have significant consequences for the way we are working, living, discussing, educating, and progressing, so they need a systematic scientific analysis and evaluation. In particular, we need methods to widen the stage and invite individual of all ages and with all levels of education to be part of it and to participate in the discussion process. We also need methods to prevent damages by misusing digital tools and anonymity. Furthermore, the infrastructures, methods, and algorithms for digitalization open numerous possibilities to enhance the research processes in cultural sciences and humanities. A most visible part is surely the impact of digital technology in schools, training, and academic education. The ongoing discourse of future education with a scientific but also creative and experimental approach brings into focus the design of new forms and formats of education and the development of innovative patterns of human-computer interaction.

The cultural institutions and collections benefit from digitalization as well. Most of our invaluable cultural treasures are accessible remotely. Putting the knowledge about them in context and relation with other collections will increase the understanding for events and processes. Large archives may be retrieved and processed faster but also by applying alternative methods for pattern recognition and connection of multiple sources as well. The opposite direction is even more promising: researchers from these areas have significant experience in semantic data-analysis, annotation, interpretation, and categorization. This knowledge is valuable input for the evolution of methods for machine learning and information retrieval. Finally, the emergence and shaping of conventions in the internet will focus on internet-interactions and will compare them to patterns of emerging conventions in society and in different historical periods.

Innovation Area Digital Health

The innovation area on digital health addresses the improvement and transfer of health resources and health care by electronic means. The main areas of research in digital health encompass the generation and delivery of health information, for health professionals and health consumers, through the internet and telecommunications. Moreover, using the power of IT and e-commerce, the public-health services may be improved, e.g., through the education and training of health workers. To further support the development of digital health, and to support tomorrow's medical care, this innovation area will foster two main aims. First, a focus for human capital and resources on a data-driven approach to the advancement of translational biomedical research. It complements many excellent projects and institutions focusing on experimental and clinical studies in medical research. Its aim is to develop integrative methods to derive novel and significant findings from the analysis of very large, heterogeneous, and comprehensive data sets, ranging from classical laboratory pa-

rameters and demographic information over high-resolution imaging and person-based sensor readouts to the latest advances in high-throughput omics technologies. It is dedicated to following a translational roadmap in that its research explicitly takes practical issues of implementing novel diagnostics or therapeutics in the clinic into account and is integrated in the clinical and patient environment. The Berlin Initiatives for Digitalization of Therapy and Diagnostics focuses on an improvement of current treatment strategies based on computer based optimizations. The initiatives will include approaches such as, wearable diagnostics, e.g., for use in tele-dermatology, improvement of hearing aids and modeling of cardiac events.

Innovation Area Digital Industry and Services

Digitalization initiated a revolution in industrial processes, widely titled as Industry 4.0. The numbering symbolizes the focus on continuous monitoring and optimization of production infrastructures as well as products and services bundles using methods and algorithms for data-analysis. The original idea went beyond the factories and production sites and now includes control and optimization of everyday life in metropolitan areas (SmartCities), the change towards renewable energies (SmartEnergy), the utilization of new mobility concepts (SmartMobility), the adaptation of health treatments to the specific patient (eHealth) or the creation of safe and pleasant living environments (SmartHomes). All these issues deal with problems regarding fundamental changes towards a service-based logic and interoperability in terms of interconnecting the analog world of, e.g., products and services with the digital world of information, together with the human interaction involved with those. Once the initial challenges regarding real-time processing, security, and quality of service are solved, the worlds of cyber-physical systems and the internet of everything will become the guidelines for the production and management of large infrastructures as well as improved business models within service ecosystems. The vertical integration of products and production processes with cyber-physical devices requires novel IT solutions. Through embedded software, functionally integrated systems can create tight and effective bonds with humans involved in the value chain. New forms of collaboration are created within businesses and across businesses, thereby establishing adaptable supply chains and redefining the future role of system suppliers. ECDF will support the transition from today's industry to the digitally networked industry of the future through interdisciplinary research in the fields of engineering, automation, IT, and economy.

For further information please contact
digitalisierung@tu-berlin.de