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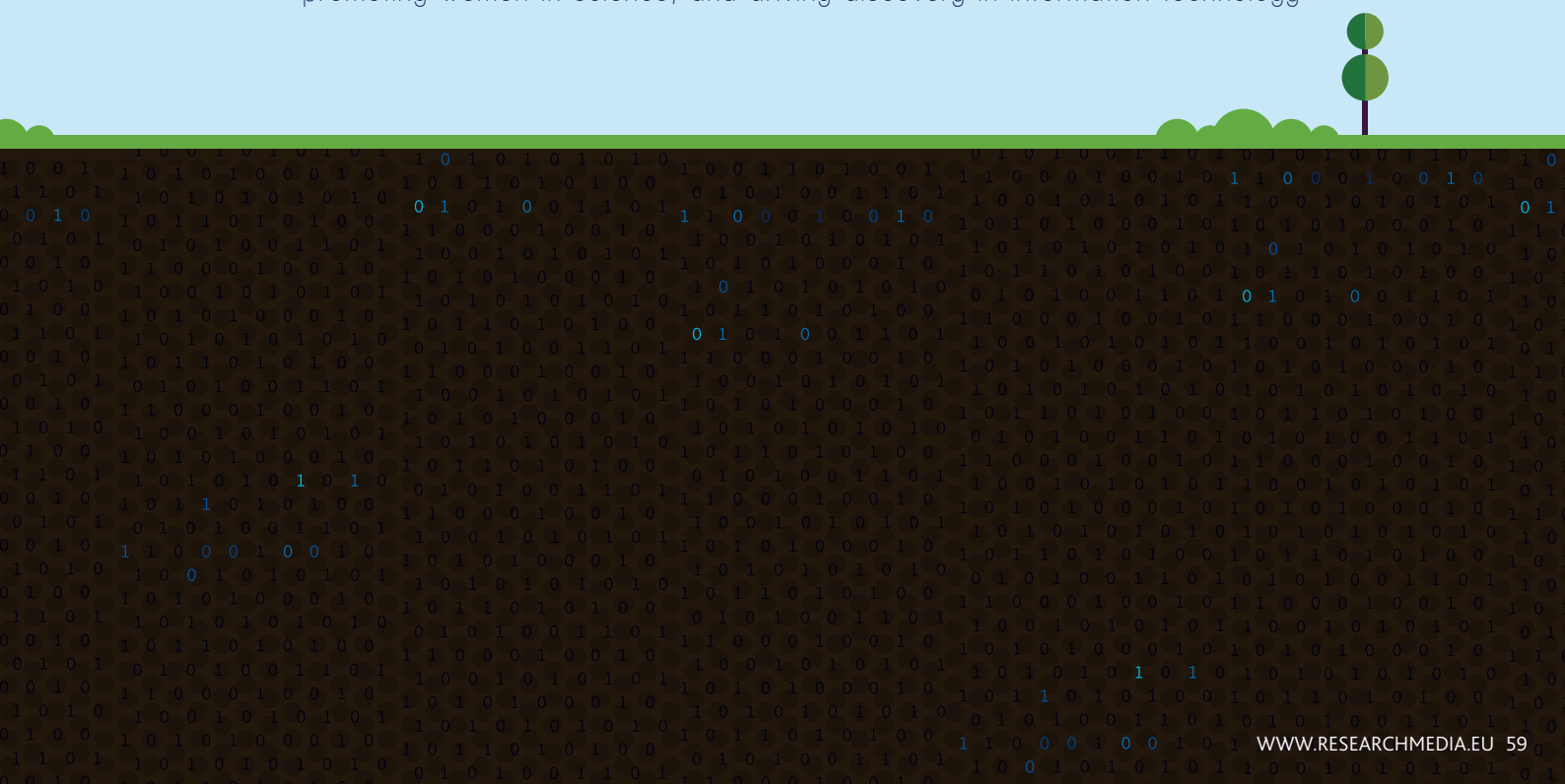
DEFINING THE FUTURE OF TECHNOLOGY

IBM Research boasts a rich history of innovation. It is headquartered in New York, USA, but has maintained its first European research laboratory, based in Switzerland, since 1956. Here, Dr Matthias Kaiserswerth discusses how IBM Research – Zurich, which is world-renowned for its scientific achievements – most remarkably two Nobel Prizes – is cultivating relationships on a global scale, promoting women in science, and driving discovery in information technology



To begin, can you briefly explain what led you to your current role?

After receiving my PhD in Computer Science from the University of Erlangen-Nuremberg (FAU), Germany, I joined IBM Research – Zurich as a research staff member in 1988. Having spent many years in a university environment, I wanted to experience work in an industrial research lab, where projects must be not only academically interesting but also hold practical relevance to the future of the enterprise.

I worked on numerous research projects in various positions ranging from high-performance communication systems to message brokering in a medical environment. Following an assignment at IBM´s TJ Watson Research Center near New York, USA, in the late 1990s, I was offered the position of Lab Director in 2000.

Your mission as the European branch of IBM Research is to foster relationships with academic and industrial partners throughout Europe, attract the most talented and promising European research staff and pursue research in technical areas in which Europe is the global leader. What strategies do you employ?

These goals are not targeted in silos and are the responsibility of all IBMers at the Zurich and Dublin labs. Several of our most senior scientists have teaching duties at the renowned Swiss Federal Institute of Technology (ETH) in Zurich, which affords them a prime opportunity to seek out and identify new talent. We are also very active in promoting our scientists at academic conferences and via social media. Finally, we have been very active and successful in participating in the EU's Seventh Framework Programme (FP7), which enables us to collaborate with top universities throughout Europe.

In addition to working with academia, we cultivate strong relationships with industrial partners; for example, in collaborative research projects such as FlexLast. FlexLast was a joint endeavour including BKW FMB Energy Ltd, the electricity utility provider of the Swiss Canton of Bern, and Migros, Switzerland's largest retailer and supermarket chain, in addition to Swissgrid, the national Swiss grid operator, and IBM. The goal, which we successfully reached, was to use refrigeration warehouses as buffers to help balance fluctuations of the availability of sun and wind energy on the energy grid.

Can you offer a brief overview of some of the areas in which your labs currently work?

IBM Research – Zurich is one of IBM's 12 research centres around the globe and was the first to be established outside the US in the 1950s. Our scientists represent more than 45 nationalities and their expertise covers everything from atoms to analytics. More specifically, our research spectrum ranges from exploratory research in nanotechnology for future devices, to novel microserver and storage technologies, advanced computer simulations for science and industry, big data analytics, cognitive computing and cloud technology, to cyber-security and privacy. In the latter area, which is currently receiving a lot of public attention, I am proud to say we have a world-class team here in Zurich. Its main focus is to develop cryptographic methods that allow people to protect their personal internet data while still being able to identify themselves in a secure manner when using the internet services of their choice. We are also developing applied technologies in fields such as business process optimisation, inventory management and smart grids. We often pilot these innovations directly with clients.

The Industry Solutions Lab addresses future technology and emerging business trends. What are the most interesting emerging areas?

The Industry Solutions Lab – recently renamed IBM Client Center Research – is a unique place for our European customers to gain insights from IBM researchers, industry and trend experts. It is a cutting-edge think tank that provides companies, academia and governments with an opportunity to find out how IBM's R&D assets, trend research, advanced technologies and solutions could enhance their success. At the Lab, customers can also gain first-hand experience of innovative prototype solutions that we demonstrate in the Center.

Clients can learn about many different research projects in the Client Center, but let me highlight two emerging areas in particular. The first is cognitive computing. Tomorrow's computers will drastically change the way people interact with computing systems. These cognitive systems will use natural language processing and machine learning to enable humans and machines to interact more naturally. They will help people extend their expertise across any domain of knowledge and make complex decisions involving extraordinary volumes of fast-moving big data.

These systems will have the ability to learn and interact and will provide expert assistance to scientists, engineers, lawyers and other professionals in a fraction of the time it takes today. A good example is the IBM Watson system, which is helping doctors at the Memorial Sloan-Kettering Cancer Center. It supports them in their decision-making processes in the context of evaluating and determining the most appropriate cancer therapies based on data from medical literature and research. The amount of data is so vast that it would be impossible for humans to process it within a reasonable timeframe. This is an exciting new frontier for computing.

A second example is big data analytics, where our researchers in Zurich are developing a cutting-edge platform for enterprise use. This system can aggregate in near real-time a broad variety of different data sources, including enterprise data and data streams from social networks and news channels, and combines them with analytic engines to achieve an entity-centric view of the data. In our prototype, customers of an organisation are the entity, and the tool extracts and aggregates all relevant data about each customer in an app to support the sales teams. But the analysis can be adapted and applied to a variety of uses. For example, in procurement or supply chain management you would want to have all relevant internal and external data about your suppliers at hand in order to best manage these processes. We believe that leveraging data using such innovative technologies will transform industries and in our Client Center we explore such possibilities together with our customers. It's really exciting and we can literally bring our innovations to the market.

Improving the framework upon which research innovations are developed into marketable products is a much discussed priority in the EU. Can you offer insight into how such success is achieved?

I think flexibility is required regarding routes to market. One example is our work with hot-water-cooled supercomputers. Our scientists

recognised the global energy crisis in 2006 when the *Stern Review* was announced. In response, IBM management allowed them the flexibility to pursue this research. The result is a long-term roadmap spanning the present day to 2050. But leading up to this, shorter-term results need to be achieved. As one of these shorter-term milestones, a US $80 million hot-water-cooled supercomputer was developed and sold by IBM in 2011. This success has afforded the team time to continue this exploratory research.

Another lever we employ is licensing our intellectual property (IP) to customers, which generates income while also getting our innovations to market. The voice technology used in mobile phones, for example, has been developed by a company called Nuance, which licenses patents for speech recognition from IBM.

What do you consider the main obstacles to successfully developing research innovations into viable industrial customer solutions?

I refer to this as the dilemmas of innovation management. The mission of any research organisation is to pursue a bold agenda to ensure long-term success and technological leadership by means of fresh ideas and groundbreaking innovations. Radical innovations are often based on significant long-term investments in research, yet many R&D executives still need to focus on quarterly targets.

Therein lies the dilemma. The question is, how can research accommodate the seemingly contradictory expectations of creating value in the short term and achieving radical new innovations in the long term? The answer isn't simple, but it starts with a balance we must strike between long-term research versus short-term business success, bottom-up versus top-down management and open innovation versus IP protection.

Can you outline the significance of IBM Research's Nanotechnology Center? What were the biggest challenges during its construction?

When I requested the funding to upgrade our existing clean rooms on the Zurich campus, our worldwide IBM Research Director told me to make it much bigger and find a partner. ETH Zurich was an obvious and logical choice and, once again, our close proximity to ETH has proved fortuitous. The Binnig and Rohrer Nanotechnology Center, which we started constructing in 2009 and opened in 2011, is the centrepiece of a strategic private-public partnership with ETH Zurich. It's a cutting-edge facility for nanoscience and technology, which features a large clean room including six noise-free labs.

These labs required special planning. Of course we involved our scientists in the project, and even built a prototype before starting with the actual construction. The noise-free labs are shielded against external vibrations, acoustic noise, electromagnetic fields and temperature fluctuations, and the combined levels of noiselessness we achieve in these six labs is truly unique worldwide. They offer our scientists the capability to characterise novel nanoscale structures and take ultraprecise measurements.

Even in a research organisation as large as IBM, collaboration must form an important aspect of the innovation process. Can you highlight some of the most important partnerships you are currently involved in?

I trace our collaboration with ETH Zurich back to 1956 when we initially opened the IBM Zurich Lab. The founding Lab Director was hired from ETH and that marked the beginning of an extraordinarily beneficial collaboration. This is best illustrated by our joint Nanotechnology Center. Scientists and engineers from both IBM and ETH Zurich are pursuing joint and independent projects there, ranging from exploratory research to applied and near-term projects including new nanoscale devices and device concepts as well as generating insights about scientific foundations at the atomic level. Four ETH professors and their teams have moved into the new building and conduct part of their research in nanoscience there on a permanent basis. Even more ETH researchers will benefit from the partnership and will be able to use the excellent infrastructure for various projects.

Are there any pertinent examples of events or workshops that help disseminate IBM Research's work?

I'd like to highlight a unique event we hosted back in March at our Client Center with a distinguished group of chief technology officers (CTOs) and R&D executives from 23 companies across 10 countries. We called it the Rüschlikon Dialogue, named after the leafy Zurich suburb where the IBM Research – Zurich Lab has been based since 1963. This event enabled us to position IBM as a key partner to help these firms innovate with big data, cognitive computing and advanced computer simulation.

For this first-of-a-kind event, we focused on discussing major technological advances, our capabilities in these areas and how they can transform R&D in our clients' industries. To put the topics into a broader perspective, I started off the event with a keynote presentation about R&D 2020 over dinner on 6 March. My goal was to demonstrate how IBM is applying these technologies internally to our own R&D and share the lessons learned.

The event also included interactive sessions focused on creating a dialogue among participants. After short keynotes and lively Q&A discussions on the future of collaboration, smart analytics and simulation, the rest of the event was dedicated to technology demos and breakout sessions in small groups, where we had intensive discussions on big data analytics, cognitive, simulation and social business, as well as millennials. The breakout sessions really got the CTOs involved and engaged – sharing their current practices and visions. I hope to organise a similarly stimulating event next year.

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