

# CHAPTER 12

## Preparing the University and its Graduates for the Unpredictable and Unknowable

*Alain Beretz*

*Les prévisions sont difficiles, surtout lorsqu'elles concernent l'avenir.*  
(Predictions are difficult, especially when they deal with the future.)

Pierre Dac

Universities are a key player in the “knowledge society”. But this increased influx of knowledge and the exponential rate of technical progress also generate anxiety and fear that could undermine the fundamental role of universities to elaborate and disseminate knowledge. Universities should not be locked into the sterile debate of the “knowledge society” vs “risk society” (Hansson, 2002), because this can only undermine their fundamental role and missions. But, if universities are here to take risks, to open new paths and to innovate in every sense, they have also to defend this role in society and implement policies and procedures that can secure this responsibility in a sustainable manner.

### **INTRODUCTION: SUSTAINABILITY AND THE UNPREDICTABLE/UNKNOWABLE**

What is the exact nature of the “unpredictable” that we should be prepared for? Prevention of dangers, whatever their origin, is nowadays a central preoccupation. The word “preparedness” is used, for example, for describing the different measures against emergencies and disasters, i.e. do we have “in store”

the materials, structures or procedures to react to some major events, many of which are now environmental issues? Clearly universities can be key actors of this preparedness, and should provide some key components of this “preparedness toolbox”, which should contain tools used both in research and education. In this volume, Chuck Vest discusses in detail the complex relationship between uncertainty and risk (Chapter 6). However, Andy Stirling (2010) reminds us that concentrating exclusively on risks can bring dangerous bias: “Overly narrow focus on risk is an inadequate response to incomplete knowledge. It leaves science advice vulnerable to the social dynamics of groups — and to manipulation by political pressures”. Indeed, this debate cannot be reduced to a mere technical issue: Tannert *et al.* (2007) also state that “when it comes to decisions that affect people’s lives and health [...] carrying out research to diminish uncertainty and, consequentially, risks can become an ethical duty”.

Therefore, evaluating risks and being ready to respond to threats is not enough. We must not only be prepared for these unknown challenges of the future; a core role of universities is to *generate directly* the unexpected. Discoveries and major breakthroughs are not always planned nor expected; being prepared for the unknown and the unknowable is an absolute condition for scientific progress. It is also a key asset for the personal accomplishment of our graduates, although this latter aspect is usually underestimated. Major discoveries can indeed be considered as “black swans” (Taleb, 2010), as introduced by James Duderstadt in this symposium (Chapter 7). Universities should be a privileged provider of what we should here call “positive black swans”, i.e. unexpected events that have a major impact, and can be the support for major breakthroughs and discoveries.

As it is usually seen in science, one basic question generates a series of others; some of them will be asked in this paper: What is sustainability in this context, how and why to prepare for the unexpected, and finally how do these questions impact on our basic academic missions, both as scholars and as teachers?

Although we all know that sustainability is one of the key issues of our times, the clear meaning of this concept for the evolution of the duties and objectives of modern universities is far from being straightforward, and many speakers during in this meeting have stressed this point. In French, sustainability is often translated as “*développement durable*”. French is probably a beautiful language, but this translation is indeed tricky!

Firstly, there are two ways of understanding this “development”: the first one is about growth and expansion, and the second one is more about maturation or evolution, but without necessarily a quantitative aspect. Speaking about growth in universities has of course a completely different meaning in the Western hemisphere and in developing countries. In the former, our sus-

tability is now clearly oriented on the qualitative side, aiming for a new role of universities, while, for the latter, universities will have to grow, sometimes almost from scratch, in order to become major assets of their country and secure for them a healthy and prosperous future.

Secondly, the “durability”. Sustainability involves something more than durability, although we deal in universities with “durable” time frames; it also implies that we can *afford* whatever endeavour we are involved into, thus it also involves *accountability*. This is precisely why should budgetary issues are a core subject of university sustainability.

But maybe the main question of this paper is not only *how* universities can prepare for the unpredictable and the unexpected, but to ask *if* this should be considered a core mission of universities. Any scholar, when asked this question, will probably immediately answer “Yes!” because this issue actually sends us back to some of our basic academic duties and challenges, and we can easily assume that all these principles are rather straightforward for a university scholar of the 21st century.

Still, we should not just live on principles, but should examine candidly if we are really taking all the necessary measures to fulfil this duty, and to live up to these challenges. Then the question is not so much to discuss these basic principles, but to examine how they are implemented in the academic community, and what measures can be taken to apply them, as well as to make them well known in our society.

## **PREPARING THE UNIVERSITY FOR THE UNPREDICTABLE**

In order to prepare for the unpredictable, the university needs to be itself a sustainable structure. It cannot afford to change its policies or priorities to answer short-term requirements of governments or economic stakeholders. Long-term sustainability is an absolute requirement if we want to be able to respond quickly to the unpredictable; it implies that universities are granted enough autonomy, both on academic and financial aspects.

### **The university as sustainable economic entity**

This subject is analysed in more detail in other presentations at this symposium, thus it will not be covered in detail here (Newby, Chapter 20).

One main issue resides in the balance between the various mechanisms of financing of universities (for both research *and* education), i.e. between programmed, finalized financing on one hand, and basic, non-directed budgets on the other. At a time where financial accountability is a legitimate societal requirement, the plea for non-directed financing is not always popular with politicians; they will almost systematically prefer to invest massively in “applied research” or “technological degrees”, where they see clear and imme-

diate economic outputs. Our duty is therefore to provide stakeholders and decision-makers with sufficient data and proof that investing in basic, non-finalized subjects is indeed yielding significant economic returns, if one is patient enough. It is precisely these long-term investments that can produce these unexpected, unplanned results that carry the highest potential of innovation and subsequent economic value.

## **The university as an academic institution**

### **Directed research: both a need and a danger**

Universities were built on academic freedom as a central value. Researchers must be given the freedom and space to develop their ideas innovatively. But universities need to be well rooted in their societal environment, and thus any funding programme should ensure a well-balanced share between directed and non-directed research. This requires funding schemes to contain a significant part of bottom-up, investigator-led or non-directed research.

### **Use a long time frame for evaluating results**

Many of the regulations and incentives (especially financial) to obtain forms of behaviour in universities are based on outcomes defined as desirable by authorities within a very short-term frame of reference, which is very often tuned with the duration of political mandates (Bolton & Lucas, 2008). Adhering only to these short-term calendars will dangerously shift our priorities and reduce the output of unexpected, Black Swan type of scientific breakthroughs. As Bernd Huber stated during one of our discussions: “Conservative universities can produce innovative solutions!”

### **Avoid restrictive research programming**

In my own field of research, pharmacology, the standard drug discovery paradigm has shifted over the years more and more from serendipity toward a target-based approach, although it is difficult to say which of these two pathways has finally yielded the most significant results (Schlueter & Peterson, 2009). The advancements of science have now enabled us to identify precise molecular targets for many drugs. When such a target is validated (and this is in itself a complicated question), it can indeed lead to the discovery of original and successful new therapeutic agents; however, in many cases, it remains difficult to predict which targets will offer a real therapeutic benefit. In spite of the fantastic precision (and scientific interest) of the newly identified molecular targets, new drug development is presently stagnating. Such a shift to “targeted research” is also a general tendency of our research granting agencies. This is not in itself a disputable strategy; but concentrating all our research efforts on single target drug development carries the risk of restricting therapeutic inno-

vation to well known pathways and strategies, and producing what is referred very often as a “me-too” discovery, rather than a major innovative therapeutic breakthrough. The unexpected or unknown will not be easily detected by such a research scheme.

Another strategy is sometimes referred to as “phenotypic”. In this strategy, one goes back to studying the effects of drug candidates not on simplified targets, but on complex models, for example transgenic mice affected by a model disease. This global strategy is more prone to yield breakthrough advances, but it is costly and time-consuming. Ironically, it is sometimes difficult to find the pharmacologists and physiologists who can perform such global experiments because training and research programs have for many years extensively invested in molecular aspects of pharmacology, neglecting global physiology which was regarded as an old-fashioned domain. We now pay the price for this short-term planning.

### **Basic research as a central paradigm**

When looking at the future, anticipation is one thing, vision quite another (Campbell, 2001). Basic science can yield unlimited and original thoughts about the future; and when scientists are (too rarely) given freedom to speculate, the result is fascinating: they are capable of shedding new light on the unforeseeable by focusing on what might take us there: cutting-edge basic science that might lead to unexpected technologies, and adventurous technologies that should lead to unpredictable, fundamental discoveries (Campbell, 2001). Of course governments, which provide directly or indirectly the vast majority of funds for universities, should have a word to say on research planning and research strategies. But universities have to convince them that the most useful knowledge is that grounded in deep understanding, and that it should not be relinquished for shallower perceptions of utility (Boulton & Lucas, 2008).

### **Leave some place for serendipity**

According to the Merriam-Webster Online Dictionary, serendipity is “the faculty or phenomenon of finding valuable or agreeable things *not sought for*”. Serendipity is a term coined by Horace Walpole, suggested by “The Three Princes of Serendip”, the title of a fairy tale in which the heroes “were always making discoveries, by accidents and sagacity, of things *they were not in quest of*”. This surely rings a bell and would suggest that, if we want to be ready for the unknown and the unthinkable, we should devise research and education systems in which serendipity remains possible. However serendipity cannot, and should not, be considered as the magic wand, or the only efficient source of scientific breakthroughs.

## **Defend academic freedom**

“Academic freedom is not only seen as a goal in itself. It is important especially since it makes it possible for universities to serve the common good of society through searching for and disseminating knowledge and understanding, and through fostering independent thinking and expression in academic staff and students.” (Vrieling *et al.*, 2010).

In this respect, academic freedom can be considered, not only as a “classical” value of universities, which is of paramount political and ethical importance, but also as an important tool to guarantee that we are given the means and leeway to stay prepared for the unpredictable. This is also an example that ethical values, not just technical schemes, are one of the major safeguards that are needed to guarantee that universities can remain prepared for the unpredictable and unthinkable.

## **PREPARING OUR GRADUATES FOR THE UNPREDICTABLE**

### **Preparing our graduates for the unpredictable as scientists, scholars or skilled professionals**

#### **Knowledge is global, and knowledge is multidisciplinary**

Universities are of course here to transmit knowledge, and especially knowledge with a true and immediate professional value. The “knowledge society” requires skilled individuals. This transmission of professional skills, often based on state-of-the-art scientific knowledge, is a clear mission of universities, and the transmission of pure, abstract knowledge cannot remain our single objective.

However, we need a broader and revised definition of the notion of “transferable skill”, i.e., what type of professional abilities do we want our students to master, and what do we want them to gain from their years of academic training?

Geoffrey Boulton and Colin Lucas have summarized, in a position paper written on behalf of the League of European research Universities, this fundamental issue (Boulton & Lucas, 2008):

*“The key to retaining the flexibility to exploit the unexpected lies in a fundamental understanding of the nature of phenomena. Such understanding continuously resynthesizes specific knowledge in the form of general understanding that is broadly applicable [...] Basic research that compresses and generalises understanding in this way invigorates teaching that probes the limits of understanding. Together, they are the fuel for the university engine. Such generic understanding also represents a fundamental ‘transferable skill’ which can be applied to a much wider range of circumstances and phenomena than any catalogue of specific knowledge. It is a vital investment in the future [...] Universities serve to make students think: to resolve problems by argument supported by evidence; not to be dismayed by complexity, but bold in unravelling it.”*

Our curricula, but also our pedagogical methods, are thus key assets to prepare our students for uncertainty, for deep underlying issues and for the general context in which their knowledge will be applied. We thus have to face this double challenge: on the one hand, promote education that can transfer skills which correspond to an immediate demand of our society, while, on the other, providing our students with generic tools that will help them, throughout their life, to face the unexpected and remain original and creative.

### **The importance of research-based education in the construction of student skills**

Research promotes in students a practice of positive criticism, adaptability, capacity to challenge and a constructive experience of failure. Research-based curricula provide a pedagogy based on students' autonomy. It makes it possible for them to challenge magisterial attitudes that, for some of us (students or professors), should remain indisputable.

Relying on research also means making the choice not to teach everything, but to base curricula on local expertise, and thus to get away from the notion of homogenous, administratively-decided programs and curricula that would be based on an objective, reproductive and stereotyped ideal of knowledge.

### **Preparing our graduates for the unpredictable as citizens**

Research-based education does not only provide students with a learning method and technical know-how. It also provides an *ethical* framework, which is unique to the type of pedagogy developed in universities. These ethical principles are essential in the development of a sustainable society. Because it familiarizes students with collaborative, socially constructed knowledge, research-based education also promotes these collective values, which they can also apply to other fields of their professional or personal life.

By rooting deeply our mission in society, we should also make our graduates conscious that “when it comes to the main values in life, or to what should be done with our newly acquired knowledge [...] the answers are not scientific but political in nature” (Dubochet, 2003). Universities should not only train scientists, they must also educate them as citizens.

## **CONCLUSION**

In summary, some key factors for universities to prepare for the unexpected and unthinkable could be:

- practise research-based education;
- put strong emphasis on basic, non-oriented, research;
- defend long-term, sustainable goals and values;

- consider all societal consequences of scientific, technological and scholarly issues;
- invest in **trust** towards universities.

Taken from the Glion declaration of 2009, sustainability in our academic field can be seen as requiring “collective scientific and technical expertise in the environmental sphere, but also economic, social and political policies that nurture sustainable communities”. This sentence stresses two of the important issues facing universities in the 21st century: we have to provide *collective* expertise, and this expertise has to reach *far beyond* the traditional academic sphere. It thus links more closely the general question of our symposium, sustainability and the narrower subject of this paper.

This suggests that, in order to prepare for the unknown and unthinkable, a university has *itself* to be sustainable. We do need the universities to be fully sustainable institutions in order to guarantee sustainability in the present society, which Hansson has called “the uncertainty society” (Hansson, 2002).

We now live in a global environment of knowledge. If we want to capitalize on our academic assets, then why not use the tools, fundamental values and even the vocabulary of general environmental sustainability? Indeed we should consider universities as a global ecosystem. For Andy Stirling (2008), technological change, at a variety of scales is best understood, not as a race along a single preordained track, but — like biological evolution — as an open branching process more akin to organic growth, where random contingencies can play a crucial role, and he coins the term of “Evolutionary Dynamics of Technology”.

In this sense, a university should not base its strategy on the determinist understanding of an oversimplified linear relationship between science and technology. Universities, just like our whole planet, require “biodiversity”, supported by sustainable methods and procedures. It is well known that the global decline in biodiversity leads to associated declines in the services provided by ecosystems that support human societies (Corvalan *et al.*, 2005). This generic principle is fully relevant to the university ecosystem. Only a true “academic biodiversity” will guarantee that universities fulfil their missions and are able to respond to actual and future challenges.

Universities must be considered as a complex and fragile environment, not just as a knowledge factory. All stakeholders should ensure that universities remain the best environment for innovation to flourish. In this way we can set the stage for our society to be prepared for the unpredictable and unknowable. But whether we are on the right path remains totally unforeseeable.



## REFERENCES

- Boulton, G. & Lucas, C. (2008). What are universities for? LERU position paper. Available: [http://www.leru.org/files/general/What%20are%20universities%20for%20\(September%202008\).pdf](http://www.leru.org/files/general/What%20are%20universities%20for%20(September%202008).pdf)
- Campbell, P. (2001). Vision things, *Nature* 409, 385 (*an introduction to: Paths to unforeseeable science and technology, Nature* 409, No. 6818).
- Corvalan, C., Hales, S. & McMichael A.J. (2005). Ecosystems and human well-being: health synthesis: a report of the Millennium Ecosystem Assessment, Geneva: World Health Organization.
- Dubochet, J. (2003). Teaching scientists to be citizens, *EMBO reports* 4, 4, pp. 330-332.
- Duderstadt, J. J. (this book). "Global Sustainability: Timescales, Magnitudes, Paradigms, and Black Swans", in Weber, L. E. & Duderstadt, J. J. (eds), *Global sustainability and the Responsibilities of Universities*, Economica, Paris.
- Hansson, S. O. (2002). Uncertainties in the knowledge society. *Social Science Journal*, 171: pp. 39-46.
- Huber, B. (this book). "Research Intensive Universities in a Globalized World" in Weber, L. E. & Duderstadt, J. J. (eds), *Global sustainability and the Responsibilities of Universities*, Economica, Paris,
- Newby H. (this book). "Sustaining World Class Universities — Who Pays and How?" in Weber, L. E. & Duderstadt, J. J. (eds), *Global sustainability and the Responsibilities of Universities*, Economica, Paris.
- Schlueter, P.J. & Peterson, R.T. (2009). "Chemical Biology and Cardiovascular Drug Discovery", *Circulation* 12, pp. 255-26
- Stirling, A. (2008). "Science, Precaution, and the Politics of Technological Risk". *Ann. N.Y. Acad. Sci.* 1128: pp. 95-110.
- Stirling, A. (2010). Keep it complex. *Nature* 468, pp. 1029-1031
- Taleb, N. N. (2010). *The Black Swan*, second edition, Penguin, London.
- Tannert, C., Elvers, H.-D. & Jandrig, B. (2007). "The ethics of uncertainty". *EMBO reports* 8, 10, pp. 892-896.
- Vrieling, J., Lemmens, P. & Parmentier, S. & The Leru Working Group On Human Rights (2010). Academic Freedom as a Fundamental Right. LERU advice paper Available: [http://www.leru.org/files/publications/Academic\\_Freedom\\_final.pdf](http://www.leru.org/files/publications/Academic_Freedom_final.pdf)