

A knowledge-based society under catalysis: a personal summary, and some naive proposals for action

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*Edited transcription of JM Gago's concluding the conference on
"Flanders Future as a Knowledge society from an international perspective"
Brussels, Palace of the Academies, November 28, 2014
Slides can be downloaded from
http://www.kvab.be/denkersprogramma/files/4.4_Gago.pdf*

I'll try to be as brief as possible, and that's not simple. I was asked to speak about the whole subject and your work that I have tried to catalyze during one year. I was also asked to draw some conclusions out of this conference.

First of all, I want to thank you, and to praise your initiative. You probably don't know, but initiatives by an organized scientific community, like the Academy or other scientific societies, are normally invisible in Europe and very scarce. There are very few initiatives that go beyond their immediate objectives. Of course there are initiatives for research spending, laws or organization of universities, but societal questions raised by professional scientists, which are of course needed to successfully bring in other members of society, are not very common in any European country. I have been following this for several decades and I can tell you that the initiatives by the organized scientific community are not very common. Individual initiatives are of course plenty. And because of that, I was proud to help. Because you were enthusiast, and committed to a difficult task in which you were not sure you could succeed. And no one could be sure to succeed, because it requires an enormous involvement, not only by those related to the science based professions and economy, but also to the rest of society.

1. Some history

I tried to organize my mind, so I will try to go swiftly through this organization. It has been recalled during this conference, and I have checked it with Luc Soete, that the coining of the word Knowledge Economy was by Dominique Foray in 1994. In fact, it was immediately injected into the political machinery of OECD in 1995. It was at the same time the era of information technology deployment, so information society came first, because that was the American translation of what in that time in Europe were still called "highways of information".

But at the same time, the science system got the economic input it was in need of. It was the first time -- I remember, in the nineties -- that organized groups of economists and the OECD amplified the idea that indeed the science system was an essential part of the economy and of its progress. You recall that in the beginning of the '90s, John Ziman had

written "**Prometheus Bound**. *Science in a dynamic steady state*" (Cambridge University Press, 1994). In fact, the increase of the public budget for science since the Second World War and the enormous accumulation of human and physical capital for science in the United States had started to produce a true revolution in the private sector, mainly in the United States and later in Europe. The message of this recognition from the economical world at the highest level had an enormous impact on policymaking at that time.

In the year 2000, there have been major political breakthroughs. These did not come as a surprise, because they were in the line of this discussion over the nineties, strengthened by the amplification of information technology and the need in Europe to respond to the massive investment in IT in the United States. You must remember that, at that time, there were major debates in many European countries and communication companies to discuss whether the Internet should be left to the market or if the government should do something about it, namely in schools. The opinions were divided. Some said: Internet will be something like telephone lines -- you shouldn't do it. While in fact, more than ten years earlier, the National Science Foundation had dedicated money from the research budget of the US to pay for the connection of schools all over the United States to the Internet!

The major breakthrough was the European Council in 2000. This idea, that Europe should become the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion, that was 14 years ago!

For the first time, one sees the start of the transition to a knowledge-based economy and -society by better policies to favor the information society. You may recall that Luc Soete was one of the distinguished economists who were essential players in the preparation of this unanimous decision by policy leaders. At the time, the discussion was between France and the UK, on the European social model on one hand and on the investments in innovation and IT on the other. The combination of those conflicts was positively resolved by the idea of investing in education AND research and expanding the idea of investing in IT by investing in something more profound than technology, in something where people would get profit from: a different type of education would emerge, that IT would help to provide. This is the political status and the history of the question we are tackling today.

2. Some preliminary thoughts

➤ *From Thinker to Catalyst*

For the record, I would just like to address a word of recognition, on why I come here now, trying to address you with this. I must thank professor Irina and the steering committee for that. If I had the time, I would make you laugh with the exchange of e-mails starting in April 2013 and finishing

with an act of folly when I said yes. But I said yes, changing the idea of "Thinker" into the idea of a "Catalyst". I won't bother you with values and what catalysis means in Old Greek -- normally it means to destroy, etc. but one of the meanings is also "to stay just one night" -- it's in Themistocles. It's a curious idea that the Academy accepted swiftly the idea that I could just come for one night!

➤ *Charpak and the promotion of Science Education*

I would like to show you -- because at this time of the day I must also entertain you!-- the 2004 novel (*Soyez savants, devenez prophètes* with Roland Omnès, Éditions Odile Jacob) that Georges Charpak, Nobel prize winner of Physics in 1992 , gave to me. I worked together with him at CERN when he was developing his wire chambers that led to new particle- and PET imaging techniques in hospitals. After his Nobel Prize, he developed this movement called "*La main à la pâte*" for science education in schools in France. He was inspired by Leon Max Lederman from the United States, another Nobel Prize winner in Physics. In 2004, he wrote in his dedication to me: "*Ils sont fous, à Bruxelles*". The last words were "*Ils mettent le chariot avant les boeufs*." He was not speaking about physics, but about the promotion of science and science education. Exactly the topic we discuss today.

➤ *A question on the fundamentals of knowledge and technology.*

There is another point of view that I will try not to avoid, although it might seem too theoretical or too philosophical.

One of the intellectual founders of Europe, Denis De Rougemont, wrote "*Information is not knowledge*" in 1981 (Denis de Rougemont, *Information n'est pas savoir*, Diogène, n° 116). This remained as a warning for information technologists. The paper was extremely influential in the idea that to learn and understand one should go beyond just getting information. As we heard from Svein Sjöberg today, the technology for testing education systems does not necessarily improve education.

In 1939, just before World War II, one of the most interesting papers appeared in this respect-- but no one realized it at the moment -- "*La Meditación de la técnica*" by the Spanish philosopher José Ortega y Gasset.

In his December 1949 Bremen lecture, "Das Ge-Stell" , Heidegger said that:

"farming is now a motorized food industry, in essence the same as the fabrication of corpses in gas chambers and extermination camps, the same as the blockade and starving of the peasantry, the same as the fabrication of the hydrogen bomb."

This sentence has been discovered and discussed in the '50s and then people forgot all about it, as usual. But it's back now: this quotation is from next week 's issue of the New York Review of Books.

There is a lot of discussion now about it. *It has to do with the deeply*

rooted idea that as society is becoming technological all things that are technical, are more or less the same, and inspired by the same "inhuman" principles.

In fact, many people have this as a gospel and in my opinion this should be attacked from the very start when you are discussing knowledge-based societies. This is a ghost that has been hanging above our heads all of the time. And it's coming back. Don't think that it's something of the '49 -ties: it's coming back, over and over again. This intellectual debate exists. Sorry to be so brief about it.

➤ *To study science is hard work*

So you have asked yourselves: *how to mobilize society in order to convince families, young people, to study science?*

To study science is hard work. Of course it's hard work. For those who like it, it can be fun. But it's hard work. Hard work can be fun. Fine, but it can also be very depressing. It's hard, and it's work – there is nothing to do about it. *You can't learn anything decently, either science (all sciences) or arts or philosophy, without hard work.* And to send a different message to the education sector is really fooling the young people.

There is a vast international and European accumulated expertise, mainly in the last twenty years, related to this political evolution, many books have been published -- I've just chosen some of them, all European (see slides). The question addressed above has been put over and over again for the last twenty years in many countries and on the European level: *we are revisiting here something that has been intensively studied.*

Thousands of pages have been written and recommendations have been transformed into law in many countries, into investments programs, into training teachers, in structures. These are available in many, many countries and should be taken in consideration.

3. Some observations

We have developed the acronym F2KS for Flanders' Future as a Knowledge Society.

I will use this acronym as the name of a program, as if it was an object. I am now coming to the main part of the subject of this talk: about what I have learned with you, these last months.

F2KS is a decoder of new signs of societal threats and opportunities

It is about developing a process. If you want to change, you need a process, because you need to involve people and to recognize factors. As those who are experts in foresight studies know, a foresight study starts by identifying the factors and the actors that shape the future. So without the social actors, the people, the organizations etc., without the factors that condition their action, you cannot look forward.

I have recognized signs of anxiety, signs of change and signs of

perplexity.

Signs of anxiety:

- The perception of a lack of motivation for studying science and technology.
- The anticipation of a strong deficit of science teachers.
- The perception of a lack of well trained professionals in certain technical area's.

These are three signs of anxiety -- not thirty, but they are three major ones.

Signs of change

But there are also signs of change. I have put all of them with a question mark, as it's up to you to know whether they're real, or just the result of my perception

- Apparently, there is a trend to try to address social mechanisms (some would call them anachronisms) rooted in the school system and to rethink the question of the social selectivity in education. I have seen all statistics in education, but I have seen no statistics on what has been all over the place a key political issue in many European countries:
is the school system contributing to social mobility, or not ?
- Second, there is a trend to address the issue of the pupils and students' study and career orientation and information systems. To address this problem is to give political orientations to these career orientation and information systems. They are not technical, they are political. *Are the secondary school pupils and post-secondary school students properly informed, coached and oriented?*
- And third, being aware of the need to change and looking for signs of disruption: is the existing system going to remain as it is, or is it going to be disrupted? *Will it be disrupted because in some communities too many pupils/students are unsuccessful or will the system be disrupted because students do not go into the professions that are needed?*

Signs of perplexity

These are my signs of perplexity.

- How to face the impossibility -- because it is impossible -- of both reproducing social rigidity and segregation and at the same time help infusing new innovative energies in youth?
- How to increasingly assert the right of political self-determination -- that's a key point in a region like Flanders but also in other regions and nations in Europe, and Flanders is historically a nation -- and at

the same time move towards a more diverse and open society? Because this is a challenge, to go for political self-determination and not enter into isolation.

- How to invest creatively and generously in transforming exclusion into inclusion?
The percentage of well-educated women in full-time jobs in science-based professions is still very low in society -- and that's an enormous threat.
There are too many dropouts in education: young people leaving school or universities without a diploma.
- And there is a problem that you share with many other rich societies in Europe: the third and second generation of immigrants. Will they be considered a problem or an opportunity, and is society prepared to invest the money and resources needed to transform this problem into an opportunity?

4. Identifying actions to be taken

F2KS should be a platform for concerted action to solve these problems.

For that, you need to identify the dimensions of these actions. I've tried to identify these dimensions. If I look at them politically, they could be programs with budgets and leadership and so on, and they should overlap. They must be overlapping, so as to stimulate competition and co-operation among the political and social actors.

- *First is the question of promoting scientific and technical culture in society, so bringing to the people more knowledge about science and technology.*
- *Then is the question of general science education for everyone, and the role of science and technology learning at that stage -- many of the discussions we had today with the science teachers were on this specific problem.*
- *Then is the problem of life long learning that we have not addressed here today, the problems of vocational training, and of addressing social and economic perceived qualification gaps.*

These three areas need specific programs to be addressed. They cannot be addressed by wording. *In the UK, the question of the economically perceived qualification gap has been and is being addressed by UK business, in collaboration with local educational authorities.* In many other countries, there are other solutions, but all have this in common: they are systematic, they produce a kind of observatory, which involves the local education authorities or councils with schools (municipalities, parents and

so on) and employers on the other hand. They do it systematically and locally.

- Then, there is *a problem of science communication and the media*.

I'm sorry, but I have never seen this problem being addressed without a strong public policy on this area. The number of science communicators, namely professional science journalists, can be greatly improved by government. News agencies, desks for science can be asked for by the authorities. The promotion of training journalists out of the scientific professions is something that has been around in Europe for many years and in fact it attracts youth with high level of scientific training in every country. It helps to change the profession of journalists and to create professional desks of science and technology journalists in journals. We know this from economy: many journalists covering economy have got this type of training. So it could be extended to other areas.

- *And finally, the general political problem that any political party and any government must ask itself is: will my voters support me?*

For that, we have to strengthen and bring together the social, cultural and economic constituencies for science and technology. Those groups in society which are -for different reasons- disconnected from one another and can be led to favor a policy where priority is given to different areas of science and technology.

But bringing them together is something you cannot ask the people to do by themselves and you can't ask the second law of thermodynamics to do it for you. It requires the input of external energy, it requires to apply an "external field". And that external field, in democratic societies, is provided by governments -- at national, regional or sub-regional level. One of the reasons why we elect authorities in a democratic society, is to bring-in constituencies to promote causes and changes in society.

5. F2KS and the Academy could think about an independent proposal for coherent political objectives.

This is the role of an organized independent group of scientists: to address the authorities and to tell them what they think and what they propose. It's not to produce the technicalities for their action. It's to produce the ideas that will then have to be negotiated and translated into action by those who are in charge.

I have done the following exercise and this is the second moment of my speech that I will need something to protect me from the things you are going to throw at me. But I'm protected by the hour!

I've tried to write and to test a kind of political decalogue for the future of the knowledge society in Flanders. I've tested it some weeks ago in the Scientix conference in Brussels and I'm grateful for those who were there. I have checked with some of you some of the ideas there.

Ten points, that should in my view be discussed by you, because they could be part of a political program in a specific area, to all political parties and to any government.

1. *First, the main purpose of general science and technology education, in compulsory education, for everyone, is the scientific and technological culture of society at large.* It's not obvious, but there is no choice. If you do that, the training of teachers, the programs, the material, etc. have to be conditioned by this objective. This is the political objective.

2. *Second, science education is not only part of the responsibility of the ministry in charge of education. It is part of any ministry in charge of research, of science and technology.* Science and technology policy must devote a budget, organization, human means for science education and pay the political price if there is a failure. They will be proud to have, say, x % new papers in Nature, Cell, etc., a due amount of innovations and patents, but what is their record to science education? To assess this is part of the job of a minister in charge of research

3. *Third, you have to require investing in science (all sciences) and technology education, formal and informal. Informal means science centers, and the media.* You must invest in the media and in schools, at all levels.

And of course the usual aspects: you must invest in research, you must invest in innovation policies.

4. *Fourth, this is a difficult point, and it has been with us for many, many years. You have to work on the fact that, in contrast with the expectations of those who live within the science sector, the youth and even some of the most creative youth, is not keen on science and technology.*

This is a disease of rich societies.

It is the disease of not bringing enough challenging ideas about science, and the fact that science is not presented as connected to human values. *Only the human values of science can motivate and permeate youth culture.*

You will not permeate youth culture in a rich society only with job perspectives: we are not in rural China, where studying mathematics day and night is the only way out of poverty. No! We are in a rich society. In a vast number of families, youth will think: "why not choose something easier? Life will not be bad at all...after all."

So that's not the point. It's how science can permeate youth culture, and be appropriated by youth culture. It's not by telling the youth -- sorry -- that science is very important for making a lot of money in companies. That, very frankly, will not change the mind of any one of fourteen, fifteen. It's much more if you say that you are looking for extraterrestrial life.

What is, in fact, science about? *It's about pursuing the truth: proof, not authority; it's about knowledge, not ignorance; it's about technical training, not definitions* -- we haven't learned anything if in school we are taught definitions: we just learned a name, but that's not science, sorry -- *it's history that we need, where the name comes from, not sound bytes.*

On the other hand, we must teach students that science does not allow neutrality. You may have to choose in your life, if you go into a science- or technology based professions! You choose peace or war. Many of my colleagues have worked to develop very nasty bombs -- some of them developed bombs where the remains of the bomb inside the body could not be detected by X-rays!

You must tell the students: if you go into science, you must know if you are in favor of that -- and some are in favor of that -- or against it.

Science is a battle ground, it's not neutral. And if you know it's not neutral, it becomes interesting. It can become part of the modern youth culture. You must choose between generosity or greed, and choose between disclosing or hiding the truth.

Many sciences are key to attract the imagination both of the society-at-large and of the students. Astronomy and elementary particle physics -- I am a particle physicist myself -- are well known examples.

And last but not least, the importance of science for society must be spelled out: you can't have life-quality control -- the water you drink, the air you breathe -- without science. Science provides society with a culture of evaluation and quality control, with risk governance -- you would be submerged by epidemics without science -- and without the tools for social communication and social cohesion -- because public policies, if they are not tested by independent scientific methods, they will be rotten, as we all know.

5. *The fifth commandment* is straightforward: general science and technology education in schools is key to lifelong learning, to social adaptability and to social and political participation. It has to be handled with care and expertise.

6. My point in *commandment six* is related to the former: *please do not split and create barriers between what you call STEM education and all the rest.*

You are not doing a service to the science teachers, nor to the students. I've told you, some hours ago, that *some of the best science projects all over the world, have been obtained by the combination and the involvement of teachers and researchers of different areas.* It includes languages, history and geography, etc. It can be lead by science and technology, but it must involve the school-at-large. If it doesn't involve the school, it's a failure. It means that the culture of the school has not been permeated by this drive for science and technology.

7. *The seventh commandment* is a difficult one, because it's related to a

threat, in many European countries. We have seen it in the past and we are seeing it today in Germany, France, the UK, and many other countries. The world has changed a lot recently and is changing even more every day. Poverty and war are at the frontiers of Europe. Ten years ago, the number of people crossing by night the Mediterranean by boat, was less than one tenth of those who are crossing today, and this number is increasing and will increase, because of war and refugees. *The refusal of addressing poverty and war at the frontiers of Europe -- of addressing, I'm not saying accepting or rejecting -- and addressing the increasing inflow of refugees and (illegal) immigrants as an opportunity -- because you will have them, anyhow -- are major threats for the development of highly advanced European societies.* With the declining birth rates in Europe and with many people coming in anyhow, something has to be done. Europe does not exist politically. Some countries, some regions, will do much better than others. The future of their economy and their social peace will be the price to pay at the end of the day.

8. *The question of the perceived lack of science and technology-based professionals in the economy and in society must be taken seriously.* It has been said loudly by many people, coming mainly from companies. Of course they know their field; they can't speak about society in general, but they can speak about their company. The issue must be taken seriously by the whole scientific community. First, for a political reason: if there is a group, which is part of the constituency for science, and that this group perceives a problem, then this problem must become a problem of all of us. That is the only way to build a social constituency for science.

9. *The question of the lack of high level science teachers has been predicted many years ago.* There is a demonstration by John Ziman, who died some years ago: he said the following. "It is a sad fact that in most countries very few students who have specialised in science, technology or mathematics are recruited into teacher education. *Paradoxically, the more a society has a need for people with a science and technology background, the less likely it is that such people will enter the teaching profession.* Part of the reason is that remuneration, working conditions, possibilities for in-service training, etc. make the teaching profession less attractive than other areas of work for people who are in demand, in those areas. Well qualified and motivated science and technology teachers are key when it comes to stimulating future generations' interest in science."

You see the political lessons. If symbolic, social and material remuneration, working conditions and possibilities for in-service training are not improved, the situation will be degrading. It has happened in other countries, and it will happen in Flanders if nothing is done. It has been predicted years ago, it is not a novelty. And we know the solution! Many countries have solved this problem.

Here I come to my ninth point.

Only the empowerment of science teachers and their social recognition by society, but mainly the empowerment of teachers in schools, is a key for success of sustainable science and technology policies.

I discussed this already earlier tonight: the machinery that exists for funding research project work can be extended easily from the research budget, in addition to the education budget, for project work by science teachers themselves, teams of teachers and teams of students. But there is just one caveat about it. It must be additional funding: you can't just move money from one place to the other. And the scale must be big enough. *The temptation is to transform all that into a pedagogical experiment, into innovation in education. But I'm sorry, if you do that, you will not reach the scale necessary to have an impact on society, to bring the empowerment of the science teachers to the attention of parents and kids.*

I've made a calculation based upon my own experience and your population in school. I would say that annual calls for proposals should aim at reaching, in less than three years time, at least 50 % of all schools, at least 1000 F2KS science teachers -- I would call them F2KS science teachers -- and at least 100 researchers. And that is a very modest number. I hope that the generosity of researchers in giving free time for the schools in their neighborhood as part of their social responsibility would very much increase this number. Numbers lower than this would not have an impact in society.

10. *My 10th commandment* is probably the most ambitious and federative one. Devising and funding large scale stable national and international initiatives and supporting independent initiatives *aiming at bringing together schools, research centres, science-based professionals as well as industry and science centres* are key to opening the gates of an inclusive , curiosity and innovation driven knowledge society.

6. The end

The end must be peaceful and it must come from history. It has to do with our common background: Portugal and Flanders have been very close during the sixteenth century. Both have been doomed by intolerance. In fact the richest families in Leuven and Antwerpen, who were not only a source of wealth, but also of humanist culture, escaped to Amsterdam. The rise of religious intolerance in Europe, the rise of inquisition and religion wars, transformed two of the richest regions into normal dependent regions. The rise and fall of tolerance, humanism and prosperity in Flanders and Portugal in the 16th century should be a lesson for us -- and it is a lesson that I try to remember. We are now in a stage where the rise of Europe as a knowledge society -- there is no doubt about it: during the last 20 years, not only Flanders, but the whole European Union, has experienced an extraordinary progress towards the knowledge society. The number of students, the number of educated researchers, the investments in public and private research, the results and appropriation of research in products and services in society has been tremendous in the European Union in the last years. And that has been appropriated by almost all political parties and all governments; at least they all do something or pay lip service to the idea that they are in favor and they do what they can for a knowledge society.

That, I call the rise of Europe as a knowledge society. But now we face an uncertain future. War has surrounded Europe and poverty is tending to come into Europe since the last ten years. Division has doomed the hopes of the years 2000 within Europe. *Any of us, in each society, must do our best, to overcome this difficult situation.*

As in a conference almost one year ago, I wish to recall the famous humanist Damião de Góis, Portugese by birth, married to a Flemish family who fought for the defense of Leuven against the French troops. He was arrested and rationed by the king of Portugal. He was a friend of Erasmus. At the end of his life, after being back in Portugal as the historian royal he was imprisoned by the inquisition and probably assassinated. Some years ago it was found that his many competences in the highest level included music. In fact a few sheets of music written by his hand, were found. It's a few seconds. The music you are going to listen is without words, but the words intended for this music are known and come from a passage of the Bible. They should be read in retrospect of these dark times, the times that came after an extraordinary expansion, the first globalisation of the world.

This is the passage in Latin, translated as :

"Do not gloat over me, my enemy! Though I have fallen, I will rise.
Though I sit in darkness, God will be my light".

Five centuries later, I invite you to listen to his music.

Ne laeteris, inimica mea
Super me quia cecidi
Consurgam cum sedero
In tenebris Dominus lux mea est

Thank you.

Transcription due to Bert Seghers