CHAPTER 16

Traditional universities: challenges and opportunities

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INTRODUCTION

What is at stake?

Never before has there been such a huge choice of providers of higher education as today. As this sector grows in reach and impact, it is also becoming more international. OECD data show that the member countries host more than 3.5 million international students; 6% of all students in tertiary education in OECD countries are international, and the number rises to 12% for masters and 27% for PhDs. (OECD, 2019) In response to this development, a few years ago *Times Higher Education* introduced a special ranking of the world's most international universities. The latest survey shows Switzerland, Hong Kong, Singapore and the UK as being home to the 10 most international universities in the world (*Times Higher Education*, 2019) The ranking is based on four groups of scores: international students, international staff, international co-authorship and international reputation metrics.

With globalization acting as one of the main drivers of economic growth, higher education has become a global affair, setting in motion a process of differentiation and the emergence of a plethora of new players. What does this all mean for a traditional university such as ETH Zurich in its 165th year

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of existence? The university's role is to prepare the next generation of engineers, scientists and leaders, and to shape the world through basic research and forward-looking education. So, what is at stake when not only competition with peer universities is fierce, but large corporations compete for talent and new educational providers challenge the business model of traditional universities? What needs to be done in order to marry change with tradition, and develop the university in a sustainable way? In what follows, we address these questions and provide some answers.

GLOBAL TRENDS AFFECTING HIGHER EDUCATION

End extreme poverty worldwide. Significantly reduce marine pollution and take action to combat climate change and its impacts. These are just some of the 17 demands the United Nations has set out in its Sustainable Development Goals (SDGs) that all member states adopted in 2015 within the framework of the 2030 Agenda. All countries are therefore called upon to come together to solve the pressing challenges of the world and commit themselves to sustainable development. Universities have a special role and responsibility in this global endeavour. The difficulty is to achieve this whilst navigating the complexities of the Fourth Industrial Revolution, as described by the WEF (World Economic Forum, 2017). How universities shape the way talent thrives is a key driver in the transition to a new work environment dictated by the scale and pace of technological innovation.

The race for technological supremacy and Asia's ambitions

Fueled by advances in robotics, data science, artificial intelligence and life sciences, we are witnessing a global race for technological supremacy. There are two main protagonists in this race — the US and China — while Europe tries to keep pace with the massive investments on either side of the Pacific. According to OECD data, China spent US$443 billion on research and development in 2017, second only to the US, with $484 billion. China produces more scientific publications than any other country, and in the next decade is likely to rank top for citations. (*The Lancet*, 2019). A similar development can be expected for patents. This shift in scientific and technological prowess goes along with Asia's ascent as an economic powerhouse. Asia-Pacific countries' share of global GDP was close to 43% in 2018, compared with 15% for the US and 16% for the European Union (*Die Volkswirtschaft*, 2019).

For many observers, the conclusion is crystal clear: if the 19th century was the zenith for Britain and the 20th century for America, the 21st century will belong to Asia. The confidence among Asian leaders is epitomized

by intellectuals such as Kishore Mahbubani. In his book *Has the West lost it?*, Singapore's former ambassador to the UN not only predicts the inevitable growth of Asia's dominance, but sees this shift in geopolitical power as a natural development towards historical normality: "Viewed against the backdrop of the past 1,800 years, the recent period of Western relative over-performance against other civilizations is a major historical aberration. All such aberrations come to a natural end, and that is happening now". (Mahbubani, 2018).

The US is struggling to respond to this world-changing challenge. Unlike China, where the central government is pushing the implementation of AI technology, America's efforts seem fragmented and decentralized. In the words of Professor Amy Webb, a specialist in strategic foresight at the NYU Stern School of Business, "China is the OPEC of data. In an authoritarian society, every human and social interaction feeds a vast pool of structured data for machines to ingest" (*Washington Post*, 2018). Meanwhile, Europe tries not to be outstripped by the two dominant regions and is raising its financial bid with a total investment of €100 billion in the new Research Framework Programme "Horizon Europe", which will run between 2021 and 2027.

Tech giants push into basic research and compete for talent

Competition for technological leadership is not only between countries and continents: the digital era has also seen the rise of so-called "superstar" companies, with inevitable consequences for universities. Four out of the five US corporates with the biggest market capitalization are tech companies (Microsoft, Amazon, Alphabet and Apple). The value of three of these economic behemoths — Apple, Amazon and Microsoft — has at times hit the one-trillion-dollar mark. Tencent and the Alibaba Group are the two most capitalized companies in China. By comparison, Europe's big five comprises traditional industries (Nestlé, Shell, Roche, Novartis and Anheuser-Busch InBev). Europe's biggest software company — SAP — is not even in the top five.

Alibaba, Amazon, Apple, Baidu, Facebook, Google, IBM, Microsoft and Tencent are a group of nine tech giants that are instrumental in the development of AI (Webb, 2019). While the US government has largely outsourced basic research to the commercial sector, China's AI push is part of a coordinated attempt to create a new world order, argues Webb. These tech companies are so financially strong that they can invest billions in research and increasingly compete with universities for top talents. This is not only happening in the AI domain, but can also be seen in Google's secretive Calico project. Launched in 2013, this biotech company is trying to find the causes

of ageing — a dream of many Silicon Valley billionaires. There is not much information available about the scientific activities of Calico, but the San Francisco based company seems to be generously funded, with $1.5 billion in the bank. Calico's Chief Scientific Officer, David Botstein, has described it as "a Bell Labs working on fundamental questions, with the best people, the best technology, and the most money". (MIT Technology Review, 2018).

THE DIGITAL TSUNAMI AND THE UNIVERSITIES

Towards a more personalized education

The advent of massive open online courses, or MOOCs, and other disruptors in higher education has led some observers to proclaim the end of the traditional university altogether. A decade on, this scenario has clearly not materialized, but technology — and particularly the potential of AI in education — will undoubtedly disrupt our concepts of knowledge acquisition and transfer. The dawn of the Fourth Industrial Revolution and the global trends described previously have encouraged a new set of societal expectations. Explicit knowledge will no longer suffice to prepare students for an ever-changing career path. Learning sciences have made a strong case that explicit knowledge needs to be combined with implicit knowledge in order to deliver the best educational outcomes. Implicit knowledge, as opposed to its explicit sibling, is hard to codify and is transferred most efficiently through experience-based learning.

These two forms of knowledge are, for example, at the core of an innovation project which ETH offers to students in mechanical and process engineering. The semester program, which is compulsory for all second-semester students in mechanical engineering, fosters critical thinking and is problem-oriented. Rather than acquiring knowledge about mechatronic relationships passively, students gather that knowledge on their own by working in small project teams. For support, the students can turn to coaches from more advanced semesters, who have enhanced their skills and experience in a tailored coaching course.

As our societies evolve and the educational functions of a university change, the need for a systematic and scientific way to look at learning grows too. At ETH Zurich, we are therefore investing in this field by launching the "Future Learning Initiative". This initiative aims to carry out interdisciplinary research on learning, and translate the basic research to build and test interventions and applications for deep learning at ETH. The initiative will see the establishment of new professorships, as well as projects that will not only tap into the potential of technology for learning, but at the same time reflect the role of humanities and ethical aspects in the education of engineers and natural scientists.

Fledgling universities and new kids on the block

Part of the impressive Asian story relates to the rise of relatively young universities. A number of fledgling institutions in China and other parts of South-east Asia have been built from scratch in recent years and have followed a fast track to academic and scientific achievement. The Southern University of Science and Technology (SUSTech) near Shenzhen, established only in 2009, is typical of this new brand of rapidly expanding institutions. Bolstered with important financial resources and vast state support, they are investing in the development of their campus and are recruiting scientists from all over the world with tempting offers.

Furthermore, tradition-rich educational vessels see themselves challenged by disruptive speedboats that come up with specially tailored offers. Minerva is a case in point. It claims to offer a reinvented university experience of small, online seminars delivered through a unique digital learning platform, combined with residential experiences across the world. The company does not hide its ambitions, openly declaring that it wants to become the world's leading university. To achieve this, Minerva has dissected traditional academic institutions structurally and pedagogically in order to identify their strengths and weaknesses. Putting the students at the centre, Minerva shifts the learning paradigm from imparting past and present knowledge to developing lifelong skills. These are not just the skills required for the jobs of today; the emphasis is on how to learn and adapt throughout life, so students can be ready for the jobs of tomorrow.

As learning technologies progress hand in hand with the changing needs of a new global workforce, universities will have no choice but to embrace this paradigm shift and adapt to cover a broader range of educational imperatives — or face competition in this field from new players attempting to fill this gap. From the delivery of knowledge to the facilitation of learning, more and more competitors are vying for space in an untapped educational niche. These factors, along with the advancement of digital learning, reflect the changing purpose of education, and by extension the role of universities in a societal context.

We have mentioned only one disruptor here, but there are many more — 2U and Khan Academy, Singularity University or Ecole 42 to name a few — and while their rapid rise has not spelled the end of traditional universities, which tend to have a much wider mandate in research, education and tech transfer, they are not going away either.

As the custodians of traditional academic institutions, we should take note: the persistence of these new kids on the block highlights the disruption taking place in post-secondary education and suggests that the university of the future will not look like the academic institutions of today. As Richard

DeMillo from the Center for 21st Century Universities at Georgia Tech puts it: "We need to rethink the nature of the contract between society and its universities." (DeMillo, 2015).

THE UNIVERSITY IN ITS CULTURAL AND NATIONAL CONTEXT

The weight of history — Humboldt's legacy

Every university has its own "genius" and history that in some cases extends back to medieval times when the first universities on European territory were founded. No matter how long this history is, the origins of a university transcend into the present and the future of an institution. Just as scientific advances are built on previous discoveries, traditional institutions benefit from the experiences of their predecessors. Many universities — including ETH — are imbued with the educational ideal of Wilhelm von Humboldt, the founder of Humboldt University of Berlin. His principles of academic freedom, the unity of research and education, and his holistic approach to education can still serve us well as guidelines. ETH Zurich's starting point is intrinsically tied to the advent of the modern federal state in Switzerland and its economic ambitions for development and industrialization in the mid-19th century.

When discussions started in the first half of the 19th century about the establishment of a national (federal) university in Switzerland, several cantons competed for the coveted status. Zurich was one of several possible locations, and the political compromise of the time was then to create a national school of engineering and natural sciences instead of a fully-fledged university. The institution's mission was set down in a special law of 1854 on the establishment of a Federal Polytechnical School, as ETH was called at the time: "The task of the polytechnic school is to train technicians 1) for road, railway, hydraulic and bridge construction, 2) for industrial mechanics, 3) for industrial chemistry, always taking into account the specific needs of Switzerland, theoretically, and as far as possible also practically." (Schweizerisches Bundesarchiv, 2019). In short: the new school was meant to train experts to build the necessary infrastructure for industrialization.

A hundred years later, Swiss politicians made another farsighted decision when the Ecole Polytechnique de Lausanne (EPUL) became the Ecole Polytechnic Federal de Lausanne, thus gaining the same federal status as ETH Zurich. The foundation of EPFL in 1969 as a Swiss Federal Institute of Technology paved the way for EPFL's outstanding development over the last decades to become one of the top technical universities worldwide.

Embedded in the ETH Domain

Our two leading universities — ETH Zurich and EPFL — are embedded in a national framework of scientific excellence, along with four research institutes: the Paul Scherrer Institute (PSI) where the Swiss large-scale user facilities are located, the Swiss Federal Institute for Forest, Snow and Landscape Research (WSL), the Swiss Federal Laboratories for Materials Science and Technology (Empa), and the Swiss Federal Institute of Aquatic Science and Technology (Eawag). All these institutions make up what is known as the ETH Domain, under the auspices of the State Secretariat for Education, Research and Innovation (SERI).

Every four years, the Swiss Parliament deliberates and sets the parameters for the country's education and research area. The Dispatch on the Promotion of Education, Research and Innovation (ERI Dispatch) encompasses vocational training, the Swiss National Science Foundation and universities (including universities for applied sciences, cantonal universities and the ETH Domain), and provides funding for the next four-year period.

It is within this framework — and based on the Federal Act on the Federal Institutes of Technology — that ETH Zurich and EPFL are free to set priorities and define their respective strategies. Although the institutions of the ETH Domain are independent of one another and are competitors in the global arena of higher education and research, they cooperate in a number of areas in the national interest. Some examples: both ETH and EPFL operate the Swiss Data Science Center and provide industry and other Swiss universities with access to expertise and infrastructure. Furthermore, the two work closely together in cyber security; 28 of ETH Zurich's professors conduct their research within one of the four research institutes of the ETH Domain. Since all institutions of the domain belong to the same legal structure, collaborations can be easily set up. This situation provides a strong competitive edge, around which future strategies of the ETH Domain must be developed.

Quadruple mission — education, research, tech transfer and dialogue with society

Since its inception some 164 years ago, ETH Zurich's core mission has not fundamentally changed. Its mandate is still to educate the next generation of engineers, architects and natural scientists. As a largely publicly financed university, social equality in the access to university is an important issue. As opposed to other (private) universities that require an entrance test, ETH is open to every prospective student holding a Matura, the Swiss secondary-school diploma. At the end of their first year of university, however, students have to pass a demanding test in order to continue their studies. Both systems have their advantages and drawbacks. I am convinced, though, that a

test after one year is a fairer solution than raising the barrier right at the beginning, as it allows students at least one year to adapt to their new environment.

While research also goes on in industry, both basic and applied research remain key to innovation and the country's economic development. Whereas research results are persuasive vehicles for communication, it is far more challenging to persuade politicians to support basic research because of its uncertain nature and putative commercial use. Thirdly, knowledge and technology transfer belong to the core tasks of a university, a fact that has become even more important in recent years as politicians realize that technological progress is an essential condition for the nation's future economic prosperity.

A final dimension must be added to ETH's core mission: the dialogue with society. This basically serves three purposes: firstly, to explain to politicians and the Swiss taxpayer how the public funds are being used, and for what purpose. Secondly, an ongoing dialogue with various stakeholders prevents ETH from losing touch with social reality. And thirdly, it is imperative that universities play an active role in the social discourse over the introduction of new technologies and the multiple ethical questions change brings about. The crucial discussion on AI, for example, cannot be left to the tech giants and other interest groups. To address this issue on a more neutral footing, ideas have been put forward for an international hub for AI research linked to the UN, in which Switzerland could play an important role (Fischer & Wenger, 2012).

INSTITUTIONAL CHALLENGES

Stormy times for the university

Increased media coverage and a change in perception of hierarchies and institutional power among the younger generation are two reasons why personal conflicts in academia have become more public in recent years. ETH is no exception here. The institution has had to deal with several cases of misconduct and abuse of power by professors in their relationships with (doctoral) students (ETH Zurich, 2019) in its recent past. As conflicts in a highly competitive environment such as a university can never be completely avoided, the cases have brought to light not just individual misconduct, but also structural weaknesses. Allegations of bullying have not only led to intractable confrontation between the parties involved, but have unleashed tremors that have shaken the institution to its foundations. The extensive media coverage, fuelled by incessant leaks of confidential information, has tarnished the university's reputation.

For the first time in its history, ETH has approached the ETH Board for permission to terminate the employment relationship with one of its professors. As challenging as a crisis can be, it also presents an opportunity to become a

better institution. The major lessons of these upheavals fall into three categories: prevention, leadership and management of conflict situations.

Strengthen leadership — reduce structural dependencies

Prevention starts with the selection process for people who join ETH. Leadership skills will be given more consideration when hiring new personnel. We have adapted the appointment criteria for new professors: now their leadership skills are being assessed, as well as their excellence in research and teaching, both of which are, of course, still crucial.

ETH will renew its commitments to diversity and inclusion, and ensure these topics feature prominently in the leadership criteria. Students, administrators, faculty and academic staff should reflect this commitment at all levels. Embedding this at the institutional level will demonstrate that diversity, fairness and inclusiveness are an integral part of our vision for the university.

Special induction programs for new professors, as well as for doctoral students, will address the expectations and values associated with a good working relationship. Leadership skills will be strengthened through coaching programs tailored to participants' specific needs. Furthermore, ETH will introduce multiple supervision for all doctoral students by 2020, along with a set of other measures to reduce the dependent relationship between professors and doctoral students. That said, it is important to note that completing a doctorate at ETH remains a challenging task, with no guarantee of success.

Conflict management — fair and swift processes

The problems explained earlier have also shed some light on processes and structures that need to be improved in order to prevent further escalation of personal conflicts. One such weakness was the fact that the conflicts were not addressed early enough. The number of ombudspersons has already been increased, reports of sexual harassment and inappropriate behaviour will be dealt in future by a specialized reporting office within the HR department and also through an external independent office. The process for dealing with complaints will be streamlined to ensure that all reports are addressed and if possible resolved within six months. Last but not least, ETH's leadership continues to raise awareness about respectful ways of interaction. A culture of "speaking up" when things go wrong, must be further developed. All this will require time, however.

Remaining open to the world

Switzerland's success story in terms of competitiveness and innovation prowess is regularly confirmed by international rankings (World Economic

Forum, 2018), which put the country among the best-performing economies worldwide. This strong record is primarily owed to Switzerland's openness to the world. The same assertion can be made about the Swiss higher education system and particularly about the two Federal Institutes of Technology, which not only excel in the scientific rankings, but belong to the most international universities around the globe.

Close to 70% of all faculty members and more than 70% of all doctoral students at ETH are non-Swiss. The research network of ETH numbers more than 9,000 international contacts, of which more than 50% are within Europe. This is to say that Europe remains hugely important for the university, and full and unhindered access to the European Research Area is imperative for ETH and the other Swiss universities. While Europe is preparing for the next seven-year Research Framework Agreement (Horizon Europe, 2021-2027), Switzerland's position is still uncertain. Its status will depend on the outcome of the political discussions on a Framework Agreement between Switzerland and the European Union.

The Swiss science community already suffered negative consequences in 2014, when Switzerland was temporarily excluded from Horizon 2020. There is growing concern that Swiss universities could again pay the price for political disagreement between the EU and the Swiss government. To continue this train of thought, Europe may lose some scientific heavyweights should British universities be barred from full access to Horizon Europe because of Brexit, with Switzerland relegated to the rank of a third-party country. This is in the interest of neither Switzerland nor Europe.

Quality through autonomy

A previous section has already alluded to the political framework within which ETH Zurich operates. It is thanks to the political wisdom of the Swiss government and parliament that ETH (together with the whole ETH Domain) has in the past benefited from its autonomous status. This autonomy gives ETH the necessary leeway to determine the direction of the university and the flexibility to seize unforeseen opportunities. Swiss politicians and the supervisory authority, of course, evaluate on a regular basis whether performance targets have been met and the university is prudently managed. But there is no "industry policy" (as there is in other countries) that would prescribe what research fields the university should engage in. ETH's autonomous status is one of its success factors and should not be compromised in any way.

As a publicly financed university, the bulk of ETH Zurich's funding — roughly 70% — comes from the Swiss Confederation. The rest of the budget is composed of third-party resources, mainly competitive research funding.

Compared to peer universities abroad, ETH Zurich has minimal reserves to compensate for a decrease in public funding. Federal funding of research, education and innovation falls into the category of non-committed expenditure, which means that the ETH Domain is more likely to be affected by budget cuts in times of financial austerity.

CONCLUSIONS

Reconcile tradition with the future

Traditional universities have grown into centres of excellence and innovation thanks to liberal and democratic systems. They are built on the legacy of more than 2,000 years of Western civilization and "stand on the shoulders of giants", to paraphrase Bertrand de Chartres (Wikipedia, 2019). Universities can only thrive and contribute to the progress of humanity in a climate of academic freedom and autonomy. If they become the extended arm of a government agency or a powerful corporation, their very core is at peril. What at first sight seems to be a given, is no longer self-evident in times of growing political pressures, scepticism toward science and the concentration of technological power in the hands of a few tech giants. Universities must stand up for their rights and fundamental values. It should not come as a surprise that Jonathan R. Cole, long-time provost of Columbia University, lists academic freedom, along with free enquiry and trust, as the most important core values for any academic institution (Cole, 2016).

Digital transformation is radically changing every aspect of human activity, such as the labour market. In the face of so many unknowns, education becomes a lifelong task. Universities such as ETH Zurich have something to offer for the next generation. Not only do students get a rock-solid education in mathematics and natural sciences, but they are also exposed to critical, creative and ethical thinking, which prepares them for the future.

The global higher education market is a lucrative target for players pushing new business models. The traditional universities would be well advised to take the new "kids on the block" seriously and look more closely at what they can learn from them. On the other hand, traditional universities also face expectations from politicians, the taxpayer and the media, who increasingly demand transparency and accountability. Universities must prove their usefulness in helping solve the huge global challenges expressed in the Sustainable Development Goals of the UN, and pro-actively pursue an open dialogue with society.

The relationship with industry is a delicate one. Collaboration with companies both at national and international level is undoubtedly crucial for speeding up the innovation process, and every party benefits from real

partnerships. But effective collaborations need clear rules and mutual understanding of each partner's particular role.

If universities such as ETH Zurich manage to strike the right balance between tradition and change and are willing to update their "operating systems", they will remain competitive in the global race for talents and will continue to play a crucial role in the progress of humanity.

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