Publicly Funded Research & Innovation in the EU

Unlocking its public value, in the EU and beyond

Every year the EU commits an amount of around €12 billion to fund so-called framework programmes (Fps), which aim at supporting research and innovation (R&I) activities in the EU. The first question is: Do we really need this investment? My answer is a firm yes and I will shortly only argue on the rationale of publicly funded research and innovation. A second question is whether this investment yields the maximum return and, if not, what may be needed to optimise it. Answering this question is the principal aim of this book.

Nikos D. Sakkas
Author

Nikos Sakkas: I carry out energy & ICT related research as a professor at the Hellenic Med University, Greece & the Un. Of Hull, UK. I also participate in innovative global ventures (wirelessthings.biz, leiminte.com, hellohoreca.com) as an advisor or a partner. Often these businesses have been spin-offs from EU funded research and innovation and have by themselves greatly inspired this book. In my free time, in lounges and aeroplanes, I have found a strange pleasure in writing; fiction and non-fiction alike. Two years ago, I published the book "Democracy again! The EU megapolis and the democratic challenge" that was another source of inspiration for the current endeavour. Unconnected as they may seem at first sight, it is the passion for a progressive and self-challenging EU that underlies both these topics. This book, in particular, was written with consultation, direct contribution and inspiration by my good friend Serafim, a person of a rare quality whose friendship I have enjoyed in recent years and whom I greatly thank for this collaborative experience. I remain hopeful that this is just the first of a series of joint ventures to follow. All my books are available at Amazon and www.artdrop.net.

Serafim A. Kotrotsos
Contributor

Serafim Kotrotsos: Swinging between academia and business, start-ups and incumbents, entrepreneurship and social services, research and management, execution and coaching, the key common factor in all three decades of my career so far has been innovation. This is the main energy source throughout my endeavours across sectors, including e-Business, Teaching, Software engineering, Management Consultancy, Telecommunications & Utilities, Artificial Intelligence & Big Data, Social networks etc. With the background of a tech start-up founder and a leading role in the B2B operations of a leading ICT provider group in the Middle East, innovation has been more of an everyday practice rather than an exception. In parallel, when an inner voice can no longer be suppressed, I resort to documenting and publishing some of my views about critical concerns of my home country Greece and our larger home Europe. This book is the intersection of all these, along with my friendship at first sight for Nikos.

by Nikos D. Sakkas

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DEMOS
balanced thinking

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In loving memory of my father

My gratitude to the RadioArt Internet radio, for the inspiration and the company

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Preface

I am a fan of innovation. It has played an important part in my life and I have had ample empirical exposure to it, allowing me to reflect on it on numerous occasions and in various contexts and roles.

I see innovation in a broad sense. As a game-rule changing concept and not just in its technological dimension. Innovation in art, lifestyles, perceptions, besides innovation in technology.

Innovation is not some side activity of our society; it is its beating heart, what makes the difference. And it is, of course, not only linked to technological innovation, although this is indeed a great part thereof. Great art almost always represents a new approach to things. There is a considerable distance between the neoclassicism of the 18th century and the post-impressionism school of the early 20th century, with many fascinating and disruptive turning points. Truman Capote became famous because he established a new writing category, that of a non-fiction novel. Bauhaus, the Beatles, Picasso: all became famous because they broke the rules, because they were innovative.

Taking a fresh look at our world is a rare capability and the very first step to discovering new things; a fundamental aspect of our well being and prosperity, throughout all threads of our lives. Such a disruptive and status-quo challenging outlook cannot be programmed nor framed in tight business schedules or within some 10-year business plan. Besides, this is how the

World Wide Web emerged; by the endeavours of Tim Berners-Lee, in the course of a largely unplanned and pretty accidental trip.

The "Think Different" campaign, launched by Apple Computer, Inc. at the turn of the century, mainstreamed, perhaps for the first time, this broad perspective of innovation. In that rare and inspiring initiative, Bob Dylan, Martin Luther King Jr., Richard Branson, John Lennon and many more featured next to the likes of Albert Einstein, masterfully portraying the frontier-less nature of innovation.

I find it important to say all this, so the reader understands the true perspective of the author and why he may sound passionate about this idea of innovation. Yet, in case someone already wonders: no, I won't point, after this point, anymore in this broad direction. Of course, there are some common behavioural and cognitive traits along all threads of innovation and in all its successful practitioners. However, in this treatise, I will rather narrow the focus on technological innovation. And, in particular, I'll look into the public EU instruments for fostering and financially supporting innovation. Approximately every six years one new such instrument comes out. They are typically called framework programmes (FPs) for research and development; the latest one is better known as Horizon 2020, running till 2020. Horizon was supported financially with the amount of €80 billion, for a period of six to seven years and the successor instrument, Horizon Europe, will receive about €100 billion.

A call for creative destruction

Either history is really governed by laws, and in that case, a truly human-activity is impossible, except perhaps in a technical sense; or human beings really make their own history, and then the task of theory will not be directed to discovering "laws", but to the elucidation of the conditions within which human activity unfolds.

Cornelius Castoriadis

Every inception, such as this book, comes with a long background of experiences, thoughts and emotions that accumulate over time. Inceptions may start as somewhat fluid, with no clear direction. In time, the more interest and concern a person has in a particular topic, the more he consults with and cross fertilises his experiences with his peers and seeks to validate them in the light of the dominant theories, the clearer will be the pattern that will emerge. It is at the confluence and the interplay of experiences gained and theoretical abstractions attempted that clarity and a feeling of confidence will eventually result.

Indeed, experience is not the only way that opinion and knowledge is generated. The second, equally important tier is that of a theory creation; meaning by this the identification of causal relationships that are rationally robust and acceptable, and validated in a number of circumstances. Though validation will always be necessary, a theory stands out mostly for its solid causal, deductive or inductive, inference. A theory is more about insight and causality than it is about data correlation.

However, the usefulness of a theory lies also in its ability to point in a direction and support predictions. Trivial as this may sound, theories have been paramount in shaping the world we live in. When we enter an aeroplane to fly over the ocean we

are at the mercy of these theories and their causal predictions. They underpin every single moment of our flight. If one of the numerous predictions made by the theory of the flight failed, our aeroplane would with no doubt come down.

Yet, the aeroplanes fly and, therefore, the theory truly exists; it is no fancy. Aeroplanes very rarely come down and even then it is not because our predictions betrayed us but because of some other mechanical failure; some technical incompetence to manage an otherwise safe and trustworthy prediction.

However, it took a long period from the flight of Icarus to our modern flight fare. A long period with many failures in-between and significant human loss. In time, however, our flight theory became more and more perfect, could account for extremely rare conditions and cope with them efficiently. The science of the air flight could provide us with the most accurate predictions. And its technology peer, developed in parallel, could fully and successfully manage these predictions and take us safely across lands and oceans.

Innovation has a large legacy, similar to that of air flights. In fact, Archimedes who came out of his bathroom shouting "Eureka, eureka!" was a keen and a major innovator and, incidentally, the inventor of the basic laws of the air flight. However, it took a very long period for them to emerge into a practical innovation, and this happened only after a great number of in-between contributions from many other researchers.

Innovation, however, is also linked to social issues and not just natural phenomena like the air flight. In the realm of society, we have proven, as humankind, much less capable of developing theories, delivering predictions that are trusted by all. This is why we have, throughout history, an abundance of socio-economic schools of thought, whose views may often be

separated by a deep gulf. On the contrary, we have only one theory for the air flight; and it is respected by all sane people.

And then came Einstein. And one of the many big things that Einstein did was that he shattered our cherished theories and our safe predictions stemming from them. He demonstrated, beyond any doubt, that even these natural laws that we place so much trust in have their limitations. Outside a given context they simply crash. Maybe our plane will never endeavour out of this context and so we can still board it with easy minds. Yet, the theory that we so much loved to consider as an absolute value is not really such.

Einstein's main social contribution, besides his grandiose and breathtaking scientific theories of relativity, was that he demonstrated how relative things truly are. How we still do not have any perfect theory that we can safely rely upon. How our much-cherished laws are trapped in a specific context and that if we venture out of it very strange things may happen.

A main point in this treatise is that the era that is unfolding, that of the Fourth Industrial Revolution, is again challenging our theories and the current status quo. We are entering a period that has characteristics which for Joseph Schumpeter would have perhaps signalled a clear and bold mandate for creative destruction.

Elucidating these conditions of our era may require us to overhaul even some long established theories and practices stemming out of them.

It may require us to make our own history.

Inspirations and aspirations

I have had ample opportunity to get to know the EU research and innovation (R&I) context. I would say, for the last 20 years

it has been a part of my professional life. Just a part, however; one that I have deliberately tried and succeeded to keep in specific boundaries. Because I enjoy the whole life-cycle of innovation; not only its development but all the way down to the moment when one interacts at some trade fair with ordinary people, presenting and debating on the real thing. Besides, this latter kind of activity led me to a major discovery; the unique knowledge of the customer, and, therefore, also of the citizen. A discovery whose paramount relevance and repercussions will pop up time and again in the following pages.

This controlled engagement unfolded along the three following distinct pathways.

First, I have personally directly benefitted from this engagement; being a contractor myself several times I contributed to pushing research into the real world and real-life products. I have been contracted by the European Commission for the evaluation of applicants' proposals for more than 20 years and have been invited several times to carry out the evaluation of other funded projects of the framework programmes (FPs). Last, I have been an elected member of the steering committee of the EEB (Energy efficiency in buildings) public–private partnership, in the period 2011–2012, enjoying a rare learning experience and the opportunity to see from a close distance and from the inside how the R&I FPs were designed and set up. Statistically, however, all this experience has limited significance and I need to be frank about it. It represents no more than just a very limited viewpoint on the EU R&I FPs.

Second, I came to meet interesting people, some of whom turned into current day collaborators, friends or both. Others just remained short term, yet unique and impressive acquaintances whose company was a learning experience that I en-

joyed in full during the typically weekly evaluation mandates in Brussels. Taking into account that my definition of life quality is largely related to the quality of people that surround me, I would not be at all exaggerating in saying that the EU research & innovation has impacted upon my quality of life.

Third, I have been offered an opportunity to contemplate European Research. To develop my theory. This theory was not built only on EU innovation funding. It is supported by many other experiences and engagements with innovation as well as inspiring reading that I will reference wherever appropriate. It is underlined by a deep appreciation of the unique potential of innovation for social well being. In addition, this theory has not been just a mental exercise. Often it came with moments of enthusiasm and moments of frustration and weariness, especially when this large potential was not fulfilled. In short, with a range of strong feelings and not just thoughts of the intellect.

It is this third dimension that mostly helped put in place the theoretic substrate of my treatise here. With all the natural boundaries and limitations I referred to above, which any science worker needs to strongly observe and acknowledge.

Indeed, in the following I will avoid risky generalisations based on personal experiences. I may, indeed, in some cases make some reference to things that I have repeatedly and consistently sensed, some common patterns that make me think that even if I am wrong, I cannot be totally wrong. Besides, as a matter of principle, my arguments below do not point to a narrow band of something being totally right or wrong or even being right or wrong at some precise percentage. I do not attempt any such resolution. I raise some issues, I register some persistent patterns and, just because of this persistence, I think these patterns cannot be wholly wrong. There must be some

element of truth in them and from this perspective, I lay them, patterns and conclusions, in front of the reader.

However, my main approach will not be driven by data but by theory. It will attempt the elaboration of a theory for the EU public R&I, perhaps more suitable for the current condition of the fourth phase of the Industrial Revolution (IR). Or, to be more precise, it will rather be a critical review and a proposal for amendment and adaptation of an existing theory; the one currently already in place and deeply embedded in the EU FPs.

Thus, the critique and adaptation of the current dominant theory of the EU R&I policy is at the heart of my methodology. In full acknowledgement of the limitations inherent to all theories. Limitations that not only do not subvert the usefulness of a theory, but rather add to its beauty. Besides, perhaps, being unique challenges for the creation of a new theory.

I will, therefore, not be too data-centred, primarily because of my limited experience-based data. However, besides acknowledging my lack of access to statistically significant data, I will also emphasise below the lack of such data in general. I will expand on this, as one of the key points of my critique is what I will call a "low transparency exercise".

This has nothing to do with human intention. It is more a matter of inertia, an attitude that is a remnant of the pre-Fourth IR era, and, thus, falls short of what is currently a completely feasible and absolutely essential transparency. Something that is not just a noble goal but that can be tangibly aimed at.

Overall, the FP programmes are a key brick in a vital infrastructure that we need to seriously revisit, drastically improve and partially, at least, redesign. Perhaps, with a sense of urgency.

I am aware that this concern is taking shape and emerging

now and then in diverse contexts. It is my aspiration to highlight the significance and perhaps add some insight to this ongoing discussion and exchange.

Why this book?

I have said it already above: I am passionate about the idea of innovation. I mostly want to talk about this passionate idea of mine. Incidentally, it is broadly acknowledged that technological innovation is a fundamental key for wealth generation. Literature and media abound with stories of tigers like Korea and Singapore, or more individual ones such as that of Ibrahim Mo who, against all odds, in the mid 90s set up a telecom business in the middle of nowhere in Central Africa, only to completely change the way of life in that part of the planet 10 years later.

This wealth generation is also a prerequisite and a most promising and stable track for pulling in a good deal of important things: employment, social cohesion, happiness and the like. In this sense, I am confident that my passion is not radiating into some vacuum; it reflects also on such massive change-for-the-good patterns.

I think there are some things to be carefully preserved and another strand of practices that need to change, sometimes radically, in order to make the most out of the EU R&I FPs. I do not underestimate the former, but I do confess I am here far more interested in the latter; in addressing what I see as an innovation deficit in the EU and how it can be overcome.

It is not accidental that the EU has an innovation shortage when compared to the Far East and the USA. This well-documented fact is not just a matter of the publicly funded FPs; it applies more generally. It is our whole culture of innovation that we need to adapt if we are to bridge this gap. Even more

so in our era, when the unfolding fourth phase of the Industrial Revolution (IR) is challenging stereotypes and creating massive opportunity, waiting to be harnessed.

In Part 1, I propose some guidelines for such a strategic re-orientation of R&I in the EU. I believe that publicly funded innovation should prioritise the areas of innovation that maximise social value; this should be its strategic positioning. Obvious as this may seem, I doubt that it has been accounted for in the implementation roll out. Of course, I fully endorse the idea that business value generated by innovation has also a great positive social impact. Yet, if we remain at this level of analysis, no priorities for a publicly funded innovation scheme can ever emerge; everything will turn out to hold about the same potential, to be about equally important.

One needs to take a closer look at what social value is really about and which R&I activities, in particular, are those that may maximise it. If one carries out this prioritisation exercise, then the "equally important" activities will now start to stratify while those of a higher social value will start surfacing at the top.

I will argue that these strategies are where the EU publicly funded research should be directed.

I would, however, strongly caution against any idea that such socially prioritised strategies would come with any intrinsically higher value, compared to those driven by more clear business interests. This is by no means the case, nor is it my intent to examine this. It is not a matter of being superior in some sense; it is only about maximising social value.

Such society-targeting strategies would still generate business value and thus maintain their high importance also for the private sector. Besides, most of the evidence I will call upon in the main text and in support of these strategies will derive

from the private sector. Clearly, there is no risk that such a prioritisation could possibly curb the interest and compromise the participation gear of the private sector. The very contrary! It is about a win-win and not a zero-sum game.

This prioritisation exercise is what I mostly carry out in Part 1. And at the end of it I will point in three distinct directions: market generating innovations, collaboration and peering, and co-creation or social innovation.

Part 2 takes a more operational look into the EU R&I FPs. Though it perhaps highlights some current deficiencies, this is not the main approach or intention. Operations are there to serve strategies. Thus, if one suggests a strategic reorientation, as I do in Part 1, operations will, in general, also be affected. Optimising operations without a close consideration of the strategy they are supposed to serve may be a very confusing and wasteful practice indeed.

This also extends over and applies to impact assessment; one more key operation. Impact assessment should again be defined in the light of the overarching strategies. It serves decisions and decisions are taken in the light of strategies. The more clear and consistent this line is, the more effective the assessment operation will be. Otherwise, assessment will seem difficult; frequently it is then bypassed as mission impossible. In essence, however, this may only be a matter of not knowing what decision is really there to be supported.

I focus on assessment because we direly need to measure our EU R&I performance and to do so in a tangible way. In the era of big data it is not enough to resort to dubious, as I will show, macroeconomic impact indicators. We need micro level, data driven measurement and impact assessment strategies.

And we need these for one more reason. In the light of the

new, revamped strategic approach, measurement and assessment will now be essential for true society-wide transparency. With society as a key stakeholder, papers, patents and macroeconomic projections will not secure true transparency; they will be of little relevance. Other things will matter more.

For the greater part of Part 2, I propose an approach for securing transparency; one founded on the principle of impact communication and not general information dissemination, which is already adequately practised. I will argue that such a true, micro level impact can indeed be measured. It ought to be measured. And it can serve a multifold purpose, extending well beyond transparency. It can help rationalise and optimise the FP evaluation exercise. And, in this way, it can deliver massive insight and assist fact-based decision making at all levels.

Who is this book for?

For sure, this is not a book for people that would like to inform themselves about the EU R&I workings and opportunities, perhaps thinking of taking advantage of them, on behalf of their organisations. There is no intention at all to offer any such "how to" guidelines; I would have to strongly caution against any such misplaced expectation.

That said, the book is for everyone that has even a broad interest in innovation. The more this interest approaches the publicly funded EU instruments for innovation, the greater the relevance will naturally be.

Traditional innovation stakeholders, such as academia and business as well as related policy makers, will naturally pop up as protagonists throughout the text. However, a key premise, in the following, is that the unfolding fourth era of the Industrial Revolution provides ample space for society itself to innovate.

And to really harness this we need to sincerely reach out to society, build new collaborative models, readdress and actualise new intellectual property approaches, etc. Although perhaps the more difficult part will ultimately be to transcend stereotypes, change mindsets and challenge the status quo.

In this sense, the book does not address only those who have the traditional capacities of a researcher or an innovator: strong analytical skills and deep formal and thematic knowledge. All these undoubtedly remain pillars of innovation; yet, our era allows them now to be complemented and drastically leveraged and empowered by the formal as well as informal and empirical knowledge that society carries. This novel co-creation paradigm defines a radically new role for society in innovation; it receives an important and strategic placement in the discussion below.

Einstein himself quoted that "*the only source of knowledge is experience*". Perhaps his intent was not to fully downplay formal knowledge but rather to highlight the systematically undervalued, experience-based knowledge. The point, however, remains and is in our era clearer than ever: there is massive talent out there, awaiting to be harnessed and linked to the innovation effort. And this is one of the major opportunities and challenges ahead.

The EU is justly proud of its superior and globally attractive social model. Yet in innovation it scores well below the USA and SE Asia. Can this advanced EU social model fuel an innovation advantage? Would this not be a most natural expectation? This is a central point of my investigation below. Indeed, I think it is worth a try.

In the book I also try to explore one more, somehow unexpected connection. Something that reaches out of many cur-

rent definitions and perceptions of innovation, although, as I will show, this is something that is more and more revisited and challenged.

Can innovation provide an instrument to transform and leverage the EU support to the developing world for its battle against poverty?

My answer is yes. And though this idea may initially appear to be somehow out of context, I will discuss below the related literature and show how innovation can be key in creating new markets and how new markets can be instrumental in eradicating poverty. I believe there is here an important and rather unharnessed opportunity to link with other important EU Aid policies. Perhaps we need to pay far more attention to this link; it will result in unique, multifold and mutual benefits, and also alleviate undue and needless immigration pressures.

In this way, the strategic view of innovation proposed here takes a more broad perspective, one encompassing also other hot issues currently on the EU agenda. Whether this holds the promise of empowerment or brings the risk of diluting the message is for the reader to say.

For this reason, I suspect that, deeper in mind, this book may have also been written for a broader audience: all those who embrace, wholeheartedly, the unfolding EU project and adventure.

Acknowledgements

In all my multifold engagement with innovation, there have been several people that have played a role and provided important inspiration and stimulation. The list is long and it would perhaps be futile to attempt to reconstruct it in full. However, I would like to single out a few of the most relevant performers

that have had a great impact upon me and have influenced significantly the ideas laid out in this book.

Hans Eder, an Austrian businessman who early in my professional life passed over to me, in a relaxing way, some powerful advice on what innovation is about. I would continue with my mentor, Themis Lekkas, whose multifold, rare and laterally developing professional track has for many decades been a source of learning and inspiration. Also, my old and dear friend George Chamilothoris for the multifaceted exchanges we have had on the many matters underlying innovation, from the early days of our friendship and, luckily, also over a long period of professional cooperation in a great diversity of business and academic contexts. Another old friend, Christos Housiadas, for his unique creative suspicion when talking about innovation matters over a long period of time, in his capacity of a most accomplished scientist and successful manager, of a rare and genuinely multidisciplinary breed. Last, Harvard Professor Clayton Christensen, whom I do not know in person but whom I have been following for some time now, ever since his inspiring jobs theory and up to recent days and his market generating innovation concept, in his breathtaking "The Prosperity Paradox" (2019), a book whose influence will be traceable throughout this treatise.

Introduction

In 2017 public and private sector R&I expenditure in the EU amounted to €320 billion[1]; this represents an R&I expenditure as a percentage of GDP at 2.06%. In the same year Korea spent twice as much (4.55%), while the US (2.78%) and Japan (3.2%) stood also significantly higher than the EU. The EU scored even slightly below China, whose related expenditure was, in this period, as high as 2.13% of its GDP. In the same year the majority of R&D expenditure in the EU was in the business sector, this being 1.36% of the GDP or roughly 2/3 of the overall expenditure. Business here refers to the private sector; in the EU, the important public enterprise spending in R&I is accounted for in the government spending. Overall, the sources of funding (2016) are as follows:

56.6% of the total expenditure within the EU-28 was funded by EU enterprises, 30.9% was funded by the government[2], and a further 10.0% by foreign business. Funding by the higher education and private non-profit sectors was relatively small: 0.9%

1 Eurostat, Statistics explained, 2019, https://ec.europa.eu/eurostat/statistics-explained/index.php/R_%26_D_expenditure

2 It is perhaps worth noting that the public sector is an important player and funding agent of innovation throughout the world, even in the USA where the military and the US National Institutes of Health are two among the many, very active R&I supporting agents (https://www.newscientist.com/article/mg21929310-200-state-of-innovation-busting-the-private-sector-myth/).

and 1.6% of the total respectively[3].

In addition, the EU produces three times fewer quality patent applications[4] than Japan, while the venture capital available in the EU is at least five times lower than in the US, as also is the number of fast-growing start-ups: so-called unicorns.

In line with the above figures, it is also noteworthy[5] that foreign-owned firms account for 20% to 25% of total business R&I expenditure in France, Germany and Spain; a percentage that may rise to 30% and 50% in other countries, the UK included.

The EU framework programmes for R&I are publicly funded schemes that have allocated, in recent years, about €11–12 billion on a yearly basis for the support of R&I in the EU. This figure amounts to approximately 3.5% of the related total EU expenditure (€320 billion, 2017) or, equivalently, 10–11% of the public domain expenditure. This figure refers to the Horizon 2020 FP, covering the seven-year period 2014–2020. It is expected to increase by more than 10% in its sequel Horizon Europe. The exact figure is unknown at the time of writing.

Overall, the above snapshot illustrates a clear deficit of R&D in the EU. Also, the EU lags behind the strategic goal for a 3% investment in R&D by the year 2020, as laid down in the Europe 2020 strategy.

Why public research?

Recently, I deviated from my everyday norm; instead of using

3 Eurostat, Statistics explained, 2019, https://ec.europa.eu/eurostat/statistics-explained/index.php/_%26_D_expenditure#R_.26_D_expenditure_by_source_of_funds

4 Patent Cooperation Treaty, http://www.wipo.int/pct

5 Internationalisation of business investments in R&D and analysis of their economic impact, EC, 2012.

my car to go to one of my usual destinations, I took my bike. It was a feasible distance, just some 10km away. I then found myself utterly delighted by a new discovery! A wonderful track, just 50 metres away from the highway I had been driving on for years. A track through nice, quiet streets, through freshly bloomed lemon trees. It literally made my day. And it was just weird to contemplate how this accidental path of mine had gone by unattended for so many years. We enjoy end goals but we also enjoy paths. There must be hardly any modern country that does not have some poem to cherish the journey, the accidental journey, and the many delights it often comes with. Indeed, our life is built around journeys as it is built around pursuit of goals. And it is often fulfilled more from the unexpected than from the planned.

Of course, market forces could have discovered my delightful track; in fact I see them already working in this direction. Cafés and parks and other amenities will gradually show up on the sidewalks. Of course, there can be a promising business model around a pleasant, picturesque city route. But this obvious fact is not where I really wish to point my argument. The important thing is that path values are not as easily identified by markets in the same efficient way that they can cater for end goals. Let us see some examples to understand what I consider as a very notable limitation of the market mechanisms. Accidental journeys are not only about uncapping beauty; they are also the principal way that much of our current wealth and civilisation has been developed. Science is perhaps the area where this is most profoundly true.

Archimedes accidentally came across the law of lift, which today carries our boats and planes. Maxwell's discovery of the electromagnetic waves was more conscious and not as acci-

dental as Archimedes' "eureka!". Yet it never crossed Maxwell's mind, nor the mind of any of his contemporaries, what he had really discovered. Edison, Marconi and so many other people that would follow would decipher the true value of Maxwell's achievements. Even today, we cannot be certain we have fully reaped it.

A better known story is that of how the Internet and, in particular, the World Wide Web developed; nobody in the mid-80s had the faintest vision about something that 20 years later would be used by eight year olds. Key business executives of the times consistently played down the hype around computers and cautioned against what they saw as a massively exaggerated potential. It was a completely different mandate and context (CERN, Switzerland) that, again accidentally, set the foundations of the World Wide Web. We have to face this reality of "accidents" that may generate massive and unique value, even if we might have preferred an infallible law about the universal ability of market forces to optimally predict and moderate all economic and social value.

Indeed, markets would have been reluctant to fund Archimedes' and Maxwell's wonder journeys. And they laughed at any notion about something like the Internet, even as recently as the 80s. Because this type of value, the journey value, resulting from such essentially objective-less investigations, is largely unknown to the markets. As an impact it only manifests in the long term, often in the very long term. And the markets are pretty indifferent to this.

Why do we analyse our business plans in a time frame that typically and with only very limited exceptions spans over five, 10 or maximum 15 years? Because this is how far we can see, maybe because this is how far we wish to see. If wishing, in this

context, really represents something different to seeing and is not a restatement of essentially the same thing, as I tend to believe. If an off-track journey was about beauty alone, as with my recent bicycle ride, we need not be so much concerned. Markets understand and reward beauty. But science is much more long term than beauty. And markets cannot tackle long term phenomena; they are too hectic for that, too uninterested and low motivated. There is too much risk for any to bear. If we really wish to harness this value, the value of the accidental discovery, we should not consider markets as the enabling mediator. There is ample empirical evidence for this.

Such accidental innovation, as I will call it, is a distinguishing trait of humans, as pertinent to our present time as it has ever been in the past. This inquisitorial spirit is commonly also referred to as research, or even basic research. Research may work in a planned way towards a goal but often this goal may not even be initially perceived and may be reached all of a sudden, as a by-product of other investigations. In this latter case it occurs rather accidentally. And if it also succeeds in delivering tangible use value then it also qualifies as innovation. Indeed, I will use throughout this text the term innovation to denote anything that carries novel and tangible added use value when considered with regard to the labour, materials and knowledge it has required for its generation.

Accidental innovation is the most obvious but far from the only or even the most sound reason for public research. As I will show below, there are several types of innovation and though they typically generate value for both the private/market and the public/society side, the balance of this value is not always the same. There are cases, I will later denote them as "market generating innovations", where the social value is potentially

largely in excess of the market value. Though the term may be encountered here and there, I have personally borrowed it from a book[6] that has very much influenced me, enlightened I could say, in general and with regard to this book undertaking.

Such innovations are, therefore, reasonable to attract the interest of the public sector as it appears now to be the main stakeholder and key beneficiary. This is not to suggest that the public should withdraw from the other innovation arenas. Only that it should prioritise those areas where the public benefit will be higher.

Accidental innovation and, especially, market generating innovation should, in my view, be the spearheads of publicly funded R&I. The former I have introduced just above. I will refrain from expanding on the latter here as it will be discussed in detail below, when addressing the categorisation of innovation.

The private–public innovation frontier

A highly interesting point is the relationship between public and private operators with regard to the development of innovation. This book is based on two key premises. First, that innovation is not a zero-sum game and is, potentially, greatly beneficial to investors, practitioners and society alike. And second, that the various types of innovation may not necessarily have the same impact across these many beneficiaries. To this extent, I will argue in the following that there are types of innovation that hold a larger potential for society, although they will typically also carry benefits for the rest of the innovation stakeholders. And there will be other types of innovation where the

6 Clayton Christensen, Efosa Ojomo and Karen Dillon,"The ProsperityParadox: How Innovation Can Lift Nations Out of Poverty", Amazon, 2019.

benefit leans excessively towards private operators with society now left with a less tangible and rather indirect impact.

If this is truly the case and given that in the book I address EU publicly funded research and innovation, then it is a central issue of the book to suggest how one can trace the line across innovation strategies, in such a way that the society benefit is maximised. Indeed, this is one of the key issues discussed below, something reflected also in the subtitle of this book. In this sense, the broad debate on the relationship between private and public innovation is also very much pertinent to my investigation here.

Mariana Mazzucato, a Professor at University College London (UCL), has extensively researched the public–private frontier as regards innovation. Her position is that public research must be credited for several major innovations of our time, to which private entrepreneurs shifted their attention only much later and only after the difficult and risky early phases were successfully completed. Here is a passage from one of her works, highlighting the underestimated importance of publicly funded research[7].

State funded organisations (mainly decentralised ones such as DARPA, SBIR and so on) have been fundamentally involved in generating radically new products and processes, which have changed the way that businesses operate and citizens live — transforming economies for ever from the internet revolution to the biotech revolution to what (it is hoped) will be the greentech revolution.

Similar approaches to those of Mazzucato often show up in the press.[8]

7 Mariana Mazzucato, "The Entrepreneurial State", Demos Editions, 2011, page 115.

8 Tyler Cowen, "The Lack of Major Wars May Be Hurting Economic

Fundamental innovations such as nuclear power, the computer and the modern aircraft were all pushed along by an American government eager to defeat the Axis powers or, later, to win the Cold War. The Internet was initially designed to help this country withstand a nuclear exchange, and Silicon Valley had its origins with military contracting, not today's entrepreneurial social media start-ups. The Soviet launch of the Sputnik satellite spurred American interest in science and technology, to the benefit of later economic growth.

Indeed, wars and other mega projects have been instrumental for publicly funded innovation as they have exceeded the financial capabilities of private side operators. Many innovations would not have occurred without the critical intervention of the state.

I agree in full with the approaches of the writers above; I find that they are built on solid and unquestionable facts. Indeed, innovative private entrepreneurs have benefitted from massive and publicly funded research which they have tapped into in a timely fashion and have largely capitalised upon, for their own innovative and proprietary agendas and without having to share the typically huge upstream costs. Additionally, if not even more importantly, private entrepreneurs have also benefitted from huge previous knowledge assets generated over the centuries, by "being able to see while standing on the shoulders of giants", as Newton humbly put it. But it is society that is the inheritor and, therefore, the shareholder of these knowledge assets; it is only logical and ethical that it should demand a return on them.

Does this then mean that the private sector has enjoyed a disproportionate benefit with regard to the risk it has taken in the process, and has even in some cases extracted more val-

Growth", The New York Times, 13 June, 2014.

ue than it has generated, as Mariana Mazzucato vehemently suggests? I personally find it difficult to respond in a conclusive and fact based manner. As underlined above, a part of the value generated by innovation must reach society, as a return for the massive knowledge resources, owned by society, that have over the years overflowed to private entrepreneurs, for them to harness and create their disruptive innovations. Yet, how much is this value that has been, in this way, transferred to the private sector? And why has it not already been returned via taxation and other resulting social benefits? For example, could anybody 25 years ago have imagined having something like Google Maps being made freely available to her? I doubt it.

The idea that markets have benefitted hugely from state infrastructure and investment is, of course, accurate but does not reflect the full truth. Because markets have been pivotal in pulling in significant infrastructure (see the rail and road infrastructure built in the USA in the 19th and early 20th century to take advantage of the breakthrough innovations of the time, especially the commoditisation of the automobile by H. Ford, or the case of Toyota in postwar Japan and the pressing need to develop road infrastructure) and in some cases have taken this responsibility upon themselves (there are several such examples in the third world, where infrastructure vital for business could not be provided by the state).

This relationship between infrastructure and innovation is something important and I will come to it again later, especially in the context of the emerging economies. Because innovation, if well-targeted, has the potential to be a great enabler of added value infrastructure. And infrastructure investment can assist innovation as well. But infrastructure *without* innovation that generates market activity may not always be sustainable

and can easily turn into a liability. If China runs today with an infrastructure investment amounting to 8% of its GDP this is only because there are rising, significant market and innovation-driven forces to sustain it. Infrastructure may in some cases, indeed, be a vital and an unconditional priority; for example, water and sewage treatment plants in the developing world. Yet, infrastructure can often be just a facilitator and may have no intrinsic value on its own. It is there to allow value to flow and has no real use if there *is* no adequate value. It may easily evolve into a value trap. For example, an extensive road network that cannot even be sustained, because of poor economic activity.

In our time especially, this private–public coexistence in innovation raises several important technical and legal issues. Is the intellectual property rights system fair and rational and up to the challenges of the modern age? Do corporations, such as Facebook, respect privacy and competition legislation? As important as it is to constantly revisit such issues, I doubt this will be sufficient for us to come up with an innovation value distribution concept that will keep everybody happy. The evolution of innovation in our societies and this subtle frontier between private and public opens a bigger and broader discussion: the inexhaustible topic of wealth redistribution. Of course, along with the reasoning of the previous paragraph, I can personally only be in favour of the idea of wealth redistribution. But, so would the vast majority of people on Earth. Even Milton Friedman, often considered one of the toughest free-market oriented ideologues, acknowledges the need for redistribution and proposes an implementation instrument called in the literature "negative taxation". The tough issues are, therefore, not the "Yes" or "No", but the "How much?" and also the "To whom?".

Realistically, we can only expect a vast diversity of respons-

es on these thorny and most controversial issues. My personal outlook is to consider this diversity as natural, if not even welcome. In the end, the whole controversy might just be a matter of the preferences of people and their collectives (societies). Instead of aiming at some unanimously accepted calculation methodology for redistribution we might just need to moderate and live on with our many, unavoidably different preferences and perspectives. To this purpose, we have a most efficient tool, one that I think we may be making a rather limited use of: democracy. A revamped democracy, perceived in a decentralised manner, would allow these many preferences to take distinct shapes and lay out their preferred agendas[9].

In short, I fully realise the importance of value distribution of innovation endeavours, with which both the public and the private operators engage, such as the EU FPs for R&I. In fact, I am eager, in the pages below, to make some practical recommendations in exactly this direction. To question, in particular, to what extent the current setup of EU R&I really maximises the public part of this value, as it ought. And to suggest some strategic reorientation in that direction.

This is as far as I will go. I have no data and no method to take any more general and all-encompassing approach on the matter and suggest a clear line passing between value points A, B and C. I hinted above that such a thing may not even exist for our overarching issue at stake here: wealth redistribution. I am a strong believer in the power of measurement, and this will

9 I am, however, already reaching beyond the borders of the effective area that I want to address in this treatise. I will, therefore, not expand further on the issue, referring the interested reader to a previous book of mine on the matter: "Democracy Again!: The EU megapolis and the democratic challenge", that can be downloaded from www.artdrop.net or bought at Amazon.

show up now and again in the following. But to measure, you need to have a clear mandate and a well formulated decision you wish to make. In wealth redistribution this is not the case; there are an array of opinions available, for treating and deciding upon the issue. In consequence, there is simply no way to define how wealth should be redistributed. There are a great number of ideological and philosophical standpoints on the issue and it is not my intention to challenge or side with any of them.

I will, however, make an exception for some ideas that are clearly extremist and out of tune with reality. Luckily, we have not much left from the Marxist legacy that downplayed the importance of individual and private side action and considered it as synonymous to exploitation. Perhaps, with the interesting anomaly of modern day China, that in the name of a questionable Marxism follows its own reverse and aggressively pro-market path. But we have a new wave of a reverse kind of extremism that now considers that the private side by definition acts in the interest of the common good and that the public side, driven by a web of self interests, is only setting up traps for its noble goals.

It is no surprise that this dogmatic approach also extends to the domain of innovation.

The sceptics of public research

I am myself aware of many cases where I think we would be better off with the public sector completely stepping aside and leaving the markets to work. In principle, I do not contest exploring the potential this idea may have, in some given contexts. However, this book does not target the general balance between public and private operators in our societies; it explic-

itly targets innovation. And I have shown above and will continue to demonstrate later on that the quest for innovation cannot be optimally served with the public side stepping out of it.

Yet, this is not something unanimously accepted. As an example, here is how Peter G. Klein from the renowned Mises Institute puts it[10]:

The reality is far more complicated than the myths repeated by those who claim that many of the technologies and innovations we now value were produced single-handedly by the government. Yet, the historical reality does not diminish the ease with which Obama and other fans of government spending can point to innovations like the internet and the interstate highways and say "you didn't build that." We can only speculate on what might have been produced had the market been allowed to function. Likewise, we can still see the pyramids today and marvel at the innovation that went into their construction, but unfortunately, the wealth and labour stolen from ordinary Egyptians to build them has now been long forgotten.

I do value markets and give them the huge credit they deserve, but I love truth and rational reasoning more than I value markets. So the kind of argument, "If the public had not got involved we would have done it faster and better", as raised by Klein above, is a rather poor argument. What would it have meant to not to have Pharaohs in ancient Egypt? What would the Egyptians have had instead and why would this have necessarily been better? Besides, if the Pharaohs and their extravagances were a bad thing three millennia ago, how would the Mises Institute comment on the slave markets in the 16– 18th centuries, just three centuries ago? These were a pure, 100% market institution: no state, church or other institution was really involved there as a protagonist.

10 Peter Klein, "Government Spending on 'Innovation': The True Cost Is Higher Than You Think", Mises Daily Articles, 15 June, 2015.

In the end, I feel justified to argue that had the Internet not evolved primarily in the public domain, it would have taken us quite some time to move it out of the towers and the labyrinths of intellectual rights, erected by proprietary endeavours. A similar perspective is taken by other people, some of whom are credible authors in top business journals. For example[11]:

The early internet was noncommercial, developed initially through defense funding and used primarily to connect research institutions and universities. It wasn't designed to make money, but rather to develop the most robust and effective way to build a network. This initial lack of commercial players and interests was critical—it allowed the formation of a network architecture that shared resources in a way that would not have occurred in a market-driven system.

Klein's mindset enters us into an imaginary, a pure, black and white realm. He obviously considers that the state must be unconditionally bad and wasteful. Facts contradicting his infallible principle are of a secondary importance; they only blur the big idea and can be overlooked.

No, I don't think you can ever trick reality and get an advantage over it just by proposing some "better" imaginary scenario. This simply is not rational thinking. I am only eager to hear about step by step change; about evolution and not revolutionary jumps into nowhere.

State and market have played their roles in the quest for prosperity. Likewise, both have committed ugly deeds, but this is no reason to opt for some purist, Platonic idea and forcefully select one over the other. The only rational question here, that I find worthwhile considering, is: how do you trace the line in innovation, between public and private, and, in particular, how does the public side define its priorities? Indeed, making the

11 Joichi Ito et al., "The Blockchain Will Do to the Financial System What the Internet Did to Media", Harvard Business Review, 8 March, 2017.

case for public research is no difficult thing. Commenting on the exact approach pursued in the EU and questioning whether this effectively maximises the public value is another. It is the latter subject that will occupy me in the following pages.

Part 1 – Open strategies

Targeting market generating innovation, engaging society, fostering collaboration

The importance of definitions

Disputes about words are always disputes about things.

Madame de Staël

Defining and categorising, or breaking things up and packaging them in distinct and separate cognitive "boxes", is something very important. It is how we make sense of things and attach meaning to them. It is the basis of analytical thinking and, therefore, also of science. Robert Katz, in a classic article in HBR[12], examined the skills of an effective administrator and ended up with three distinct types. First he states the analytical capacity, i.e. the capacity to break things down to subcomponents in order to study them at the required detail. Then he mentions the ability to use existing knowledge from the past in nearby areas and synthesise solutions for problems in new areas. And finally he describes the essential communication and human skills, including leadership. The ability to define and categorise things is an important component of the first, analytical skill.

Conversely, a non robust and internally conflicted definition or categorisation is not only a source of poor understanding but also one of severe potential misunderstanding and confusion. This becomes apparent as soon as people with a different perception (definition) of the same thing set out to solve some problem related to it.

In addition, clear definitions are a key condition for measurement and assessment. It happens all too often that people believe some things are just not measurable and they hastily bypass them by highlighting some uniqueness of their context

12 Robert Katz, "Skills of an Effective Administrator", Harvard Business Review, September 1974, Sep–Oct 74, pages 90–102. (Republished in the 90s, as an HBR classic.)

and overstressing how this makes their measurement improbable. Contexts, however, are rarely ever so unique as claimed. In reality, what happens most of the time is a poor definition of what is there to be measured as well as unclarity as regards the reason and the decisions this particular measurement is meant to support. In reality, a clear definition of a term and a good understanding of the purpose of its measurement will typically also allow the development of a suitable measurement approach.

This applies especially to abstract concepts and intangibles; such as quality, commitment, engagement etc. All these terms may initially sound too vague to allow any measurement to take place. Yet, I would argue that often this happens only because the terms and the purpose of their measurement are simply not well defined and not because of some inherent inability to measure them.

Indeed, measuring things when there is no clear purpose makes no sense. For this reason, a useful tip to establish a clear definition is to first ask: "What decision do I need to support?" Purpose will shed unique light on a term and will allow true understanding to emerge. The setup of a measurement or an assessment exercise will then follow in a natural way. Perhaps it would be helpful here to note that by measurement I do not refer necessarily to an assignment of a numeric value to an entity. A broader perspective is due. Measurement is any quantitative approach that can reduce the uncertainty of our knowledge, something that often comes with significant value, justifying the measurement effort.

This tight link connecting "definition-decision-measurement" also implies that there may well be multiple definitions of the same thing. There is nothing bad or inconsistent about that,

provided that all these different definitions resonate down to purpose and measurement in their own specific way. Take, for example, the term "success". It may mean completely different things to different people, which of course is no problem by itself. However, this meaning can only truly emerge if given the light of the short- and long-term decisions they will have to make. One may prioritise professional, personal, communal etc. aspirations, all in the name of "success". The appropriate assessment of the term will then fall into place quite naturally. If "success" is not seen from the decision perspective, it will remain fuzzy and people will find its measurement impossible and revert to the typical argument about the supposed uniqueness of its context. Unique or not is a secondary detail. The true issue is that if you highlight this very context, define and understand it and link it to purpose and decision, the required measurement techniques will be established in a surprisingly easy way.

Having different personal and collective strategies is both natural and welcome, and is certain to also result in different definitions. However, it is one thing to have several definitions and another one to have an unclear and possibly inconsistent definition.

Thus, when it comes to definitions and categorisation there are two things to do. First, definitions need to be clear and linked to purpose and decision. Then, their categories need to provide for their segmentation, according to their purpose and decision. In this way, the clarity of the definitions will automatically extend over to the proposed categories. Otherwise, if these rules are not adhered to, categories will remain blurred and overlapping. Likewise, if we wish to re-purpose a term and the decisions related to it, then we will have to reconsider its definitions and the categorisation of all possible underlying

terms.

Defining innovation

Returning now to our innovation realm, a most persistent confusion is that of the relationship between "invention" and "innovation". Not just the broad public but also the scientific community often tend to perceive these terms and their relationship in two very different ways.

On the one side, there is a line of thought that more or less equates these two terms and considers them as synonyms. In this understanding, they both refer to creating something new, something that has some substantial difference from what was there before the invention or, similarly, the innovation. Of course, the term "substantial" may have various interpretations and may give rise to controversy within this same set of people. Not everybody will perceive it in the very same manner. Views may differ. But they will differ in the same way for both invention and innovation. Because this set of people considers "new" as an invention and, equivalently, as an innovation.

Equating invention to innovation means that you implicitly equate their purposes. If not, then you have set out on a wrong path. If these terms serve different purposes and, therefore, relate to different decisions then it is a serious mistake to blend them together. From the policy point of view, considering them as synonyms you imply that your support strategies will be the same. Likewise with your measurement techniques. There certainly are methods to measure how "new" something developed is compared to some previous version of it, based on the past state of the art. As emphasised above, much of the magic and impossibility of measurements is gone when the definition of the terms and their purpose are clear.

On the other side, there is an approach that draws a clear line between the two terms; it considers them as different, even radically different. People opting for this approach would agree on the definition of invention; it carries, for them as well, the semantics of something new. But they would strongly disagree that this newness is the essence of innovation. Yes, they would require that it be present for something to classify as innovative; but they would not consider it as sufficient to justify innovation. For this group of people, innovation carries one more essential aspect: usefulness. Usefulness is not attached to the invention; it is no requirement of it. But it is part of innovation, and a very important part indeed.

In this latter case, we have assigned a different purpose to innovation. And, therefore, we have opted for a different definition. One that surpasses "newness" and extends also over to "usefulness". Our decision on innovation will need to consider both "newness" and "usefulness". It will need to develop measurement techniques for both of them.

Luckily, we are at a point where these terms, within the recent EU R&I FPs, are indeed conceived and defined differently. Their separating line shows up more and more clearly, something that was certainly not the case 15 years ago when the line drawn was far less clear and the terms were conceived in an overlapping and somewhat confusing way. I see it as major progress that the line between research, i.e. activities aiming at inventions, and activities aiming at innovation are at last in different categories, consolidating, in this way, their different purposes.

To take a historical flashback on this matter, among the first and perhaps the most persistent scholars that came to draw this clear line between invention and innovation was a major

economist of the 20th century, Joseph Schumpeter. Professor Schumpeter was also a pioneer in the mathematisation of economics[13]. Yet, he never juxtaposed this emphasis on mathematical and quantisation oriented approaches to the value of more qualitative approaches. Instead, despite being a most profound and knowledgeable academic, Schumpeter was able to appreciate the great importance of experience and empirical knowledge and acknowledge it as a solid basis of entrepreneurship. And, in this way, he managed to balance himself in a unique way between theory and practice.

Perhaps it was this unique balancing skill that allowed him to also masterfully trace the line between invention and innovation. Let us see how Joseph Schumpeter in his landmark "Fundamentals of Economic Development" postulates it[14]:

And to carry any improvement into effect is a task entirely different from the invention of it, and a task, moreover, requiring entirely different kinds of aptitudes. Although entrepreneurs of course may be inventors just as they may be capitalists, they are inventors not by nature of their function but by coincidence and vice versa. Besides, the innovations which it is the function of entrepreneurs to carry out need not necessarily be any inventions at all. It is, therefore, not advisable, and it may be downright misleading, to stress the element of invention as much as many writers do.

Thus, he clearly draws the line between the two terms. Innovation is for the first time so clearly not a synonym of invention.

13 A pioneer indeed but not the very first one to ever make such a suggestion. To my knowledge, the first to highlight the necessity of such a mathematisation path for Economics was Stanley Jevons, a Professor at University College London. In the introduction to his book "The Theory of Political Economy" (1871) he suggests that "*if economics is to be a science at all, it must be a mathematical science*".

14 J. Schumpeter, "Fundamentals of Economic Development", Oxford University Press, 1949, page 89.

He is even not so strong about whether innovation really and always requires invention, and seems to consider it can exist outside it.

This may truly appear somewhat strange; is it then a new definition? If innovation does not require invention as a necessary ingredient, then how does it differ, for example, from the definition of "business as usual"?

Perhaps the most landmark contribution of Schumpeter, his creative destruction theory, can offer some insight here. Creative destruction was a term coined by him to describe the inevitable need for radical change in business, one that will typically come at the expense of principles and practices that may have been cherished till that moment as progressive and value generating. In other words, what may generate value today will necessarily come to a point where it will impede value generation; a moment when one must put it aside and destroy it, if one is to enter a new area of creativity. Here is how Schumpeter put it, in his own words[15]:

creative destruction is the process of industrial mutation that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one.

In short, in Schumpeter's world there is simply no "business as usual". There is no such definition required. "Business as usual" has no purpose; it will only lead to destruction. Business has to constantly challenge, to constantly reinvent itself, even if this requires putting aside and destroying deeply established practices that do not deliver value any more and now stand as an obstacle to it.

This may perhaps ring a familiar bell for today's frantic busi-

15 J. Schumpeter, "Capitalism, Socialism and Democracy", Routledge, 1994, pages 82–83.

ness cycles. Yet, this was not at all the case in the 1940s when this visionary theory was first laid out.

In short, innovation may typically contain invention but goes well beyond it. It is a condition for economic development, it is about the actual uptake in the real world, whereas invention is just a condition for this. Their separating line is not some secondary detail one can disregard; it is something highly important.

I would, personally, have no fundamental objection to eradicating the condition of "newness" as part of the definition of innovation, as Schumpeter suggests. It is only because of the public domain perspective on which I am focussing here that I think it is justified to retain it. In my view, the public domain should not focus on this kind of constant business reinvention. This is something best delegated to the private sector itself. As will be presented later in the text, I see other things as strategic priorities for the public domain. A different purpose. This purpose mandates the retention of "newness" when defining innovation.

As strongly emphasised above, definitions do not derive from some benign authority; they aim to support a specific decision context. They must be meaningful to it alone. And I believe the current context of publicly funded R&I, and all the decisions linked to it, justifies the retention of two different definitions: one for research/invention-oriented activities and one for innovation-oriented activities.

This said, it is also my conviction that distinguishing between invention and innovation is highly important. And is so now more than ever. For, in our times, the massive increase of the global education and research infrastructure has resulted in new and good ideas (inventions) coming out at an unprece-

dented pace. Yet, just a very tiny part of them qualify in the end as innovations that are used in the real world. Any venture capitalist, whose core business is to reduce the risk when moving from invention to innovation, would easily attest to this fact.

And this bleak reality eventually echoes in the press. Thus, it comes as little surprise when the WSJ informs us that three out of four companies supported by VCs fail[16]. Far worse are the success statistics of those seeking to be supported by VCs. Andreessen Horowitz reports an approval rate figure of around 0.7%[17]. By multiplying the approval success rate of applications submitted to VCs with the market success rate of those eventually penetrating the market, one ends up with a figure of one to two out of 1,000. Or more specifically, one to two successful innovations out of a total of 1,000 inventions.

The significant post war expansion of the education and research capacities in the developed countries, has made this conversion problem even more prominent. Because of this, one can perhaps assume that never before in history has the efficiency in transforming an invention into an innovation been as problematic as it is today. And, of course, it is not the pace of inventions that is to blame. It is rather the transfer from invention to innovation that suffers.

Moderating this poor statistic is a serious concern and one of the important obstacles in pushing forward with new innovations. Why is it, however, that we make so little use of this large pool of new and constantly emerging knowledge?

There are a number of reasons that can be here held respon-

16 Deborah Gage, "The Venture Capital Secret: 3 Out of 4 Start-Ups Fail", Wall Street Journal, 19 September, 2012.

17 Marc Andreessen on Big Breakthrough Ideas and Courageous Entrepreneurs, https://www.youtube.com/watch?v=JYYsXzt1VDc

sible.

The first reason is that a good percentage of the new knowledge developed at this frantic pace is not really amenable to innovation. There is no clear and economically viable path for transforming it into products and services and bringing about uptake into the economy. It was not developed with this in mind. On the other hand, there is always the possibility of what I called above "accidental innovation", i.e. typically disruptive innovations that may result while searching in the blind. Though this may be an expensive exercise for many countries yet its value cannot be contested.

A second reason is that inventions may indeed have a potential for market uptake but the ability to harness it resides outside the skills of the inventors. Other people and resources are needed to upscale, adapt and eventually apply in the practical context.

I could also note here that this dramatic increase in the number of inventions has not been met by the development of a new generation of tools that could steer inventions into acquiring an entrepreneurial vision. A matching middleware that would leverage and transform inventions into successful innovations is simply not there.

Clearly, there can be no clue as to how all these reasons contribute to the end result: the strikingly low uptake of inventions into innovations. There are, however, some things that have been found to work in practice, regarding how to possibly moderate this situation and especially how to influence and guide the invention generation process as early in time as possible so that it may eventually fall in the second category and increase its uptake possibilities.

David Tennenhouse, Intel Research Director in 2001, provid-

ed a solution to this problem. Here is how Don Tapscott[18], in his Wikinomics best-seller, describes this process.

In the spring of 2001, for example, Intel established exploratory research labs adjacent to the University of California at Berkeley and the University of Washington in Seattle. Two more labs, near Carnegie Mellon University and the University of Cambridge (UK), were added later. Intel selected leaders in the research areas it wanted to explore who had a strong track record of collaborating with industry, and whose faculties collaborated well with one another. Each lab houses twenty Intel employees and twenty university researchers. "Company and university researchers work side by side," says Tennenhouse, "and communicate their findings instantaneously rather than waiting to present them first via formal channels, such as conferences and publications." Each lab has a unique research focus—from ubiquitous computing to distributed storage. When a promising research thread is detected, Intel puts a coordinated set of efforts in motion that includes additional grants to leading university researchers and the initiation of its own complementary projects. At the same time, Intel works closely with its corporate venture group to identify and invest in promising startups in each new sector.

The suggested direction is quite clear: set up a permanent, interactive and collaborative environment as early as possible, comprising both the skills required for the development of new ideas (university side) and for their market orientation (industry side).

Easy as it may sound and seem, experience says that there are significant difficulties and costs to incur. It is far more common for such attempts to fail than to succeed. A major cause of this is the cultural difference between industry and academia that results in a quite different value system and different priorities. Tennenhouse himself had ample experience in the pub-

18 Don Tapscott, "Wikinomics: How mass collaboration changes everything", Portfolio, a member of Penguin Group (USA) Inc., 2006, page 257.

lic research domain before assuming his position in Intel. This might have helped him effectively balance between the two worlds and create the required osmosis, a key condition for such a collaboration.

Such collaborative settings are very much facilitated and outright enabled by the communication technologies of our times. Yet, the cultural condition takes more time to mature and neutralise the initial intense repelling forces. The idea that you will just bring people together and something magic will happen usually does not work.

Still, if there is one clear path to tap into the vast invention pool and also affect the possibility that it is really followed up, it is through collaboration. The same magic word that builds open communities, open source software, open value chains, peer production, prosumers and all these many wonders of the IR 4.0. A powerful force of our times that faces an equally powerful counter-force: inertia.

Drawing the line

Innovation is not about invention. Invention, typically resulting in the course of research activities, is only a condition of innovation. So one may correctly assume that increasing our pool of inventions increases our chances of innovation. It is indeed so, but not, alas, in a straightforward and linear way.

Increasing the pool of our inventions will nevertheless have two positive effects.

On the one hand, it will increase the chances for radical accidental innovation. A small but rare breed of highly competent people and anarchic spirits are capable of this. They are gifted and able to see out of the big box and will hardly ever care to raise our attention. It is for us to track them down, single them

out and let them shed their light as they see best.

On the other hand, it will increase the size of the invention storehouse, which is a key raw material for innovations.

Still, the transfer from invention to innovation, or rather the guidance of inventions so that they may come closer to eventual uptake and applicability, is not a trivial one. Gloomy statistics of respective success rates attest to this fact. There are cultural conditions to be established and cost issues to be met to maximise the chances. Time will be required to develop a truly symbiotic approach; something common and no surprise per se for collaborative settings.

For example, IBM required a lot of time and many ups and downs before it managed to trim its patronising mentality and embrace the Linux and Apache open source communities as equals. The benefits were huge but came only much later in time. Similar issues apply also to making our rapidly increasing knowledge and invention store more usable and more useful. A long term strategy will be required here, fostering an open and permanent collaboration. Only such an ecosystem, pulled gradually together in a bottom-up approach and not forced in any top-down way, can provide for such a mechanism.

Let me now shift to the definitions adopted by the EC as laid out in key documents and reflected in the framework programmes for research. Soon thereafter I will move on to even more subtle categorisation issues.

Innovation in the EU framework programmes for research

In 2018 the EC published a series of documents[19] at the cross-

19 Commission Staff working document, Impact assessment, accompanying the document: Proposals for a Regulation of the European Parliament and of the Council establishing Horizon Europe – the Framework Programme for R&I,

point between Horizon 2020 (covering the period 2014–2020) and Horizon Europe (covering the period 2021–2025). This documentation includes a lot of impact assessment information and, in addition, seeks to uptake and make use of it in the design of the new FP, now called Horizon Europe.

Horizon Europe uses two terms: research and experimental development (R&D) and innovation. For R&D the definition found in the Frascati Manual[20] is used:

Research and experimental development (R&D) comprise creative and systematic work undertaken in order to increase the stock of knowledge – including knowledge of humankind, culture and society – and to devise new applications of available knowledge. The activity must be: novel, creative, uncertain, systematic, transferable and/or reproducible.

As regards innovation, the definition derives from the Oslo Manual[21] and is as follows:

An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations.

Arguably the above definitions account very well for the difference between invention and innovation that, as discussed in the previous section, I find to be absolutely essential.

Indeed R&D as defined here links clearly to the "invention" concept. It references novelty and several more attributes but does not reference applicability, although some link is attempted in this direction by the "*devise new applications of available*

laying down its rules for participation and dissemination, Part 1/3, June 2018.

20 OECD, Frascati Manual, Guidelines for Collecting and Reporting Data on Research and Experimental Development, 2015.

21 OECD/Eurostat, The Oslo Manual, Third Edition, 2005.

knowledge". Yet, this refers to a potential and the direction of application and not an actual uptake in application; this is inherent in any invention but does not equate with innovation.

Perhaps, a practical-minded person may here ask: but what is the importance of a potential without an actual uptake?

I believe potential alone has great importance, because actual uptake may not come at once; it may require long and tedious preparatory work. Because true and tangible results often require a long time-frame that cannot be accommodated in the three or four years such a venture may last. The whole trajectory of science attests to this claim. In 1675, Isaac Newton modestly epitomised this fact in a very succinct way: *"If I have seen further, it is by standing on the shoulders of giants"*.

This is a huge issue I touched upon in the previous section. Although we have to come to terms with the fact that it will not always be possible to push invention into innovation, we also need to make sure that we will do our best to maximise the chances of the applicability of research results, steering them to evolve into innovations, to the maximum possible degree.

This is something that, given the explosion of the research activity in our times and its actual very small eventual uptake in innovations, is a problem, an opportunity and a priority, all in one. It can be achieved through industry–academia cooperation, inter-research networking, etc. Though technically there may be many such enabling settings, collaboration will always be the key word. The enabler that will bring together all the many required skills to evaluate invention early in time and leverage it, when possible, in innovation.

Overall, I believe this definition is quite adequate; the research activity is meaningful, even if no tangible uptake can be, by design, secured by it.

Let me now move on to the innovation definition.

Importantly, contrary to the prior definition of R&D, this definition also includes a categorisation of innovation. It now uses the word *implementation* which points more directly towards actual uptake. However, I think the definition misses a highly important word here: *value*. Innovation is to generate value, added value, more than that consumed for its generation – substantially more.

I do not find that *implementation* even of *significantly improved* approaches reflects this value concept in a sufficient way. Value is always tangibly positive. However, all too often you can end up with something that has been technically improved to a significant extent, which, however, for a myriad possible reasons, it may not be possible to uptake and, therefore, comes with no tangible value. Such a thing does not constitute innovation. At most, it is again an invention, something new, which has yet a way to go to validate its potential for uptake in the real world. In any case, it is not an innovation.

I believe this definition is not value centred and therefore not adequate. It equates improvements with value. This is simply not the case. And, thus, it may easily evolve into a substrate for cognitive ambiguity and loss of focus.

In addition, it can be seen that the above definition also attempts some clear categorisation; it talks about products, processes, marketing methods and organisational methods, in various named contexts. I have two important points to raise at this stage and with regard to them: a technical point and a more substantial one.

Technically, it is interesting to remember that this particular categorisation proposed here has been inspired by the Oslo Manual, that has been jointly developed by OECD and Eurostat

since 1992 and used as the international standard of reference for conceptualising and measuring innovation. It has since been revised on three occasions (1997, 2005, 2018) to account for growing levels of adoption and to address evolving user needs. However, it is noteworthy that this categorisation of innovation has been explicitly and purposely abandoned in the latest version of the Oslo Manual, issued in 2018[22]. Even more, this categorisation change was one of the drivers of the current fourth revision of this document. Also, this edition of the Oslo Manual, justly as I believe, stopped using the term "significantly" on the grounds that the term is ambiguous. I will review this important document when going deeper into the innovation categorisation, soon hereafter.

More substantially now, I see this definition as missing the real purpose and diluting it by extending over to the many means and categories, which in the end overwhelm and blur the definition. The true purpose can only be to combine labour, materials and technology to generate novel social value; nothing less. One can combine one or more of those categories mentioned in the definition and still end up with no added value.

Overall, I find the definition to be inadequate. And, as I tried to stress, definitions in my view are very important. They resonate through the brain and heart of their recipients and shape their actions; it is not a matter of words alone but also of values. Thus, definitions subconsciously promote and pass down the values that have created them.

This definition cannot inspire, in potential innovators, the

22 I presume that the EC definition of innovation has been inspired by the Oslo Manual although not from its latest (fourth) version which, correctly in my view, has made some changes not introduced in the EC.

idea of "value", economic and social value – especially social value, as we are talking about publicly funded R&I. It will not help develop a new generation of innovators that will be passionate about value and not about improvements. Passionate about the end goal and not about the means.

It might be that our approach in the EU needs some re-tuning. We may need to go aggressively after a tangible social value and not be lost on the way, amidst the means and also, possibly, some questionable improvements.

It is now time to go into the categorisation of innovation.

Categorising innovation

Innovation typically comes to the joint benefit of the initiating agent (public, private or even public-private), as well as the hosting society. Above, I have tried to define the rationale of public research. Clearly, although R&I are both high on the agendas of the private and public domains alike, their priorities and points of view may well differ. Thus, the categories proposed below will need to reflect the purpose and the priorities of publicly funded R&I. Of course, they will largely overlap with the private domain point of view; but they will not be the same.

Arguably, there are many approaches in the literature suggesting different levels of detail to categorise innovation. For example, the Doblin approach[23] uses the so-called "Ten Types"of innovation,while the EC, as shown above, uses many fewer categories, and the OECD has further compacted them in its recent reports. I will refer below in detail to the OECD approach as I find it more suitable for my principal investigation here.

23 https://doblin.com/ten-types

Indeed, my key issue is what is the most promising focus for publicly funded research. A distinction between "product performance" and "product system" (two of the types of innovation suggested by the Ten Types approach) may be important for some specific decision contexts but will not provide any insight on how to approach and answer our key issue here; thus, adopting such a resolution would not come with a tangible benefit that would match the complexity of the increased categories. The very statement of purpose[24] of the Ten Types approach is as follows:

to help you analyze your competitive environment, and it can reveal gaps and potential opportunities for doing something different and upending the market.

This is a decision framework that will not help highlight the priorities for publicly funded innovation; it is therefore rather unfit for our current task.

I will now elaborate on the distinct categories of innovation which I find pertinent to the discussion here. Two of them are briefly reviewed in this section and two in the following ones, in further detail. These latter categories are those that I believe bear the potential to unleash the maximum public value and therefore deserve more attention.

The first category is what I would call *process* innovation: this typically aims at making things work in a more efficient way. This innovation is primarily for the benefit of the innovating organisation. A company developing a more efficient photovoltaic panel is bound to gain a significant competitive advantage. Of course, there will also be some social benefit but in this type of innovation this typically comes as a secondary effect. A production process innovation that reduces the operational cost of a

24 Ibid.

manufacturing plant benefits the plant and the organisation it belongs to and indirectly may also benefit society. However, if a process innovation comes in the form of downsizing, it is far from clear whether there is indeed a real benefit for society. At least in the short term it may not be so, as such a process innovation may also result in less employment. Even if downsizing may gradually and in the mid term result in a more productive allocation of the released resources, in the short term its social outlook will be bleak.

OECD/Eurostat[25] also includes this type of innovation and defines it as follows:

Business process innovation: a new or improved business process for one or more business functions that differs significantly from the firm's previous business processes and that has been brought into use in the firm. This concerns the different functions of a firm, including production of goods or services, distribution and logistics, marketing and sales, information and communication systems, administration and management, and product and business process development.

One may notice that the social impact is not separately considered in the definition above. Overall, process innovations are important to the private sector, and, in general, they also have a positive impact on society as well. However, as mentioned above, there can be serious deviations from this rule and a case by case investigation is necessary to figure out the impact on society.

The second type of innovation is *product* innovation. The emphasis is now on providing new features, new designs, perhaps new additional services for already existing products. Again, OECD/Eurostat also includes this type and provides the

25 Oslo Manual 2018, Guidelines for Collecting, Reporting and Using Data on Innovation, Fourth Edition.

following definition.

Product innovation: a new or improved good or service that differs significantly from the firm's previous goods or services and that has been introduced on the market. This includes significant improvements to one or more characteristics or performance specifications, such as quality, technical specifications, user friendliness, usability, among others.

Product innovation again aims at creating a market differentiation and consolidating the innovator's position in an existing market.

Product innovation is what is most intensely perceived by customers and citizens, because it is they who are now explicitly targeted. The ultimate success of this type of innovation will depend on this exactly: how customers and citizens will perceive, appreciate and eventually receive the new product and its new features. On the contrary, process innovation aims most of the time at internal enhancement and efficiency, which are likely to remain invisible or indifferent to the customers.

The social benefit of product innovation may again be important. It may come in the shape of more and better employment, economic development etc. Also, product innovation can hardly ever have a negative impact on employment and broader society interests, at least when compared with its process innovation peer and the increased operational efficiencies and pressure on employment this latter type comes with. However, as with process innovation, its value is principally to the interest of the private stakeholder and the society benefit occurs, in most cases, as a welcome side effect of the innovative activity.

As was stated when discussing the EC definition of innovation, the new edition of the Oslo manual has made a major change in the categorisation it proposes. Here is how it is put:

Compared to the previous edition, a major change for the definition of business innovation in this manual has been the reduction, informed by cognitive testing work, in the complexity of the previous list-based definition of four types of innovations (product, process, organisational and marketing), to two main types: product innovations and business process innovations. The revised definition also reduces the ambiguity of the requirement for a "significant" change by comparing both new and improved innovations.

Thus, the categorisation has been left with two only categories of innovation: product innovation and business process innovation. Indeed, I think mentioning the organisation and marketing innovation dilutes the uniqueness of the categories rather without adding something important to them. They are part of the process, if not processes themselves, and in some cases the product innovation. I see no value or clarity resulting from referring to them as something distinct. Thus, I think their removal is in the correct direction and well justified.

The essential market generating innovation

One may have noticed that till now the distribution of the innovation benefit between public and private interests has rested mostly on the side of the private sector operator. However, this balance completely shifts in the case of my third innovation segment: *market generating innovation* aiming at generating new markets. Market generating innovation addresses the so-called non-consumers, i.e. people that for a variety of reasons have not yet benefitted from a particular product or service, or are not even aware of its existence.

OECD/EuroStat does not consider this type of innovation separately. It is rather bundled together within the above "product innovation" category. However, in my view, there is

a major difference; I see here product innovations as referring to a given market, which is now provided with new and better variants of products it is already aware of. On the contrary, market generating innovations target so-called non-consumers. It is important to trace this line. Both cases may refer to new products; yet in the former case these new products are launched in existing markets whereas in the latter they are launched in non-existing markets, in markets that have first to be created.

The difference is not just a technical one. These two approaches represent fundamentally different scenarios and fully deserve to be considered separately. In addition, their structural differences are highlighted even more in the case of publicly funded R&I. Although in the general case market generating innovations produce massively more value than simple product innovations, there is one more reason they are even more interesting and attractive in the case of publicly funded R&I. This now larger generated value, when split between the private and the public domain, is more in favour of the latter.

Overall, seen from the interest of the public side, the benefits that arise from market generating innovations massively outperform that of any of the other types of innovation that I have highlighted above.

Why does this happen?

In their inspirational book[26], Harvard professor Clayton Christensen and his co-authors provide a compelling historical description of numerous incidents of market generating innovation and how they have not only benefitted their initiators but, far more importantly for the public domain, have pulled in a great number of subsequent investments for social infrastruc-

26 Clayton Christensen, Efosa Ojomo and Karen Dillon, "The Prosperity Paradox: How Innovation Can Lift Nations Out of Poverty", Amazon, 2019.

ture.

This was the mechanism that pulled the USA of the 19th century, and the Japan and South Korea of the 20th century, out of poverty and into prosperity, to mention just some of the best-known and archetypical cases. Market generating innovation is the story of Singer, Kodak, Ford, Sony and so many other global paradigm changers. And vice versa, the authors describe in detail the case of Mexico. This country, with the exception of corruption, scores well, even very well, as regards the key OECD indicators. In addition, there is an important local industry servicing the close-by USA market, something that presents one more advantage. Why is it then that Mexico is mired in poverty? The authors convincingly relate this to the lack of market generating innovations that are the only type of innovation that can pull in investment for social infrastructure. In addition, Mexico's focus on process innovation has resulted in the creation of many so-called global jobs, which may be easily moved out of the country, as recently Donald Trump declared he will do in the case of US industries located in Mexico and supplying the USA.

As a conclusion, it is market generating innovation more than any other type that generates and pulls in significant additional social value. Just because of the huge social impact of this kind of innovation[27] that, in the typical case, far outweighs the

27 Christensen provides a detailed description of how market creating innovation, triggered by their examples of Singer, Kodak, Ford etc., impacted US society; it was Ford who doubled the worker wages and instituted the five-day working week, something strongly criticised by the local industry and the press as subversive to the US economy. On that occasion, the Wall Street Journal accused Ford of taking a biblical kind of action in a completely wrong context! Another remarkable story is that of Amadeo Giannini, founder of the Bank of America, who mainstreamed the concept of credit for low incomes, while also introducing in wide practice the concept of the cooperative, to help small customers succeed in their marketing efforts. These are just some of the most striking and less obvious aspects of social impact. In addition, of course, to the more obvious ones: the rapid expansion of the road infrastructure, the creation

benefits to the originating innovator, the above authors justly refer to it also as market democratisation.

It is also clear why the public side should have a priority interest in this kind of innovation. It is market generating innovation, more than anything else, where social value arises not just as a by-product of private sector innovation but via a completely separate and powerful mechanism; by pulling in social infrastructure needed to support the generated, emerging market. At this point, it is also important to note that "pull" mechanisms are far more healthy and viable in the long term than the push mechanisms typically used by the EU, US etc. to provide aid to the third world. Unfortunately, no matter how good the intentions may be, it is often the case that push mechanisms like investment and aid cannot be sustainable because of the lack of the new and systemic market value that would permanently support its operation. Not rarely, push aid investment ends up being underused and generating more costs than the value it is supposed to provide.

Of course, there may be exceptions to the above; indeed, there have been process and product innovations that have created an unexpected positive social impact, or market generat-

of power plants, ports, schools, security systems and many other vital elements of social infrastructure.

This said, Ford and his peers benefitted hugely from the state infrastructure and especially the electrification project that was ongoing in his time and powered his plants. Undoubtedly, Obama made a very good point in 2012 when saying his famous "*you didn't build that*" while referring to the massive infrastructure that was delivered ready to use by the emerging corporations in the US, especially at the turn of the century and beyond. Most certainly both happened; these early corporations made critical use of public infrastructure while later, via a secondary and perhaps more sustainable mechanism, pulled in new infrastructure to support their operational needs and may, in some cases, have even funded it. Whether the wealth created in these processes was distributed in a fair way is a strongly controversial and political issue, beyond my concern in this treatise.

ing innovations whose benefit has largely remained within the yard of their initiating business. Toyota, for example, in its early years in post war Japan, pioneered a number of market generating innovations, such as cars especially designed to cope with the very poor road infrastructure of the country in those days. However, it is via its revolutionary just-in-time process innovation that Toyota made the global headlines and impacted in a rare way the global industry and its competitiveness.

Overall, however, there is ample empirical evidence and a vast amount of literature which confirm that such cases are only the exceptions that validate the rule. And the uncontested rule is the huge and unique advantage of market generating innovation towards social well being.

The long way of accidental innovation

A fourth type of innovation is what I have previously called *accidental* innovation. I think it deserves a special reference as it occurs along a completely unique path, and is not related to products, processes or markets, or very often, due to its disruptive nature, may relate to all three of them simultaneously. I have already extensively touched upon this issue in the section "Why public research?", where I raised the point that accidental innovation, due to its long term nature, its high failure risk but also its immense potential in the cases where it eventually delivers, is a privileged ground for public research. The private sector will rarely ever venture here; it perceives accidents as clearly negative and unwelcome incidents and, as a result of their high risk, cannot look into them as opportunities.

From ancient times, knowledge, at least among the elites, was perceived to be power. Archimedes used mirrors (according to newer research they might have been steam cannon

balls) to destroy Roman ships during the siege of Syracuse, from 214 to 212 BC. In the early years of humankind and for a long period, innovation occurred in rather ad hoc, non-systematic and essentially accidental ways. Later, in the Dark Ages, knowledge was degraded and was considered close to sinful while those pursuing it risked and often lost their lives. For, if all truth had been already revealed, what could knowledge-seeking have to offer? Why should it be practised? It was in the wake of the Enlightenment that science was revitalised, its foundations deepened and a more organised and planned approach to it started to emerge. In time, knowledge was once again rediscovered as a key to power. In 1620 Francis Bacon published a scientific manifesto entitled "The New Instrument" where he explicitly argued that "knowledge is power". Perhaps for the first time, someone clearly did not seem so much concerned about "truth" but rather about "power". That was maybe the first line ever drawn between science and technology. Here is how Y. N. Harari puts it[28]:

In fact, the relationship between science and technology is a very recent phenomenon. Prior to 1500, science and technology were totally separate fields. When Bacon connected the two in the early seventeenth century, it was a revolutionary idea. During the seventeenth and eighteenth centuries this relationship tightened, but the knot was tied only in the nineteenth century. Even in 1800, most rulers who wanted a strong army, and most business magnates who wanted a successful business, did not bother to finance research in physics, biology or economics.

It is only in the Industrial Revolution that things started gaining speed and coming together. More and more, science and technology moved out of the privileged domain of universities

28 Y. N. Harari, "Sapiens: A Brief History of Humankind", Harper Perennial, 2011 (in Hebrew), 2014 (in English), page 345.

and the workshops of some curious and affluent aristocrats. Innovation became more and more thoroughly woven in the business fabric and was acknowledged as a safe pillar of economic development. The need to highlight the details of the relationship of innovation with development perhaps led Schumpeter to trace in a most clear way the line between scientific products (inventions) and their actual uptake in the real economy and society (innovations).

Today innovation is a high priority and as such is meticulously planned by all its many stakeholders engaged in the process. Yet, accidental innovation will never cease to happen and to be disruptive. Our planning and prediction capabilities will always have limitations; Nicholas Taleb in "The Black Swan" elaborates on this point and concludes about both the inevitability and the disruptive nature of accidents.

We cannot plan accidental innovation; but we need to try tracking and encouraging its rare practitioners. We need to maximise the chance of such accidents happening.

Learning from the Kyoto Protocol and carbon trading

Let us not forget that human knowledge and skills alone cannot lead humanity to a happy and dignified life.

Albert Einstein

I will now try to give a further perspective on the idea, the practice and the potential of market generating innovation by drawing an analogy with the Kyoto Protocol and especially the carbon trade instrument that it instituted.

The Kyoto Protocol was first enacted in 1997 as an important extension of the 1992 United Nations Framework Convention on Climate Change (UNFCCC) with the overarching goal of re-

ducing greenhouse emissions. Among the various provisions made in this protocol was a mechanism allowing countries or various industrial operators therein to trade so-called carbon credits. This was named the "cap and trade" system.

Pollution trade was not unknown till that moment. Indeed, another cap and trade system had been introduced in North America under the framework of the US Acid Rain Program (1990). The target there was to control sulphur dioxide emissions.

All these schemes have a simple rationale. Combating a specific type of pollution does not come at the same cost everywhere in the world. In other words, a reduction achieved in a specific country at a cost may come at a much reduced one somewhere else on the planet.

Kyoto signatories undertake certain obligations as far as their emissions are concerned; these are then distributed internally to sectors of the economy or specific, mostly large and polluting firms. This is the "cap" part of the instrument.

However, in case they fail to meet their obligations the cap and trade system provides them with significant flexibility. They are now able to purchase carbon credits from other operators, anywhere in the world, who are below their quotas. Equivalently, under the cap and trade scheme, they are able to carry out environmentally friendly investments in the third world aiming at securing an atmospheric carbon reduction equal to their own excess. Due to the different levels of development and the associated investment cost structures, it is typically far easier and more cost efficient to achieve the same result in a developing world country rather than in a developed one. This is the "trade" part of the instrument.

Cap and trade has evolved into a large industry. The value

of traded carbon dioxide (CO_2) allowances sky-rocketed 250% in 2019 to a record high of €144 billion. The figure was pushed higher by the soaring cost of carbon permits in Europe's Emissions Trading System (ETS), which moved from €8 a tonne to around €25[29]. All this is a clear manifestation of the dynamism and the wide use of the instrument.

Cap and trade is often vehemently condemned by many environmentalists[30] as well as scientists[31]. Such systems are criticised for loss of focus, distraction as it is often called, and misdirection of resources away from the main effort of carbon reduction. Trading is profit oriented and overall will not solve the global warming problem, so goes the story. Besides, it can be easily manipulated and misused by private interests essentially violating the cap part of the equation.

I do not agree with this rationale; I find it rooted in the simplistic and old fashioned clichés about bad and profit-hungry capitalists. The world is, however, far more complex. Nobody ever said that cap and trade will solve the planet warming problem. If you lay upon it such expectations you will only be disappointed. The core rationale is not to reduce pollution but to make combating it more cost effective. In addition, the economisation of massive resources will not just result in capitalist overconsumption; it will also result in releasing a large part of these resources in new investment and in stepping up efforts

29 "Value of global CO_2 markets hit record 144 billion Euros in 2018: report", Reuters, 16 January, 2019.

30 Miriam Schroeder, "How Things Work: Carbon Trading, The UN University", https://ourworld.unu.edu/en/the-pros-and-cons-of-carbon-trading, 2020.

31 Onno Kuik and Machiel Mulder, "Emissions trading and competitiveness: pros and cons of relative and absolute schemes", Energy Policy 32 (2004) 737–745.

for the common end goal: cooling the planet down. As for the accusation of corruption and misuse, this can also be true. Yet, why does regulation provide greater safety than a market instrument? Again, I cannot see the point. Besides, I am confident that regulation alone will never solve the really tough issues, nor has it ever done so; human ingenuity is our best bet. And by transferring funds from inefficient pollution abatement into productive development activities, cap and trade is well in the correct direction.

In addition to this, there is also the foreign direct investment (FDI) and the resulting development benefit that very often arises for poor third world countries. The higher the cap and trade market, the higher this benefit. This is one more significant benefit resulting from this market instrument. Of course, pushing infrastructure in the third world is no guarantee per se. There are other parameters that will affect how this will impact the local societies in their war against poverty. Yet, if this is not always done, the cap and trade instrument is not to blame.

What is, however, the relationship between cap and trade and our innovation discussion?

Cap and trade is in essence underlined by the inherent ability of the third world to absorb investment in a more cost effective way, something that has a wealth of important results, as discussed above. Similar advantages apply in the case of market generating innovation. Market generating innovation can generate new markets in developing and underdeveloped countries far more easily than it can in the developed world. It can drag billions of citizens there out of non-consumption. And can pull in massive investment and social infrastructure of all kinds.

I would confidently predict that this innovation-driven, non-consumer oriented, new market development would far

exceed the impact of the cap and trade instrument. For cap and trade is essentially a cost reduction approach and rarely can cost reduction benefits outperform benefits resulting from an innovation-driven new market development. Also, the impact of cap and trade does not fully spread out in the third world. It is often diffused and consumed in the already developed world.

Just as cap and trade will not solve the global warming issue, market generating innovation will not address all our innovation needs. It will certainly not push the knowledge state of the art in all domains and fronts. Yet, the state of the art as perceived by our fellow humans in the third world may also deserve some attention. This is very different from ours, and our past successes and huge knowledge storehouse, when properly adapted, may give it a dramatic push, with an unprecedented wealth of benefits. And in doing so, it may also unleash resources into more high tech and future-focussed issues.

Working myself in the energy sector, which is more than any other linked to the cap and trade instrument and the analogy I attempt to introduce here, I have never really seen in the respective FP work programmes any attempt to address Energy R&I along the above line of thought. I am completely happy with the efforts made to challenge the carbon status quo, with all the many breakthrough attempts made, and perhaps we need even more of these. But there are also large amounts channelled into "efficiency" issues. These do not really challenge carbon dominance: they just seek some mitigation of its impacts.

I think that we have far better ways to do this than those we are currently focussing on and practising. With the mature level of our technological development, how much can we really expect from pushing the efficiency frontier in our developed

world?

Is it not far easier to harness far more efficiency in the third world? Will this not contribute to a better payback of our existing knowledge storehouse? Is the challenge to adapt our mature approaches in less developed environments not challenging enough as an innovation exercise? Will Albert Einstein look down on us as subpar innovators? Will the smiles on the faces of the Africans be less rewarding?

None of these.

Why then is it just not happening? Why do we turn our back on a clear win-win case?

As implied above, I think it is because we are trapped in an old fashioned definition of innovation that runs deep in our veins. One that comes with a lot of complex formulas and a great deal of abstract reasoning. Context adaptation of technology is not really regarded as equally challenging. How many universities have such courses? Few. How many MSc courses are available? How many R&I projects have it as their spearhead? Few, again.

We need to broaden our approach to innovation, make it less EU centric. This will unleash value for the global society. Indeed, even in the subtitle of this book, the idea of the public is proposed within this wider perspective; it starts from the EU but extends well beyond it, to the global community. The demographic realities and the persisting poverty in many places in the world are hidden opportunities for massive innovation and a subsequent welcome relief of the immigration pressures on the EU, to the benefit of all parties. It is the best possible way to practically meet these challenges in a frictionless and mutually beneficial way. They require, however, that we first put on a different set of eyeglasses.

Setting the priorities for public side R&I

To summarise the discussion on the segmentation of innovation, seen from the society point of view, market generating innovations come with a significant and unique social value. Seen from the business point of view, market generating innovation can again provide huge and unique advantages to business; it is a powerful complement to process and product innovations, and often outperforms them in benefits and profitability. In the meanwhile, the accommodating society not only enjoys the side benefits of market generating innovation but often experiences a surge of infrastructural investment that is put in place to support the new market. Besides, it is this very market from which it will be largely funded, in a sustainable way.

Accidental innovation will potentially also deliver significant and breakthrough value. However, due to its long term nature and associated risks, the private sector will hardly ever take action on its ground; the void must be filled in by public research. To this purpose, there are currently in the EU FPs some instruments called FETs (Future Emerging Research) exactly designed to address accidental innovation's inherent long term time-frame. I prefer the term FET to alternatives often used, such as, for instance, basic research. I think the term used better reflects the long term focus, which I see as what makes the real difference. The other dipole used, basic and applied research, does not highlight this essential time aspect. What was the Internet innovation, then? Basic or applied? Hard to say. The only certainty is that it was, to some extent at least, an accidental innovation.

Accidental innovators are a rare resource. Even well educated people may have difficulty tracing the line between vain

ventures whose failure can be safely predicted and those few able to touch upon and challenge the unknown in their yearning for creative accidents. In the same way that researchers in 1989 despised Tim Berners-Lee in CERN as someone completely wasting his time. I feel rather unable to define the essential characteristics of an accidental innovator. Modesty will be a trait but it will not suffice. I would consider it important to track and support this type of people; but I immediately realise this may be by itself a contradictory goal. There may simply be no way to track such hidden capabilities.

How do the EU FPs respond to the innovation categories suggested above? If their relative importance from the society point of view is as discussed, then one would have naturally expected public research to focus, as a high priority, on market generating innovation or equally on market democratisation. Is this really the case?

It takes only a limited knowledge of how the work programmes of the FPs are structured to realise that this is simply not the case. Very rarely is market generating innovation characterised as a priority; typically it is considered as a welcome by-product, at best hidden behind product and, especially, process innovations.

Market generating innovation is not even acknowledged as something necessarily distinct in the definitions used; and this, perhaps surprisingly, applies also to the OECD/EuroStat. This is in spite of the fact that for OECD the development of the third world has a special relevance; it would have been most natural to allow for such a distinct definition and priority, highly relevant for the prosperity of the third world. Of course, the fact that such a category is simply not there does not necessarily mean that its unique value is not fully realised. But a definition

that is unclear or even completely lacking will unconsciously shape the value system of its users; it will, thus, affect the rate and the success of its eventual uptake.

All this, despite the fact that market generating innovation is the innovation segment that has the maximum impact on and the greatest potential for society and should therefore be, by definition, a clear priority for publicly funded research.

There are some good reasons for failing to set such a target in the overall plan. The content and the orientation of the FPs' work programmes are typically designed by committees where academics and business people participate. I have personally had such an experience by being a member of the Energy efficiency in buildings (EEB) steering committee in the period between 2011 and 2012.

The academic community very rarely has any genuine experience in the domain of what I called above market generating innovation; it is far more familiar with the process type of innovation, improving efficiencies, measuring performances etc. Indeed process type innovation is based almost exclusively on engineering and scientific approaches; it is through them that it is mostly achieved. So, it is only natural that academics are, perhaps subconsciously, very much in favour of this type of innovation. This is what they know best; what they typically teach and work on, where they feel most comfortable.

Likewise, another common problem, especially pronounced in academia but extending well beyond it, is the extreme focus that good analytical thinkers, such as researchers, scientists, developers etc., place on the notions of technology and process. They are often overly absorbed in these aspects; they develop something like an erotic relationship with them. The mental challenge they overcame, the fulfilment they received,

the pride they felt: all these are overwhelming and beyond true control. Though all these are part of our human DNA, they tend, however, to blur the context and the circumstance of the true application. And experience says that all too often this is exactly what matters; this is what makes the difference between success and failure. And this is overwhelmingly so in the issue discussed here, the market generation innovation, which is mostly about adaptation to context and circumstance.

We often talk about customer needs that are not taken into account well enough. For some time I have been convinced that the term "need" does not say much; it is too passive a term. It is not about needs that people wait for someone to fulfil. It is far beyond that.

Professor Christensen calls this "progress". I was enlightened when I first read the term; it resonated well with me. It is clearly that. People are striving for progress and are not waiting for their needs to be fulfilled. Context and circumstance are key in understanding this progress. And, unfortunately, we are not well trained in figuring this out easily. As easily and naturally as Steve Jobs did, when he asked the famous question, "Why can't PCs just be quiet?".

Business stakeholders would normally have a more balanced approach and would more easily appreciate the benefits of market generating innovation. However, being in the same working environment with academics, they themselves have a tendency also to focus on process and product innovations. Besides, these can also be of a very high interest to them. It is not their business to think in terms of maximum social value. So there is a lack of incentive on their side; they are pretty well off with the current status quo.

Thus, at the crosspoint of these knowledge and incentive

shortages, we end up with work programmes where the idea of market generating innovation is practically absent and appears only as a casual by-product.

This approach undermines the ability of publicly funded research to unleash its maximum impact and benefit for society. And if society is the first and most important stakeholder of publicly funded research then this approach needs to be changed.

One could respond that market generating innovations are more suitable for less developed countries; that in the developed and saturated EU, generating markets may be more difficult and may have less potential.

However, why should EU innovation not, as a priority, target the global markets and their billions of non-consumers? Why should it opt to restrict to the EU markets alone? In a globalised world, there is no reason at all. I would consider such an idea as a legacy of the past, something that resonates nothing of the unfolding Fourth IR.

In addition, it is indeed realistic to assume that there are billions of non-consumers in the emerging economies. We have in hand the yardstick of the already developed economies. With its assistance we can easily detect and assess what is missing in the developing world and outline innovations to address it. This by no means suggests that there are not substantial non-consumers also in the western and the developed world. It will, however, require more effort and inspiration to find them. For, there is now no yardstick to help find the way; it is only a rare skill that can trace how technology is moving, touch upon society's latent needs that are entering the domain of feasibility and design the match; and then feel its gear for progress.

I would not be surprised if a human innovation capacity

trained to think in that way and underpinned by these values eventually ended up with even more market generating innovations than those for the developing world.

One more last point. Market generating innovation, inspired by the realities of the emerging economies, and because of the social infrastructure it gradually generates, would be the most decisive and far reaching help that the EU could ever deliver to these countries. Instead of the usual handouts that often turn out to be a sheer waste of money, market generating innovation comes with all sorts of multipliers that generate massive local impact and prosperity. Not least, this would also mitigate the significant immigration pressure the EU is currently experiencing with all the internal tensions and unproductive, if not outright subversive, division lines they come with.

How can one address this deficit?

My natural tendency is to opt for and try to suggest a bottom-up approach. I believe that these are far more efficient, should they be feasible. They are pull and not push solutions. They respect and build on each society's culture and competitive advantages (pull) and do not seek to enforce them (push). In fact, market generating innovations are a most pronounced case of pull activities.

Unfortunately, I feel that this is not easy in this particular case. Market generating innovation essentially targets, as said above, non-consumers. Therefore, it is impossible to have a not-yet-existing entity, non-consumers, placed at the centre of developing an alternative strategy.

As the academic community is not really in the position to formulate a solution here and because the business community has a rather limited incentive, the burden falls on the EC itself. It is best positioned to act as a catalyst, to elaborate and lay out

a new vision, concretely placing an emphasis on market generating innovation and steering the design of the R&I FPs to embrace this innovation segment and, in my view, to prioritise it.

This should start with its inclusion in the definitions and categorisation adopted. At this moment, market generating innovation is bundled together with product innovation, i.e. any product variant any company would launch to reap some business advantage.

I argue that a line should be drawn between them.

If something does not show up in the agenda, explicitly as a separate item, I have no hope that it will ever receive its due attention. As stressed previously in several instances, definition, purpose, decision and measurement all come bundled together. Without a clear definition for market generating innovations, along the lines discussed above, there can be no related strategy and no true assessment framework in place.

Research democratisation

We are going through a gradual transformation of the way business is done and value is generated. A flatter and less hierarchical model is showing up more and more in various aspects of social life. Though this flattening of hierarchies may be the driving force, the repercussions it comes with are of paramount importance

The idea and the practice of hierarchy have existed throughout human history but they have not always been pronounced in the same way. A growing size is what essentially made hierarchies more necessary. In democratic Athens sizes were small; 25,000 free and war-able males could easily convene and make decisions. In imperial Rome this option was just not there. The aura and the tradition of the democratic institutions contin-

ued to exist in varying degrees; yet their role was now much restrained and conditioned. Representation came to the forefront; democracy was pushed aside. This happened to such an extent that currently most people equate, subconsciously, representation and democracy. However, this was not always the case and in my view I see no fundamental reason why it should remain so. Under the same Fourth IR enabling forces, flat (democratic) decision making in societies is again becoming feasible just as it is gaining ground in the business context. There are no fundamental differences; the conditions to reinvent democracy are clearly here.

Big size was the key mechanism that generated hierarchies: their inherent command and control efficiency, and their practicality when it came to managing a large population. With few exceptions, size was highly necessary and, therefore, welcome as it was synonymous to survival and power[32]. In addition, it could only be moderated in an autocratic and non-democratic way, via emperors, kings, and various levels for intermediaries, set up to organise and execute an effective and multi-tiered command and control system.

I do not agree with another widespread idea, according to which hierarchies were something of a trick and a means of the rich to exploit the poor. Our time is my best proof. Rich people may still be here, perhaps richer than ever, but hierarchies, if not fading, are certainly weakening. Net corporates are, of course, growing at unprecedented rates. Conditions for oligop-

32 This is also not the case any more: the 10 richest countries of the world, in terms of PPP (purchasing power parity) have, all of them, a population of less than 10,000,000. This is a unique statistic, in the sense that one has to go 2,500 years back, to the polis of the Hellenic world, to meet again such a systemic possibility of the small to exist and to prosper (https://en.wikipedia.org/wiki/List_of_countries_by_GDP_(PPP)_per_capita).

olies are clearly there; they distort the markets and represent a clear threat that needs to be confronted with constant attention and due vigilance. But let us not be misled; this existence of the mega-corporation is one picture, but it is not the biggest nor the brightest of our era.

A networked and flat model gains in momentum more and more, and has taken its place next to the hierarchical one. They harmoniously coexist, while in many cases there is even a tighter symbiosis of them both. For example, the likes of Uber, Facebook, Amazon are built on a dual scheme: a strong hierarchy at the corporate core with millions of loose collaborators on the periphery, adding significant or even critical and indispensable value to the value delivery. Whether the flat network model will completely erode and outperform hierarchies and force them completely out of life, or whether they will keep on coexisting, because of the advantages hierarchies may present in certain contexts, is not easy to say. The unfolding trends are clear; where they will end up and how long it will take for them to settle down is not. And, after all, it may not be so important.

Technology transforms communications turning them into enablers of non-hierarchical models. It is the key enabler behind the emergence of this parallel and non-hierarchical business model. But I can easily assume that there are also some subjective conditions in place that favour its proliferation. For, non-hierarchies are often deeply appealing to a great number of people. This is what conventional wisdom suggests and this is also what the natural and radical emergence of this model manifests. Indeed, some distinct traits of this model, especially the freedom and control of time and space it extends over to its practitioners, are highly valued by many and even more by the so-called Net Gen. Of course, they may come at the expense of

a stable, predictable and secure lifetime job. Yet, they do form a clear alternative path that is preferred by many. Not to mention that the idea of a lifetime job is also not equally appealing across the whole workforce, especially its younger part.

Thus, at the crosspoint of objective enablers and subjective preferences and values, flat models are here to stay. And along with them, all the many critical changes they engender in society; openness and collaboration being the most obvious and constantly penetrating in more and more aspects of the economic and the social sphere.

The open revolution

The idea of being open, of sharing and collaboration, is deeply hard-wired in our genes; it has lived with us for a long time. Y. N. Harari considers the ability to collaborate in large numbers as the truly critical difference that pushed humans into the cognitive revolution, around 50,000 BC. Aristotle was perhaps the first to meticulously decipher this collaborative nature of man, stating that he who does not feel the urge to socialise is either a god or a beast; being perhaps a bit unfair to the pantheon of Greek gods, who were notoriously keen on socialising with gods and humans alike.

The idea of openness may, therefore, not be new; yet the diversity and level to which it is practised and experienced in our time is of a clearly unprecedented scale, qualitatively as well as quantitatively. It cuts deeply across numerous aspects of economic life; it profoundly affects the generation of value and, therefore, radically changes the broad social context.

The new collaborative model establishes itself as a third option between two large legacies: the "Do it yourself" approach and the "Let the others do it" approach. The new motto now is

"Let's do it together".

"Do it yourself" is what vertical integration is about. For good or ill, you decide that some specific activity is best done by yourself and is, therefore, vertically integrated in your organisation. "Let the others do it" is about outsourcing, i.e. you consider that you cannot, or may not or should not take care of the activity yourself and you'd be better off if you contracted it to some external entity or entities; one or more. The important thing is not really their number but their clearly defined relationship towards the outsourcer; she is their customer and they are her provider. Nor is it of any relevance if they form a sort of partnership or are convened on an ad hoc basis.

Both these business models and all their variants are deeply rooted in the hierarchical model. There is a vast amount of literature on how you select which fits a particular activity best. In the end, it is a matter of cost and, more importantly, also a matter of competitive advantage. And there are also some interesting stories illustrating how bad things can get, should you make the wrong decision. For example, in the early days of the PC revolution, IBM was devoted to assembling its boxes and had the operating system outsourced to the little Microsoft of the time. A decision it must have deeply and dearly repented, as before long it occured to all, Microsoft first and foremost, that the real power was not the vertically integrated box but, alas, the outsourced intelligence that it required to work.

However, vertical integration and outsourcing alike will keep you safe and well in the hierarchical world. The radical and disruptive nature of the "Let's do it together" lies exactly there: it takes you well outside the hierarchical legacy; in a new, bold and flat world of collaboration and openness.

It was never easy, nor without setbacks or all sorts of other

problems. For this open model does not just require some cost estimation or a good understanding of where the competitive advantage lies. It has always required and never ceased to ask for a deeper alignment of culture and values. More subtle capabilities such as self-confidence in yourself and trust in all others in the group. Along with, of course, a clear goal, where all can find their interests represented and not compromised.

The open model first manifested in the software industry. The spectacular development of the Linux operating system and the Wikipedia encyclopedia were among the earliest, most successful and best known landmark instances of collaborative development. They were the true champions of the concept. Yet there are so many follow-ups that it is risky to attempt any classification, at least as regards significance.

For a long period there was, within the ICT community, a strong resistance, often mingled with spite and sarcasm, towards anything that resonated with open source systems and software. This is the typical inertia reaction to anything new. Later, as the open source value overflowed outside the developing communities and started reaching customers and users, then there was a strong voice and demand raised on the customer side. At that moment, irony and scepticism started to subside. The supposed magic of the proprietary solutions, with which providers consistently tried to lock their customers in, was severely challenged. Sheer realism settled in; there was huge talent outside the company frontiers waiting to be harnessed. More and more it seemed that this was key towards drastically increasing the value proposition and leveraging it to new, previously unimaginable levels.

All this was too powerful to resist. It became mainstream and gradually dominated the software industry. Mastering

this large number of external third parties became not just a source of unique competitive advantage but changed the very way business was done. Amazon, Google, SAP and many more found themselves each with many thousands of external developers adding massive value to their offerings and, of course, completely flat communities such as Linux and Wikipedia increased exponentially. IBM CEO Sam Palmisano[33] explains this core aspect below:

Tapping global talent pools is not about arbitrage, but about capability. Yes, labour savings from global sourcing can still be substantial. But it's small potatoes compared to the enormous gains in efficiency, productivity, quality, and revenues that can be achieved by fully leveraging offshore talent.

There has been a stampede toward open standards, in part because customers are demanding them. Customers were fed up with being locked into each vendor's architecture, where applications were islands and not portable to another vendor's hardware.

And, of course, such open communities attracted big guys without compromising their equity norms in the least. IBM must have had a hard time, culturally at least, getting along with the Linux people and dropping a presumably hard-wired patronising instinct. But eventually it did so very well; and the payback was handsome indeed. Here is how Dan Tapscott describes it[34]:

If you drive a BMW, chances are it's running Linux. Hardware vendors sell over $1 billion worth of Linux servers per quarter—and IBM's hardware business alone was over $2 billion in 2006. Linux

33 Pete Engardio, "The Future of Outsourcing", Business Week, 30 January, 2006.

34 Don Tapscott, "Wikinomics: How mass collaboration changes everything", Portfolio, a member of Penguin Group (USA) Inc., 2006, page 104.

is growing eight times faster than the server market overall, and it has been adopted by big users like the People's Republic of China—a fairly large organization.

The new era collaboration is, of course, fundamentally different from outsourcing; the latter was exclusively aiming at cost reduction, whereas collaboration is there to harness and tap into new, unique value, residing outside your typical organisational frontiers and ready to engage and exchange with you. The idea of openness and collaboration may have been first nurtured within the ICT industry but has now moved well beyond it, into all sorts of domains, including the manufacturing and pharma industries.

Of course, collaboration in a context of bits and bytes is understandably easier to set up, than it is, for example, in the pharmaceutical or the manufacturing sectors. Yet, there is nothing fundamental in this; it is rather just a matter of time for the message to spread. Open collaboration is becoming widespread in all aspects and types of business.

It typically comes in two settings: either as completely flat communities (e.g. Linux) or as open communities of a large number of continuously evolving suppliers towards some central coordinating and typically assembling entity. While in the former case coordination may be largely automatic (even a mega open project like Wikipedia with hundreds of thousands of active editors only has something like 300 employees), in the latter case orchestrating the many suppliers is often a key part of the business, as these partners now deliver increasingly more and more of the end value.

Innovation and collaboration

I have tried to highlight above various aspects of the huge disruption that open and collaborative technologies are already producing. Jeremy Rifkin in his best-seller[35] comes to the point where he questions the extent to which market models and even property and ownership will ultimately survive the sharing revolution. Even in his book title he dares to allude to the eclipse of capitalism. Personally, I do not particularly agree with the idea of a supposedly impending eclipse of capitalism. In 2016, the Fortune 500 companies generated wealth which amounted to 40% of the global GDP[36]. On the other hand, there is no doubt that our era is vastly different from the time of the industrial revolution. Small can truly exist today – in a competitive way, not at risk of being swallowed up by the big. And to make things even more complex in many cases, there is even a synergy between small and big (Airbnb, Uber, etc.).

Then there is a matter of subjective appetite. It seems that this emerging reality greatly and often unexpectedly appeals to a lot of people. This is why, not rarely, high ranking executives move out of their jobs into more boutique frameworks. Even the mighty banking sector is not left outside this trend. Banks, offering lucrative jobs, complain more and more about a lack of talent, as increasing numbers of highly qualified and skilful young people opt for boutique settings[37].

35 Jeremy Rifkin, "The Zero Marginal Cost Society: The Internet of Things, the Collaborative Commons, and the Eclipse of Capitalism", Palgrave Macmillan, 2014.

36 http://fortune.com/2016/07/22/global-500-in-6-charts/

37 Ed Hammond, "Small proves beautiful at boutique banks", Financial Times, 16 March, 2014.

Thus, there is no doubt that such collaborative models are rapidly emerging and a sharing culture is settling in. I do not think it will challenge and eventually outgrow markets. I do not see enough evidence for this. Yet the fact remains; sharing and collaboration are here to stay, to shake and challenge the 20th century legacy.

And all these emerging trends need to be taken up in innovation policies; not as a side issue but as a central and strategic point. And one important step further: perhaps openness, sharing and collaboration should now be positioned at the centre of a publicly funded innovation. Because it is these models that, more than any other, overflow value out of the corporate frontiers and into society. Because they directly address and benefit society: consumers/citizens and businesses alike.

We saw above that business will always be keen to look into traditional process and product innovation, something of course well understandable. We argued there that market and not process innovation is what maximises the social value of innovation and should, therefore, be the priority for publicly funded R&I.

In light of the discussion on openness and collaboration, one can now further extend this rationale and suggest a second clear priority. Business will always look into the optimisation of its closed value chains. But I see no reason why the public domain should be so much concerned and prioritise such value chain considerations. Instead, I believe the public value should be rather sought in the direction of open and collaborative networks and not strictly defined corporate value chains. Would not such networks drastically maximise the social impact of innovation? Would they not actively engage the greatest possible number of actors? Would they not, because of the many

skills available internally to the network, offer the best chance to push invention into innovation? Are they not the favourable ground for public domain innovation investments? We need to constantly keep in mind that in a context of scarcity one has always to make selections and set priorities.

Indeed, I believe we have enough evidence and reason to consider that open and long-term, collaborative research is exactly what maximises the social impact and generates value that flows out, well beyond the frontiers of the initiating organisations.

There, where society lies.

The fluid frontier of collaboration

As with all new paradigms, there is a long and tedious transition and adaptation period ahead. New things will evolve, others will phase out or will need to be drastically redefined. I would single out two major aspects of collaboration that will necessitate that current practices undergo a major re-engineering.

The first aspect of collaboration is the need to invent new ways to monetise the value one brings to an open community. The unique feeling of contribution to a common cause is a good starting point but will not suffice in the long run. We will need a brand new and far more versatile formulation of intellectual property rights. The current approach to them, as developed within the current vertically integrated model, is clearly inadequate. This often results in great tensions as creators feel that their work is left unprotected and exposed, while value contributors may also think that somebody else is cashing in on their ideas and effort. A very typical but far from unique case is the music industry. It often feels threatened and, prompted by the dominant old model, resorts to legal action. A new modus

vivendi is lacking, one that can provide for the interests of the creators without compromising the reach of their creations. Although it is too early in time to safely predict where and if the frontiers between openness and property rights will eventually settle, a new, innovative and practical perception of intellectual rights will play its role in shaping this fluid boundary.

A second key issue is related to the organisation models that we need to adopt to support collaboration. Models that are flatter, more granular and fluid, and able to orchestrate communities, thus producing a much more collaborative workforce for value creation. How can the workplace emerge into a self-organising entity, and how can flat organisations and self-regulated approaches gain momentum over their centralised peers? At this point it should be noted that even corporates come to realise the power and uniqueness of self control as a means for thinking out of the box. Google was among the first to build on this and take it a step further by instituting the so called "20% time" policy, whereby employees were "free to pursue projects they are passionate about and subjectively think they will benefit Google". However, though this policy was credited for some important innovations, it was later pulled back as it was subject to the discretion of management approval.

For sure, embracing collaboration is not going to be a straightforward process.

In the meanwhile and as things constantly unfold, it will not be easy to discern what exactly is in place in every circumstance as both models, closed chains and open networks, will coexist, mix and constantly evolve.

To add to the intrigue, one can at this point note a third case of open collaboration that is also gradually settling in.

It is called prosumption.

The pervasive prosumption

If in the case of collaboration, as discussed above, there is a fluid, collective intelligence to be harnessed, prosumption targets a crucial type of external intelligence: the prosumer intelligence.

The term prosumer stems from the merger of producer and consumer; indeed, this is the perfect way to define its essence. For a prosumer is a consumer who is also a producer. As simple as that.

One could argue that it is now a long time since customers were first invited to give their views, and to request specific configurations and adaptations of the services or products they have or plan to purchase. Indeed, all these practices have a long legacy; yet this is not what defines a true prosumer.

There are two typologies of prosumption. The first one is when citizens get together on an ad hoc basis to provide a solution to a problem they encounter, typically but not necessarily of an urgent nature. Such was, for example, the PeopleFinder project that was launched in a totally bottom-up way in the US, following the devastating Hurricane Katrina, in the summer of 2005. The technical set-up was done in just a week, engaged several thousands of technology savvy volunteers and provided critical help to people in search of their loved ones, in the aftermath of the disaster. The platform katrinalist.net served hundreds of thousands of inquiries and provided unique help. And all this set up in less than a week's time.

The second typology relates to engagement of consumers in the core of a product design process. An early and relatively advanced case of such a prosumption has been reported for the Lego product manufacturer. In 1998 the company launched a product series under the brand Lego Mindstorms: robots made

out of programmable bricks that could be turned into two-legged walking machines. No prosumer concept was used at that time. On the contrary, when the company became aware and realised the level of tinkering, hacking and reverse engineering that was going on among its customers, its initial response was that of lawsuit threats.

Only at the very beginning, however. Soon Lego executives ventured outside their cognitive inertia and started taking a different look at what was happening. In a very short time, what they had initially seen as an infringement of their intellectual rights was perceived through a different lens; as a unique source of competitive advantage. Here is how this has been reported[38].

The company benefits hugely from the work of this volunteer business web. Each time a customer posts a new application for Mindstorms, the toy becomes more valuable. Lego senior vice president Mads Nipper calls it "a totally different business paradigm." "Although users don't get paid for it," he says, "they enhance the experience you can have with the basic Mindstorms set—it's a great way to make the product more exciting." We've always thought that Lego ought to make its most passionate devotees part of its design department. And when it came time to develop a new version of Mindstorms, NXT, in 2005, that's exactly what the company did, by taking four of its most prolific users on as de facto employees for the eleven-month development cycle.

What Lego did more than 20 years ago is now practised systematically and with an increasing diversity. Engaging consumers in the design process, or co-creation as it is often called, is constantly evolving into a mainstream practice that assumes an ever increasing number of roles, on the side of the prosumers.

IBM has been a pioneer in embracing these open approach-

38 Don Tapscott, "Wikinomics: How mass collaboration changes everything", Portfolio, a member of Penguin Group (USA) Inc., 2006, page 195.

es. It started with a sincere and deep endorsement of open source software, especially via its highly successful engagement with the Apache and Linux communities. Acquainted with the idea and the culture of openness, it also expanded this to co-creation[39].

IBM seeks to engage citizens in the innovation process. A new term has been coined to describe this emerging process: co-creation. Co-creation claims that the role of citizens in the innovation process can be significant and multi-fold. As explorers, where they discuss emerging and existing issues. As initiators, where citizens may conceptualize novel solutions to well-defined tasks. As designers, where they may design and develop implementable solutions to well-defined problems, including regulatory amendments. And, last, as diffusers, where citizens can think, test and feedback on technology or policy innovations. Similarly, private investors may launch ideas and monitor the response or the activity of the community.

There is a new, clear trend in innovation, built on well known empirical evidence that highlights the implicit knowledge that consumers/citizens possess. Investing in this knowledge has been a strategy for companies for a long time. Recently, however, as illustrated in the above IBM case, this has received increased attention, diligence and sophistication. Regardless of its type, ad hoc or systematic, co-creation has been empowered by the advanced communication of our time, which is what allows companies to engage early and systematically in the design process with their consumers, leveraging them into prosumers.

Though communication technology is the enabler, the true value of co-creation lies in two types of knowledge that citizens and consumers are often in possession of. On the one

39 IBM services, "The power of co-creation",19 July, 2018.

hand, they typically have scientific and technological knowledge such as that harnessed in both examples above. However, even if consumers lack scientific knowledge they may still have abundant and unique empirical and experience-based knowledge. Tapping into this type of implicit knowledge can also be a source of significant value. Besides, any product is not just a technological construct. It comes with aesthetic, usability, friendliness and modularity aspects, just to name a few. In all these requirements and specifications, this latter kind of empirical knowledge can be most pertinent.

Prosumption and social innovation

There are a number of terms coined to describe this new consumer/citizen deep and early engagement trend. This, in my view, only demonstrates that despite the rapid expansion of the paradigm we are still at the onset of it and at the beginning of our respective learning curve. Besides the terms prosumption and co-creation (as used above), the trend is often referred to as citizen science, social innovation, etc.

Although prosumption is perhaps the best fit for illustrating the idea from the private sector point of view, social innovation may be more suitable to express the same general idea, when seen from the public side point of view. It is also semantically closer to my investigation here, about public research. For this reason, going forward, I will refer to this practice as social innovation.

Social innovation comes with a distributed knowledge benefit and is equally pertinent to the case of public funded research as it is to innovation originating from the private sector, such as in the examples discussed above.

We should remember that this knowledge benefit has two

facets, or comes in two packages: formal-scientific knowledge and implicit-empirical knowledge. Human environments where the former knowledge is prevalent, such as those of the FPs, very often have an unfortunate proclivity to play down the latter kind of knowledge. Yet, the history of human progress would not agree with this approach. Just as Newton, Laplace and Einstein have left their mark as great scientists, similarly there are many game changing market generating innovations, referenced in previous chapters (Singer, Ford etc.), that have originated from people short of academic qualifications. People that were of poor origins and often school drop-outs. Still, this did not prevent them from generating unprecedented and innovation-driven social impact. This, of course, is by no means to play down the importance of education and theory and formal qualifications. It is rather to highlight the parallel path; that of massive and untapped empirical knowledge, and the need for these two worlds to reckon with each other and harmoniously coexist.

Social innovation, in the multitude of terms used to describe essentially the same thing, is something that can more and more be traced in the FPs. And this is a good sign. But it may still not be adequate. For, in my view, social innovation is not some activity for socioeconomic scientists to experiment with; it is a philosophy that must underpin the whole of the innovation effort and the publicly funded R&I programmes. It is a vital space that first needs to be created in order for society to innovate.

In the case of publicly funded R&I, besides the knowledge dimension there is one more aspect of social innovation that deserves some attention. Fostering the idea of citizen participation and acknowledging the unique formal and implicit knowledge that citizens may possess allows us to extend the same

rationale to the sphere of decision making and democratic citizen engagement. Something which, again, is to the almost exclusive interest of the public domain.

The broader relevance of social innovation

Citizen engagement is widely acknowledged as a necessary condition for reinforcing democracy in the EU. I do believe that there is a big open issue here; it suffices to take a look at the dropping election participation rates, which is just one symptom of a much broader citizen disenchantment. The ongoing surge of multifold populism is another clear symptom. Upon what does populism thrive if not on an uninformed, uninterested and disengaged citizen?

The topic is highly important and I would say even vital for the future of the EU. I will refrain from going into any other details here, as I believe this premise is widely acknowledged.

It is, however, interesting to note that citizen engagement, as a response to this democratic deficit, is underpinned by the same principles as social innovation. In consequence, social innovation holds the potential for one more line of impact, as an efficient means to reinforce democracy in the EU. It will, thus, unleash value in two distinct directions: first, by capitalising on the unique value of the formal or empirical knowledge that citizens are in possession of, and second, by fostering democracy and citizen participation.

Overall, this trend could lead to what I would, quite naturally and in order to keep the analogy with its market peer, define as research democratisation. And it would be underlined by an increasingly sophisticated and diverse role of citizens in the innovation and civic society processes alike.

In the end, social innovation is a mindset; one that restores

the balance between theory and practice, between experience and abstraction. Not everybody looks forward to such a balance restoration and the power redistribution it will necessarily come with. As with any true change, inertia forces will be there, to remind us how powerful they are. Because of this, true social innovation will not be easy to achieve.

Joseph Schumpeter, deeply aware of both worlds – of theory and practice, as well as of the great distance that often separates them – would no doubt agree on the many difficulties and pitfalls to be expected on the journey towards change.

Finally, in talking about social innovation I would like to issue an important warning signal. There is a risk that social innovation ventures may result in shallow and short term approaches that run after some project only to soon go out of steam and extend a hand for more public support, in search of the next project. A problem that once again highlights how critically important definitions are.

Indeed, social innovation can be easily misinterpreted and equated to some sort of state subsidised welfare action.

This would be a grave misunderstanding. My argument and my effort here have been to highlight that social innovation can result in innovative and sustainable value generation. I see little purpose in disguising a welfare action as social innovation. Not because welfare is something bad but rather because social innovation is not about welfare; and if it is equated with welfare it is then simply spoiled and misunderstood, and its potential goes wholly untapped.

Unfortunately this rather narrow perspective is also to be found in the recent version of the Oslo Manual (2018). Social innovation is there[40] defined as:

40 Oslo Manual 2018, OECD/European Union, 2018, page 252.

Innovations defined by their social objectives to improve the welfare of individuals or communities.

This definition fails to clearly highlight the acting role of society and restricts it to a beneficiary in terms of welfare improvements. It therefore falls short of touching upon the true potential of social innovation.

Social innovation is a radically new way of doing good old-fashioned business. It should have resources, strategies, time-plans. Its stakeholders should have their skin in the game and they should target profits that will ensure their sustainability.

Social innovation is about measurable value creation and not about cost generation.

How energy transition propels collaboration

The EU is moving with determination on the path towards energy transition. The European Commission[41] has clearly set out a plan for a climate-neutral and zero-emission society by 2050.

It would not be an exaggeration to say that the EU is leading the way to a climate-neutral future, although China is fast adopting a similar approach – not only by evolving into the major PV manufacturer on a global scale, but by also endorsing ambitious, mid term transition policies.

Similar patterns are emerging in the USA. Although there is strong resistance from various vested interests deeply rooted in the carbon economy, it is nevertheless important to under-

41 Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee, the Committee of the Regions, and the European Investment Bank: A Clean Planet for All – A European Strategic Long-Term Vision for a Prosperous, Modern, Competitive, and Climate Neutral Economy, November 2018.

stand the importance of the paradigm set and the message sent by major states like New York, Texas and California, which have made their strategic decisions in favour of green technology and are moving decisively in that way by gradually divesting out of the carbon economy and its infrastructure, and endorsing the green technology alternatives.

The energy model has always played a key role in how business models and even social life is structured. In the 19th century, the coal and steam based energy model demanded vertical integration to achieve economies of scale and face the huge investment challenges of the era. Vertical integration persisted also in the 20th century with the emergence of the oil, road and automotive based economy.

If the unfolding energy transition moves decidedly in the direction of renewables, as all evidence seems to suggest, then the vertical integrated, big corporate model, dominant until now, will be once again challenged. For renewables are by their very nature distributed; they are laterally and not vertically scalable.

The repercussions of this development will be paramount; they will favour decentralisation and openness. And this will affect the business models as well as governance. Collaboration will be inherent in this model, while decentralised governance will also be dramatically empowered.

Simply put, the type of infrastructure that will emerge in the post carbon era will constrain and empower both governance and business models. In a distributed energy model decision making will necessarily be less centralised. Business-wise this will promote a distributed energy model while society-wise it will favour governance based upon local democracy and peer assembly.

At this point, it is important to underline that this development is a separate path, and not one resulting from the massive spread of communication ICT/IoT technology. Of course, for myriad reasons we need a post carbon concept but this could have very well still emerged around centralised technologies; such as, for example, fission, or even a centralised approach for large scale renewable deployment. In that hypothetical case, where such approaches would have been a viable alternative for the post carbon era, we could well have ended up with ICT/IoT pushing for decentralisation and the energy model pushing in the other direction.

This is fortunately not the case. Distributed renewable deployment that, according to all evidence, will be the basis of the emerging new energy model is just as much in favour of decentralisation as is ICT/IoT. It is the second, independent and equally disruptive pillar, inherently supportive of openness and collaboration. And in this way, it is also more comfortable and compatible with democracy and true citizen engagement, when compared with other green but centralist approaches.

A final note on the emerging economies, pertinent to our innovation discussion, in the light of energy transition. Green infrastructure pulled in developing countries by market generating innovations will allow them, in many instances, to completely bypass the need for costly carbon infrastructure and/or avoid its costly decommissioning. Market driven innovation and the host societies have only to benefit by placing a clear priority on identifying such potentially unique opportunities.

The EU FPs centralised model

At this point, I will link to another discussion in the EU as regards the rationale of a centralised approach to the R&I activity, un-

der the umbrella of the EU FPs. Is it really the best approach to maintain this centralised action or would it be perhaps better to use at least part of its funds to strengthen R&I at a more decentralised, national or regional level? So goes the question.

In EU terminology the legal basis for this centralised action in R&I falls under the principle of subsidiarity, a core concept of the EU founding treaties. Its purpose is to *"safeguard the ability of the Member States to take decisions and action and authorise intervention by the Union when the objectives of an action cannot be sufficiently achieved by the Member States, but can be better achieved at Union level, by reason of the scale and effects of the proposed action".*

What is, however, the official narrative for this "scale advantage" that results from centralised action, in the particular case of publicly funded R&I? In other words, what is the justification for the EU FPs and how exactly does the European Commission explain the "reason of scale" it calls upon as their legal basis?

The EC has developed models and conducted several macroeconomic simulations that evaluate scenarios of centralised and decentralised action in R&I. I will review some of these (NEMESIS) in the second part of this book, as their main purpose is to assess the impact of these programmes, which is among the key issues in Part 2. These models are also used for justifying the scale impact of the EU FPs. And, indeed, they do provide this justification, as they explicitly calculate a significant positive impact of the current centralised action in macroeconomic terms, such as GDP and employment growth. Thus, the principle of subsidiarity can be justly called upon as a legal basis for the FPs.

However, there are several other aspects that presumably are not accounted for in these models. First and foremost,

the intrinsic value of networking and the great potential that may result from far more and far more diverse collaborative schemes, as compared to an alternative action at a national level. Of course, this idea takes us once again back to the quest for a genuine strategy for collaboration and its great potential. I cannot help but believe that this is currently vastly underestimated and, therefore, rather unlikely to have been accounted for in the macroeconomic modelling. Secondly, I would say, by reason and experience alike, that there is also an important and multifold learning effect, where less experienced countries learn from more experienced ones. This further adds to the benefit of centralisation.

To keep it short, I believe that the impact of centralised action in R&I is far bigger than what is currently accounted for by the macroeconomic modelling. Even more importantly, I am convinced that this impact could be even more significant, should the collaborative model really be established as a strategic and not an accidental dimension.

Because of its huge collaborative potential, only a part of which is currently harnessed, I am a staunch supporter of centralised action and a believer in the great added value that results from moderating research in such a way. Likewise, I would welcome a further transfer of decision power and financial resources to the EU level.

I understand that initially it may sound somehow self contradictory; endorsing a centralised scheme to support decentralised collaboration. However, this is only the case on a superficial level. Because the collaborative model does not exclude a strong node that orchestrates the activity; I have referred to this possibility previously (see "The open revolution"). Nor does it entail any inherent disempowerment of the peripheral

nodes. Of course, the orchestrating node needs to be exercised under the mandate to maximise the network value and not to build a local advantage, driven by self interests. This is always a risk in such settings. But the risk is not enough to invalidate the main idea: centralised R&I in the EU comes with a great potential to unleash unique collaborative power.

In fact, R&I is one of the very few activities that I still see benefitting from central, pan-EU coordination. And this is a rare exception, indeed, to what I see otherwise as a need for a fast scale up of decentralisation.

The EU FPs consortia as precursors of collaboration

The EU FP R&I projects are typically carried out by consortia, i.e. partnerships of several organisations that come together in a joint effort. One could for a moment think that such consortia could sow the seed for true and long term collaborative networks.

When a bidding consortium is set up one typically has more short term priorities to observe: to fill in skills to provide for some specific vital roles and so on. The FP collaborative consortia are, therefore, typically formed with a short term perspective and in an ad hoc way, depending on the project requirements and the need to secure adequate representation and engagement of all stakeholders. Yet, in a world fostering collaboration as a high priority, I would perhaps expect that from at least a few of these ad hoc collaborative settings would emerge something resembling a collaborative ecosystem.

Unfortunately, this rarely ever happens. These partnerships rarely ever have any persistence in time. The bidding consortia are no precursors to the collaboration paradigm whose strategic importance I have tried to highlight above. Their life-cycle

does not resemble the dynamics of truly collaborative networks.

I would even dare to say that they are not encouraged to emerge into anything close to my collaborative paradigm.

In my view, this only manifests the lack of a clearly collaborative mandate. This is a shortcoming that I will revisit in the second part, to discuss means for overcoming the current practice and incentivising a mid-term and network-oriented approach.

The skills of the collaborative innovator

True collaboration will urge us into a new realm. It will not require just a quantitative adjustment but, rather, a radical cognitive change. We will need to revisit the skills necessary for innovation. Innovation is not just about the ability to dig deep. It is not even primarily about that. Yes, a good awareness of some thematic areas may be helpful, so that one is in possession of analytical thinking tools.

But, no, innovation is not foremost about analytic thinking. This is what invention is mostly about. And invention is a different thing.

Innovation is mostly about lateral thinking, peripheral vision, about the ability to reach out to other disciplines, cross-fertilise concepts, create associations among them. It is about questioning, challenging, thinking out of the box. It is also about networking and exploring.

It is about collaborating.

This skill-set will provide the opportunity to associate things, to see all that was previously hidden. Unfortunately, such skills are not really taught – something that takes us back to the inefficiencies of the educational system. In fact, it is the abstract and deep thinking values of education that are inherited in the

EU FPs.

Can these be really taught? Or is it more about some gene embedded inclination?

Absolutely not. Jeff Dyer[42] explains that what he calls the innovator's DNA is predominantly about behaviour and not intelligence. And behaviours can be fostered and taught more easily than gene intelligence can ever be altered.

Finally, there is a gross misunderstanding in place, suggesting that if you bring together people from different disciplines you will magically provide for this vital, lateral and multidisciplinary dimension. This approach does not question the nature of the human skills; it accepts the current status quo and, at most, perceives multidisciplinarity as the combination of skills required every time.

No, it will not work. People that only command deep thinking will remain there, stuck in their tunnel-like thoughts, incapable of reaching out and associating. To create interdisciplinary approaches you need genuine, interdisciplinary, T-shaped individuals[43] with a strong empathy antenna towards other ideas, approaches and people; and not just artificially set-up multidisciplinary teams.

We have missed the fact that knowledge, as often infrastructure itself more and more, scales up laterally, and not only vertically. This is especially relevant in our times, something already reshaping and transforming everything and unclear where it

42 Jeff Dyer, "The Innovator's DNA: Mastering the Five Skills of Disruptive Innovators", Harvard Business Review Press, 2011.

43 WhatIs.com, "*A T-shaped employee, in the context of human resources, is an individual who has deep knowledge and skills in a particular area of specialization, along with the desire and ability to make connections across disciplines.*", https://whatis.techtarget.com/definition/T-shaped-employee.

will eventually rest. This is what we have missed, and what we need to restore at centre stage. Only then will the collaborative world emerge in its full breadth and potential.

Only then will value chains naturally emerge into networks and customers into co-creators.

Till then, social innovation will be a new discipline but not a pervasive and all-applicable methodological concept. And through such a narrow perception it will, in a way, contradict its very purpose.

The interesting case of the European Investment Fund (EIF)

At this point it is worth mentioning some promising and innovation related EU initiatives taken by the EC in cooperation with the European Investment Bank (EIB). Although not exclusively aiming at research and innovation they have nevertheless included and have been supportive of such a dimension. And have done so with some noticeable success.

One of the first steps was the Joint European Resources for Micro to Medium Enterprises (JEREMIE) programme, part of which generated a public leverage to private capital investments on technological innovations across the EU, including first time innovators and start-ups. The successor of this promising start was a series of initiatives under the European Investment Fund (EIF), a public–private partnership, specialised in risk financing of small- and medium-sized enterprises across Europe.

Through EIF's programs, a number of independent private or public intermediaries (e.g. business angels, venture capital funds, investment and financing institutions etc.) in different EU member states have the opportunity to share the high risk

of investment in technological innovations and start-ups with a strong partner that is supported by EIB, EC, along with private and public financial institutions, who are the shareholders of EIF.

Here is how the InnovFin equity programme of EIF states its purpose[44]:

to provide equity investments and co-investments to or alongside investment funds, focusing on companies in their early stages of development, operating in innovative sectors covered by Horizon 2020. The aim is to develop an extensive portfolio of funds, mobilising a total amount of EUR 4–5bn worth of investments in businesses established or active in the EU and Horizon 2020 Associated Countries.

EIF's initiatives are not limited to equity investment programmes, but also include guaranties, credit enhancement, debt issuance, and "inclusive finance", a micro-finance instrument that is addressing a fundamental challenge: 99% of EU start-ups are micro or small enterprises with one third of those being founded by unemployed people who are facing difficulties in accessing the traditional financing channels.

Although the scope of EIF extends well beyond innovation, its approach has succeeded in somewhat lowering the barrier to entry, unlocking more opportunities that otherwise wouldn't have been attractive to the private sector. Moreover, the initiative contributes to inclusivity and social cohesion and often converges with country- and sector-specific initiatives, creating powerful synergies. EIF proudly reports[45] more than 1.4 million SMEs and more than 7.5M jobs having benefitted from its finan-

44 http://www.eif.europa.eu/what_we_do/equity/single_eu_equity_instrument/innovfin-equity/index.htm

45 http://www.eif.europa.eu/

cial instruments. Among these SMEs there are some remarkably successful start-ups that origin from the periphery of Europe. Countries such as Greece, with high tax and social welfare burdens on entrepreneurship, immature start-up financing ecosystems and a fluid political and institutional environment, are greatly challenged in growing and maintaining internationally competitive innovative business. It is in this context that EIF's programs have enabled the emergence and growth of highly successful start-ups such as Taxibeat and Workable, whose unique business model has connected a network of stakeholders in an innovative collaboration model.

As discussed above, the success rate of innovation is very low (one to two successes for every 1,000 attempts). This disappointing figure combined with the lower R&I expenditure of the EU when compared with the tigers of Asia and the innovation locomotives of the US creates a clear competitive disadvantage for the EU. In this context, EIF's initiatives and approach deserve some attention. They may not extend over accidental innovation or pure research targeting inventions; however, they have achieved some noticeable business success, social engagement, innovation democratisation and collaborative models. There is no reason why they could not also extend over to market generating innovation.

Refocusing publicly funded innovation

I will attempt below to provide a taxonomy for public R&I. What are the types of activities that should be put at the centre of an innovation strategy, on the sole criterion that they are innovative approaches that also maximise the public domain value? And also, implicitly, what are the activities that are better left to the capacity and the innovation instinct and ingenuity

of the private sector. Of course, I see no inherent antagonism here, between public and private. I would consider any such notion as an old fashioned Marxist legacy. And I see no zero-sum game here either.

Thus, the priority lines that will follow below are not superior, in any objective sense of the word; they are simply those that will increase the direct social benefit of innovation and are, therefore, most pertinent for public attention in general, and action in the EU FPs in particular.

Society and business need to coexist and cooperate in a harmonious way. It is only the priorities that may be different. In the context of publicly funded research, business will be extremely welcome; it will, however, have to build its agenda and define its interests through the lens of increasing social value. And it will have to do so in a direct way and not just as a by-product. Further, I see no reason whatsoever why such a new positioning would limit the interest or motivations of the private sector, or would affect and compromise its engagement. Instead, this very agenda is recognised by industry stakeholders as a highly important and promising one for their own interests as well.

What I want to point towards is the multiplier effect inherent to innovation: the massive value that may overflow out to society. And the strategically unique role of the public domain in going after it and collecting it.

Power redistribution

Above, I have tried to highlight some important innovation stakeholders that are either poorly engaged or completely missing from the current design and layout of the EU FPs for R&I. If we are to create space for these missing stakeholders, a redistribution of power will be naturally due. Academia and

business will still have their unique roles in the R&I process; only now they will need to cede part of it to society. Only in the beginning, however; in the mid term and as co-creation establishes and flourishes, benefits will result for all and the win-win mode will dominate.

Academia will also need to adapt its approach and agenda. It will need to acknowledge and become comfortable with the importance of empirical and non-scholarly types of knowledge. It must also realise that its deep-digging skills are key for research and invention but they are marginally relevant, if at all, to innovation. Innovation requires a different mindset, one for which they may not have the same advantage as they have in the invention realm. Instead, their strong analytical passion may now be counterproductive and prevent them from developing the essential behavioural capabilities. It may act as something like a cultural barrier. Indeed, they would need to pay heed to the skills of their good students and learn from them: the skills to ask rather than the capacity to answer and lecture.

There was no one that understood better the power of questioning than Einstein: *"People are sometimes afraid to ask questions out of fear of seeming stupid. And yet the smartest people on the planet are often the ones who ask the most questions"* goes his famous quote. And he went on to highlight most clearly the innovation barriers of academia: "*It is a miracle that curiosity survives formal education".* Yet, curiosity and questioning is how innovation starts.

It may not be not easy to learn to work with different skills – to appreciate, accept and create synergies with them. But it is not impossible and it is very important.

Especially insofar as these different, non-scholarly skills are most empowering for market generating innovations, which,

as has been repeatedly stressed, are high in terms of potential for social value generation and, therefore, deserve far more attention and a much higher priority on the list of the EU FPs than the one they are currently enjoying.

Clearly, all three parties, academia, business and society, will need to put a stronger emphasis and focus on market generating innovation, while necessarily reducing innovation targeted at process and product related optimisations. This brings us to the core of the proposed reforms.

Priority refocus

The classical, process-efficiency type investigations with which academia is seemingly far better acquainted will need to retreat in the EU innovation agenda. They are less capable of delivering direct social value and can be best left at the discretion of private sector investment and related stakeholders that will always be keen to fund such types of innovation.

There is a need for three fundamental reforms in the FP design. Two of them are underlined by the term democratisation, fostering the need to open up to society; I have referred to them as market and research democratisation respectively. It is important to note that in both these concepts, in both market and research democratisation, the stakes of the public sector are higher than those of the private sector. This is exactly why I believe that they should be the two priority areas, the most suitable and fertile to absorb public side investment in innovation.

We need to innovate for new markets, for non-consumers, and we need to engage society in the innovation process as a new innovation actor. And the third reform will be to make systematic use of and meticulously apply across the whole R&I activity the principles of collaboration and peering.

All these three directions deserve rather more attention than they currently receive.

We will need new concepts, instruments and approaches for research and market democratisation. In the end, perhaps these two worlds are not as far apart as it may initially seem. They both seek to empower people: citizens and non-consumers. They both benefit from the spread of pervasive openness, sharing and collaborative practices.

I'd like to see it as just one human innovation ecosystem capable of inspiring, proposing and – why not? – also participating in the generation of market generating innovations and unleashing a huge potential for accommodating societies.

And, most importantly, they are reforms that hold the promise of gradually reinforcing the international perspective and establishing the global leadership of the EU R&I agenda.

Research leading to inventions and not innovations will, of course, continue to be necessary. I have, for example, highlighted above the unique importance of accidental innovation. Accidental or systematic, invention-driven research will always be important. I also foresee that if innovation is sought in the three maximum social impact directions above, research will not remain uninfluenced; it will then have far more stimulus from the real world, it will adapt its strategy and, in the end, it will also leverage the quality and the promise of its very inventions. This osmosis will result in a larger number of inventions finding their way to useful applications.

We need to redefine the role of citizens and consumers in the EU research constellation. They can play an equally unique and currently rather unexploited role, both on the supply (research) and the demand (market) side.

In the former case, citizens are carriers of unique formal as

well as empirical knowledge that currently, by design, goes unexplored. Social innovation should be considered as a strategic concept and not just as an action line, as is currently the case. Social innovation will also foster a more tangible participatory pattern in the EU, which will consolidate democracy. It will respond practically to a major current deficiency in Europe, one which is the substrate of many insidious contemporary problems such as populism.

In the latter case, citizens are non-consumers or latent consumers and a key role of innovation is to transform them into proper consumers. Market generating innovation is the most far-reaching type of innovation and the one most relevant to public research. Market generating innovation contributes to social well being more than any other type of innovation.

Both these roles, market and research democratisation, are particularly relevant for public research. Yet, they are currently not given their due attention, and nor do they systematically underpin the FPs.

I see this as amounting to a significant and strategic deficit as regards public research in the EU. We need to integrate within the EU public research the two society capabilities above. Then we will need to design the instruments that will transparently communicate them to society at large. This will further leverage society's participation and engagement.

Last and far from least I have a strong dislike, something like an allergy I would say, for all self-proclaimed revolutionary chimeras. Instead, I opt for an evolutionary, trial and error, step by step change. Not rarely, this approach will on the way pick up an unplanned and unprecedented speed. A true revolution will then naturally result.

Only the goal needs to be clear: fostering more market fo-

cus, more social engagement and more collaboration and peering. The method and the intensity in pursuing them can only depend on and be driven by the real life feedback that will result in the process.

Result visualisation

The ten points below provide a synopsis of the above discussion. They are the tangible and measurable impact that will be visible in full shape within a time-frame of approximately 10 years, following adoption of the proposed reforms. More on the technicalities of impact and its measurement will follow in the second part of this book.

1. Practical extension of the definition of innovation, throughout the EU innovation policies, to include innovation-created markets and to highlight their unique and huge potential for creating social value.
2. Fostering innovation in terms of its true and novel value creation; and not in terms of its many possible features and means (new or significantly improved implementations, inventions etc.).
3. New innovation markets popping up and non-consumers turned into consumers on a massive scale, especially in the third world. Interaction of EU innovation policies with EU aid and immigration policies. Focus on innovation pulling in social infrastructure and not hand-out driven approaches for emerging economies' support.
4. Tangible opportunities and a clearly defined framework for advanced EU technology adaptation and deployment into the emerging economies.
5. Significant budget increase for publicly funded R&I FPs, provided the above four items become tangible to Eu-

ropean industry and fully appreciated by the national policy stakeholders.

6. Proliferation of genuine social innovation, delivering tangible added value, and of citizen engagement and co-creation schemes, where citizens perform as actors and not as observers or study objects.
7. More space for disruptive and out-of-the-box thinking, less space for proprietary, process and product innovations.
8. Innovation projects perceived as scaling out laterally and creating value and network ecosystems, and much less as optimising existing value chains. Long term collaboration, besides its own benefits, is also a much better ground for transforming inventions into innovations at a much more efficient rate.
9. Subtle coexistence and mutual respect of excellence and democratisation, of formal and informal knowledge, of deep and lateral thinking.
10. Uptake of the new paradigm in educational policies.

Part 2 - Open operations

Tracking performance, measuring impact, fostering transparency

Streamlining operations with strategies

In this second part, I will take a closer look into the more operational details of the EU FPs. Again, this is not about any detailed review and discussion of the operational framework and its many design features. I am not particularly interested in that level of detail.

What I look forward to doing here is reflecting on how the strategic reforms suggested previously would affect the operation of the FPs.

In other words, to discuss what it would mean, at a more operational level, to cater for what has been proposed above and to better serve the strategies articulated there. I see it as unlikely that the existing operational layout would ever suffice to provide for a new strategic framework; some re-engineering is due, as strategies and operations need to be aligned.

Let me for a moment ask: What is it really that mandates such a joint consideration of strategies and their operational context?

This brings us back to some ideas raised in Part 1, when discussing the innovation definitions and taxonomy. It was stressed there that any definition we introduce must clearly relate to a strategy and must support some decisions. This is necessary in order to make sure we have a clear and common understanding of the issues. It is also a condition for introducing impact assessment. As soon as definitions are clear and the decisions we wish to support are streamlined, the idea of impact assessment is demystified. It falls naturally into place. If definitions are not well reflected in strategies and strategies are not well connected with purpose and decisions, everything will remain fuzzy and confusing; any measurement and assessment

scheme will then seem close to impossible.

Thus, the answer to the above question is: Definitions, strategies and measurements come in one bundle. Impact assessment is our key measurement here, and operations are its living ground. It is the definition of a suitable impact assessment scheme that essentially requires us to streamline strategies and operations.

In Part 1, I laid out the definitions required to define and describe the clear cut strategies that I see as necessary for the publicly funded R&I activities in the EU. In this part, I will now re-focus on the operational aspect. How can operations serve our strategy? And, in particular: is there an assessment concept in place and can it be used to measure the strategies' success? Or does it need to be outright invented?

The quest for transparency

"Openness" is a key word underlining the strategic part of the elaboration in Part 1. The equivalent of openness when we move to the operational context is transparency. And I will argue that transparency must now underpin the operational context. Indeed, we cannot opt for an "open" strategy only to delegate it later to closed and non-transparent processes. Moreover, this is not just about a semantic alignment between open strategies and open (transparent) operations. It is about sheer substance.

Let me take a deeper look, to define what is meant by a transparent process.

At the EC level, transparency is indeed valued as something of significance; there are many activities and processes in place to support it. For example, there are numerous information days aiming at communicating, creating awareness and stirring

interest in related upcoming R&I activities. And there is a lot of information disclosed on projects, applicants, budgets, etc. to any one concerned.

Arguably, there is an important informational aspect to transparency and this is admittedly served well already. Yet, I do not think that such campaigns and information dissemination, no matter how useful they may be, can provide the transparency I have in mind. And this is because I see transparency in its deeper meaning: as communication and deliberation on purpose and impact, and not so much in terms of information sessions about upcoming activities or past results – especially insofar as the FPs are publicly funded and, therefore, society is their primary stakeholder. I would even argue that unless such dense information is communicated, unless such a fully-fledged transparency and a connected, impact-oriented concept is put in place, there will be a risk of society becoming distant and disenchanted. Instead of embracing R&I, it will feel alienated and suspicious. And this is not only detrimental for the progress of innovation itself; it will also affect the quality of democracy in the EU.

In just a few words, what I think would dramatically leverage the quality of the transparency boils down to just this: impact communication.

This is how I see it. Transparency is not just about the communication of plans and upcoming activities; it is first and foremost about impact communication.

Clearly, all the many R&I stakeholders do not necessarily have similar interests, nor do they perceive transparency and impact in the same way. If we want to assess how well interests are taken into account, we will need to define and communicate suitable impact metrics. For example, publication of

papers says a lot to academia but far less so to business and hardly anything at all to society. Patent applications are higher on the interest scale of business, and quite low on the academic one. And so on.

Defining impact

There are many ways to approach impact assessment but I would say that they are mostly variants deriving from two major methodologies.

First, there is a macroeconomic approach, whereby one uses an aggregate view of the activity under evaluation, making use of a great number of underlying assumptions and data sources. For example, the increase of GDP is such a macroeconomic metric resulting from the setup of appropriate macroeconomic models. Policy makers would be the prime consumer of such an indicator.

Second, there is a more individualised or micro approach, where the participants are, ideally, evaluated one by one against some criteria and then impact results as the collective impact of these many individual performances. For example, patent production is a metric of this approach; the difference here is that we do not predict its value via modelling as above; we rather collect the data at a project level and then report on them both individually and collectively. The collective view of such an indicator would again have as a prime consumer the policy makers; additionally, these more individualised views would, most likely, increasingly attract the interest of business and academia stakeholders.

One can notice that macroeconomic models provide only aggregate views; they hold no information as to any particular project performance. On the contrary, micro approaches

are bottom-up; they collect data from individual projects and aggregate them in any meaningful category (sectoral, country etc.).

Let me go through them, to first see how things currently stand.

The macroeconomic approach for impact assessment

In the EC, there have been many efforts mostly in the first direction: the macroeconomic assessment. To this extent, a number of such models have been developed and used. When preparing for the launch of Horizon Europe, a working document of impact assessment was produced[46], to consider and analyse various scenarios for the next chapter of the EU R&I, and Horizon Europe in particular. In this document, the whole idea of impact was underpinned almost exclusively by macroeconomic modelling.

Here is how the result of this impact type is reported there:

The continuation scenario[47] is expected to bring an estimated average GDP increase of 0.08% to 0.19% over 25 years, which means that each Euro invested can potentially generate a return up to 11 Euros of GDP gains over the same period. EU investments in R&I are expected to directly generate an estimated gain of up to 100,000 jobs in R&I activities in the "Investment phase" (2021–2027) and to foster an indirect gain of up to 200,000 jobs over 2027–2036, of which 40% are high-skilled jobs, through the economic activity generated by the Programme.

GDP and employment changes are key outputs of these

46 Commission staff working document, Impact assessment, June 2018, SWD (2018) 307 final.

47 "Continuation" implies here that the funding of Horizon Europe will be carried out along the same lines as in the past with Horizon 2020; this is one of the many scenarios analysed.

models. Not the only ones, but the most important ones. In addition, it is interesting to note that the predicted expected GDP increase ranges significantly between such approaches. From a value of 0.08% (Rhomolo model) up to a value of 0.19% (NEMESIS model[48]) per year and over a period of 25 years.

I have no doubt that such modelling approaches have a very sophisticated and robust scientific background. Given the thousands of parameters used in such models (the assessment approach based on the NEMESIS model reports more than 750,000 coefficients[49] used, only to measure knowledge flows between countries and business sectors) it is only natural that their outputs may diverge significantly (Rhomolo and NEMESIS models differ in their predictions at a relationship 1:2.5). Therefore, one can only claim a broad indication of the impact and not any detailed calculation of it. However, even at this level of detail, such models and their results still have a good value in touching upon and highlighting, to some extent, the critical impact issue.

However, this "reduced accuracy" is not what I see as the key limitation of such approaches. Besides, in terms of macroeconomic accuracy, I doubt one can realistically aim at something more accurate. There are, however, three other issues that I consider to be major drawbacks and limitations in approaches such as those reported in the EC documents referenced above and their scientific backbone, the NEMESIS model, in this particular case. And these three issues I hold to be far more important than the limited accuracy of the models used.

48 Support for assessment of socio-economic and environmental impacts (SEEI) of European R&I programme: the case of Horizon Europe, EC, 2018, doi:10.2777/038591.

49 Ibid, page 15.

The first issue is that these models are not what I would call politically neutral; their Keynesian underpinnings are obvious. The multiplier effect, a Keynesian concept that suggests that government spending acts as a multiplier for the economy, is both explicitly referenced in several instances and implicitly applicable throughout the analysis. For example, it is stated[50] that *"This phase (investment phase) can be viewed as a Keynesian multiplier".*

However, this is not an idea accepted by all current economists; neoclassical economists (Milton Friedman, Friedrich Hayek, etc.) vehemently reject this idea of John Meynard Keynes and even talk about a negative multiplier effect. Thus, this is a highly controversial assumption, far from being unanimously accepted. It politically polarises the whole discussion and, in my view, is not something suitable for a report targeting perhaps our key stakeholder, as singled out above: society. Addressing this stakeholder should be done in ways free from political bias and should be based on unanimously accepted scientific concepts.

The second issue is something that strongly contradicts the strategic axis I have tried to lay out in the first part of this treatise. And it does so in two distinct ways.

First, the impact analysis pursued abides closely with the process/product innovation model. This, as I have also shown in previous instances, is still dominant in the literature, especially that used and contributed to by EU institutions. However, this model fails to account separately for the market generating innovation and the unique social impact it comes with. If the idea and the practice of market generating innovation must strongly

50 Ibid, page 12.

underpin the publicly funded EU R&I activity, as I strongly believe and have suggested, then such an approach is clearly not suitable. It results in diluting or even missing what I see as perhaps the most important dimension in terms of social impact: market generating innovations.

Second, in the first part I emphasised the "openness" idea; not some general need for openness but the unique power open approaches have brought and are increasingly bringing to the innovation effort. This dimension is missing. Even more, it is not only missing but is somehow juxtaposed to impact as if it were in an antagonistic relationship with it. The report suggests that it will look into two distinct "design" options[51]. Here is how it is stated: *"The first axis, called 'More Impact', focuses on the orientation of the FP, whereas the main objective of the second axis, called 'More Openness', aims at the widening of knowledge and innovation diffusion".*

I think openness as defined here vastly underestimates its true potential; it explicitly perceives it as an activity related to diffusion of innovation and widening of knowledge, and not as a fundamental and powerful way, as I see it, to *produce* innovation.

In short, in my view, "more and true openness" can only lead to more impact and should be tightly embedded and integrated with it, and not treated as an alternative axis of action, one that may potentially risk straining the resources of "More Impact".

The third point of my critique relates to the usability of the outputs of such macroeconomic approaches. In the above paragraph, I highlighted the tight, stakeholder-specific relationship

51 Ibid, page 48.

between what we measure and communicate and what our stakeholders perceive as value. There are no one-size-fits-all solutions. The same activity is perceived differently by various actors and they will, therefore, need different metrics to understand it. If our main stakeholder here is society, would the outputs produced via such a macroeconomic approach really be those expected to allow society to enhance its understanding of the value generated by the publicly funded EU R&I?

I very much doubt that this is what society really wants and understands. I believe society would appreciate far more tangible information on the impact of specific activities in specific contexts and also about its own engagement in the process. I think these two would mean far more for society than macroeconomic indicators. These would perhaps be sufficient for "value" as understood by other stakeholders, such as policy officials, researchers etc. But not for society.

These approaches do not provide adequate transparency for society. Equally, they cannot serve to communicate impact to society. They may hold important information for policy makers but not for society. If one remains at that level of detail, EU publicly funded R&I will remain as something non-observable and non-transparent to society. Because there is a clear mismatch between the information these models offer and what is needed for society to understand the importance and the impact of what is going on in R&I, and engage itself with the activity.

I have personally often felt that society remains distanced and disengaged from the EU FPs such as Horizon 2020 etc. And, for sure, I am not alone in this feeling. I think what I laid out just above provides the key reason for this and also highlights what direction one needs to look into to overcome it.

The individualised, micro approach for impact assessment

Currently, in the impact assessment of the FPs there is a lack of any individualised impact approach. Strange as it may seem to an outsider, nobody has any good idea of what has really happened and what has been effectively delivered in terms of actual and tangible results (and not predicted macroeconomic indicators), when an FP comes to its end. There is some qualitative information[52] collected towards the end of projects but this can hardly be considered as a value viewpoint on results and impact.

Indeed, a part of the investment may go into infrastructure that is under the management of large public organisations. This can perhaps be monitored, but it amounts to only a small part of the overall investment. The truth is that there is no insight into what the direct or indirect benefits of any particular research project are. Even more, this lack of systematic monitoring of impact does not allow the feedback of information into the design of the following FPs; to see what went wrong, learn from it and rectify it, to highlight the positive sides and take measures to further consolidate them.

Clearly, this no-impact-monitoring approach stands out from any good practice, be it for private or public funds. Regardless of context, there are hardly any people that would contest the vital and unique role of impact monitoring in being accountable to the private or public stakeholders (taxpayers in this case) and in designing the next step.

How did we then come to this point?

52 Ibid, "Figure 23 – Example of a qualitative, self-evaluated assessment of impact from FP7", page 86.

There is no doubt that the EC fully realises this issue. Its proxies typically respond that in the context of publicly funded research there are big difficulties to really tracking impact; the impact only manifests at some time in the future, and there are many confidentiality issues surrounding it that make it practically impossible to have access to all the intricate information required to evaluate it.

However, the need to take action is fully highlighted in a report[53] that was mandated by the EC and subsequently used by it in the design of Horizon Europe. The issue of impact is indicated as one among the total of 11 recommendations raised therein. Here is an excerpt from this document: "*The post-2020 EU R&I programme needs a definition of impact beyond GDP that captures for instance impact on science, skills and competences, competitiveness of European industry, innovation practices, performance of Member States, and on policy-making*".

Unfortunately, this wording and approach to impact is again a way apart from the idea of a micro-level collected impact. It suggests some further directions (science, skills etc.) and does not comment on how these should be measured. As I stressed above, my main objection is not so much with regard to the content but relates far more to the approach and the exclusive reliance on dubious macroeconomics. This document does not really raise this issue and in this sense does not touch upon what I see as essentially missing in terms of impact.

Intentions aside, there is a good reason for all the difficulties claimed when it comes to micro impact monitoring. Indeed, the impact of R&I is not something you can expect to reap in the

53 LAB – FAB – APP — Investing in the European future we want:a Report of the independent High Level Group on maximising the impact of EU Research & Innovation Programmes, 2017.

very near future. It will take some time to evolve. In the project lifetime you need to set the foundations for this, develop truly new and powerful concepts and demonstrate them as prototypes on a small scale. There is a very long distance from all these to true and tangible impact. And there are all sorts of risks in between. There is truly good research that is not successfully followed up and ends in nothing, and there may be mediocre research that when taken up by ambitious people can, in a matter of years, make a true difference.

At this point, one should not forget the effective time-scale of public research; in principle, this is more mid to long term. And it is justly so. Public R&I should address this time-frame where the private sector will see a high risk and will be sceptical about investing. Of course, there is nothing fundamental in this; bright and disruptive ideas may indeed result and reach implementation in the short term. Even more, the idea of market generating innovations, most suitable for public action, may often, but not necessarily, be a rather more short term context adaptation exercise.

Overall, however, embarking on a micro-level assessment of projects, one could safely claim that the time horizon where impact manifests would typically be above five years. Consequently, any idea of impact monitoring would imply collecting reliable and comprehensive data over such a time-frame and well beyond. Something that can certainly be further complicated by the many confidentiality issues that may be claimed by the beneficiaries. Not to mention the possibility of an in-between transfer of intellectual rights that can happen along most complex paths, impossible to track, explore and evaluate in any objective way.

Clearly, the arguments typically raised for not monitoring

micro level impact and for not, in the end, being able to really report on it, do not stem from a misunderstanding of its importance or from any other omission; they are rooted in reality. It is an extraordinarily difficult task even to plan, let alone to execute.

Yet, I still find this to be no sufficient reason for completely abandoning the concept of micro- or project-level impact monitoring. Can this ever be acceptable as an inevitable and uncontested situation? Can we, in our current big data era, ever get used to this idea and live happily with it? I believe not.

The importance of such a practice is paramount for our key stakeholder here (society) as well as for the full range of other stakeholders. Even if, because of all the above constraints and insurmountable difficulties, a fully optimal solution cannot be put in place, some sub-optimal approach still needs to be designed. This may, of course, offer less than ideal clarity. It may be rather fragmented and also come with some uncertainty. Yet, one should not forget what the current baseline scenario really is: a macroeconomic-modelling based impact assessment, with all the many severe shortcomings addressed in detail in the above paragraph.

Below, I will propose a scheme for micro level impact monitoring. It will take into account all the real difficulties summarised above. It may not be as detailed as I could have hoped. However, it will be tangible and easy to put in place. I believe it will make a difference, visible in a short time ahead. It will rationalise a process and also affect the attitude of R&I actors. It will put them under scrutiny, make them more responsible, oblige them to place more interest in the results themselves. Incentivise the beneficiaries to communicate their results across society.

This impact scheme will aim at two distinct goals:

First, to launch a set of measures and practices that will, as I believe, significantly leverage the overall R&I activity, making it more result oriented and allowing it to engage in true micro-level impact assessment. These measures are not only about measuring impact; they are also about leveraging it. I'll call this the procedural approach to impact.

Second, to provide motivation, a well-defined driver that will urge stakeholders to register and communicate their impact. In a more systematic, thorough and less wishful way than is currently the practice. I'll call this the communication approach to impact.

The remaining pages in this second part will serve exactly that purpose: to suggest operational changes that will leverage and measure micro impact (procedural approach) and to propose drivers for its comprehensive communication (communication approach). I foresee that both these strands of action would have a catalytic impact and they would do away with some of the caution, the indifference and the scepticism with which large segments of society in the EU respond currently to the publicly funded R&I effort.

Once again, I would like to draw the reader's attention to the tight link with the recommendations in the first part of this book. Most of all, impact requires an aligned strategy to be in place. Moreover, it can only be defined in the light of an equally well defined strategy, in terms of purpose and decisions. And, as discussed in Part 1, there are some aspects of the current EU strategy that need urgent attention and a possible overhaul as they do not resonate well with the disruptive paradigm of the Fourth IR era and the related opportunities.

In other words, what will follow below will first require an

adaptation of the strategy. For it is well known that to optimise operations for a problematic strategy will be an inherently futile and expensive approach. For this reason, in the following discussion on operations, all that will be there proposed will only make sense in the light of the overarching strategy that has been laid out in the first part.

Back to our focal point, the new impact management system will aim at harnessing and communicating impact and will address three essential requirements via three respective intervention tiers, as summarised below:

First, one will need to *re-visit and overhaul the evaluation process*. What is needed is a *new evaluation scheme*, one with a memorisable and publicly available track record (ranking) that will be consulted when making funding decisions. This will leverage the quality of the process and provide for, primarily, academia and business transparency. Currently the evaluation system is memoryless; meaning by this that it keeps no track of past performances. This revamped evaluation scheme will go hand in hand with a *new impact communication scheme*. Stakeholders must be actively encouraged to communicate their results.

It should be remembered that this result communication will now be directly linked to the stakeholders' own benefit and interest; so there is no reason to design any additional incentive for it to happen.

Communicating tangible results will also be in the interest of society and would add dramatically to the transparency towards it. Currently, I would argue, there is practically no systematic impact communicated to society; consequently, there is a questionable level of transparency in place.

Second, one will need to set the foundations for *true, mi-*

cro-level impact assessment of the FPs, adding to the quality of the communication to all R&I stakeholders. FP impact will now be based on the actual data collected from individual projects, as explained above when roughly outlining the new evaluation process. The more true micro data we have the greater the clarity of the FP impact and the less need to seek recourse to questionable macroeconomics.

Third, one will require the *revisiting and optimising of a number of side processes*. This will again leverage the quality of the overall operations and is especially pertinent to business and academia stakeholders.

The two first tiers are tightly linked. Participant performance data are used in parallel with bid quality criteria for the evaluation of the R&I bids. In this way, the driver and the incentive to publish such data are automatically embedded in the process; it is to the great benefit of the bidders. But then, they are there, available also for a second purpose: for seeing and understanding the global picture and grasping the FP overall impact.

The more micro data are collected the more possible it will be to develop statistical models of impact, in the third component. This micro data collected will serve as a sample for the overall population, i.e. all impact from all projects. The greater our amount of sample data, the less the uncertainty about the population. A powerful and iterative process that will gradually increase our impact understanding. The power of statistics and analytics will have been unleashed.

The third tier is quite independent and more local in nature. I will not consider it exhaustively and will limit it to some key highlights, reflecting personal experience as well as established good practices.

The first tier of impact management: Revisiting evaluation

In a typical business project, as in any human venture, failure is possible and can never be wholly ruled out. A similar rule applies to R&I. However, there is one remarkable difference. The chances of failure are now, by definition, much higher. To realise this, one can take a look at the venture capitalist business which targets the creation of successful innovative ventures. Venture capitalists will hardly ever be engaged in pre-competitive research. In order to proceed and allocate funding, they wish to have in front of them the basic ideas already developed and the core human skills available. They typically look forward to something like the so-called "10/10": ten times return on investment in a period of 10 years. This is markedly different from the public R&I we are discussing here. Public R&I often works on a different time-line, one that would perhaps leave VCs indifferent, due to the much higher risks involved.

Still, the failure rates in the VCs are very high and this is the reason why they need to compensate for this large risk they incur with very high returns – significantly higher than one would plan for in other, more conventional business projects.

All this confirms what research practitioners and stakeholders know and what even ordinary people feel: R&I comes with a significant risk and the more pre-competitive it is, the more remote in the future are its planned results, the higher is its risk. For many projects, a good portion of luck is necessary if you are to reach some meaningful end. Motivated by these realities, Harvard professor Clayton Christensen published a book "Competing against luck: The story of innovation" to discuss ways and approaches to restrict luck to a more natural dimension,

similar to the risk and the uncertainty companies face in other aspects of their operations. Yet, the fact remains: innovation is about doing new things and often changing things. It is fundamentally different from walking down the same road. No matter how well we compete against luck, innovation will remain a risky business.

Back to our FP context, the above discussion highlights that failure will not be the exception, but the norm; and it will keep being so, no matter how well you organise the approach and compete against luck. A high failure likelihood is something quite inherent to R&I, something inevitable. A big, fundamental difference in public EU R&I when juxtaposed to the VC business is not so much the risk failure, which is pretty unknown, but the memoryless nature of the exercise.

For example, if some applicants are supported by a VC and fail in delivering the planned results, for which they received the financial support, it is most unlikely and can only be mandated by very exceptional circumstances that the same VC would ever consider working with them again. The system has a good memory to track and store these performances and react accordingly, while the business overall is quite hectic and transparent so that the news typically spreads around fast. The same failed applicants, would most likely have few chances with other VCs in the industry.

On the contrary, EU public R&I is a system without memory. Performance evaluation is not really tracked, so there is no record of it available for the next time the same applicant may show up.

Of course, there is a bid evaluation process in place. And there are several good things about it: it is simple, fair and impartial, while all possible effort is made to avoid conflicts of in-

terest. Besides the bid evaluation there is also a project review process in place. As already said, this is a memoryless one. It produces no track record. An applicant can show up again and again and nobody will ask her about her past performance. The bid evaluation takes no account of anything in the past.

I argue that the above points already clearly indicate the need for a project evaluation process whose results will be registered and taken account of in the future. What exactly this will comprise is a matter of technical design. Some ideas will follow below, yet the important thing is to realise the void and take action to fill it. To make performance information available to the next bid evaluation. To close the loop. To realise that a memoryless system in innovation management is inadequate for the requirements of the exercise.

Such a track record and a closed loop would leverage the quality of the whole exercise and better serve the interests of the R&I stakeholders. It would also provide for society transparency.

Action 1: Instituting performance tracking

To start with, there should be a moment, early in time, where a go/no-go decision should be made, based on well defined criteria, communicated at the onset of the project. Just as in the parallel world of privately funded innovation there must be an early moment of critical review where a go/no-go decision is due. This is imperative because one needs to see the true set up and progress of things and not rely on the imaginary plan as laid out in some proposal. There are all sorts of reasons that may lead to large deviations between these two. This is something broadly applicable and as large as the distance between theory and practice. It is especially valid for multi and unknown stake-

holder settings. Partner incompatibilities, conflicts of interests, a different and diverging perception of things among partners, even their chemical or any other incompatibility – these are just a few of the many issues that may undermine the effective roll out.

If a project goes past this point successfully, I believe there is nothing more to be gained from further go/no-go reviews, later on in its time-line. Currently, the project can indeed be later considered to have failed to fulfil its contractual obligations, resulting possibly in the financial support granted to it being claimed back. This can result in great tensions and comes with many practical issues; and some ethical issues as well, as ideas of collective responsibility are not appropriate and it might be difficult to locate those who are responsible for this breach of the contractual terms.

One should keep in mind that FP funding is granted after quite a fierce competition, where for every proposal selected for funding there are around three to 10 rejected. Also, the critical go/no-go test has been passed successfully. Therefore, I would argue that there is no purpose for a further project evaluation. Or, more accurately, I think it should be re-purposed under a different mandate; by refocusing from the project to the participants and their track record. A late moment in a project lifetime is not the right point to declare the project to be a failure. But it might be high time to update the record of the participants, to document a good or poor performance.

This publicly available record would follow the applicant and be taken account of during the evaluation of subsequent bids in which he participates. Clearly, these should take account of both the merit of the proposal (more or less as currently the case) and the track record of the participants. This approach

would most certainly yield a much better result.

It would also change the way consortia are built. Quality criteria would prevail. Having a good track performance record would make someone a highly wanted partner. Teams formed would be much better and much more devoted to the task; a poor performance would not go by unnoticed. Putting in place a system that memorises performances to make future use of this information will always increase motivation and engagement.

In addition, this practice would gradually filter out opportunistic behaviour. What do I mean by this?

The current memoryless system is a window of opportunity, an unexpected manoeuvring space for any possible opportunist who may show up as a bidder, having in mind only to put some funds under her grip and not because she looks forward to some genuine R&I results. Unfortunately, this is quite a common practice; it penetrates the EU R&I activity and lives parasitically on it. A whole spectrum of intents, with various possible combinations of genuine and opportunistic interests – and, yes, at the extreme end this includes organisations that are fully and consciously after the R&I funds although they, by design and by intent, have not the slightest interest in using them as they claim. In a world of scarcity, such practices only block the way for other organisations that may have a much more genuine aspiration; to do research to invent and to innovate to develop new things, and not just to cover their running costs or any other irrelevant expenses.

The ability to fail, combined with the no-memory design of the FPs, allows such opportunistic behaviour to recurrently and parasitically benefit at the expense of other committed participants, and results in a severe subversion of the programme

rationale itself.

Things can get even worse; for it is not rare that such opportunists are even rewarded for their many failed participations, again and again. Lacking performance tracking and evaluation, these many participations may be easily misunderstood and perceived as a mark of experience, relevance and excellence!

Non-evaluation ends in exactly this problem and fosters the idea that EU R&I is a separate and isolated business. It suffices that opportunists build a strong participation record and link with other entities that are similarly strong. This, somehow, automatically raises your chances high and is a safe and cost-effective way to get on board. The substrate for opportunism is put in place. And the more opportunism advances its position, the more genuine interests are marginalised and discouraged. Unfortunately, I see this as quite a clear pattern and not just as a minor detail. A pattern that is a good substrate for many parasitic organisations, public and private, small and big alike, with lengthy CVs of little if any substance and no genuine motivation.

The concept of self funding is often claimed as a tool against such an opportunism. Indeed, very often FP research is not funded at 100%. The core idea is that the participant must somehow have his skin in the game, accepting some of the inherent risk of R&I. As a principle, it is not a bad idea. If research is about risk management and if you are genuinely serious about it, then why not fund at least part of the risk yourself?

The intention is good, yet in most of the cases there is no difficulty at all to budget, in a given project, for any cost item you wish. Especially when it comes to labour, which is by far the major expense here, literally everything can be claimed for anything. And for a number of reasons it is utterly impossible to really verify a claim. Think for a moment of the intense contem-

porary mobility of people between companies and organisations. Clearly, there is no real way to check the validity of labour claims made. One should live with this reality and face the fact.

Thus, despite the good reasons behind the cost-sharing principle, it is unlikely that it will provide any shield against opportunistic behaviour. It may only work for very small companies, which have no big storehouse of invoices and payrolls. Only these may, due to their particular circumstances, be prevented from such behaviour. All the rest will have no difficulty by-passing and eroding in practice this otherwise well-intentioned principle.

As a more broad remark, administrative processes are necessary for administrative purposes but can hardly ever provide stable solutions to essential problems. If they attempt to do so they will typically be by-passed. A possible reaction may then be to introduce one more administrative provision to block the new hole. For which new measure, a whole new hole will soon appear. And so on and so forth.

The point is that there can be no administrative equivalent or substitute for tracking performance. Evaluation is an essential aspect of the innovation exercise and requires a different mindset that would treat it accordingly. The thinking of the typical administrator is of no help here.

Tracking performance and maintaining participant records would do away with all this; for who would ever have any appetite to join forces with such opportunists and low performing organisations?

The reader may already be wondering: but how easy is it really to track performance in an R&I project?

It is important to keep in mind that tracking performance as discussed here will need to be done at a micro level; no macroe-

conomic analysis would be of any help for our current purpose. And micro- and project-level FP impact evaluation is something that is currently not really, even remotely, in place. I will address this key issue in detail in the tier 3 actions.

However, at this point I will raise an interesting point pertinent to "collaboration" and "openness" strategies. In R&I activities, with a pronounced openness and collaboration aspect it would be far easier to track performance and use it to update all related participants' track records. Whether this is about citizen engagement and co-creation, or manifest in the direction of fusion and alignment of business and other agendas towards new network constellations, there will be little difficulty for the evaluation radars to keep track of them.

While product and process impact typically develops and remains within closed and obscure value chains and tight proprietary rights, impact that lends itself more towards collaboration and openness will spread out. Even if for some improbable reason you so wished, it would be almost impossible to keep the impact a secret. This ease acts as an automatic and inherent further incentive to include such a dimension in your work-plan and easily credit yourself with a few more points in your track record.

A similar argument applies to the strategic priority for market generating innovations. You cannot keep such results to yourself; they will always radiate in societies, in wide communities and not narrow value chains. Their impact will be far easier to track and register; and, of course, to appropriately credit.

A final but very important comment. All new and good-intentioned ideas risk being misused and ending up creating more problems than those they were designed to solve.

A most important caveat here would be that the new evalu-

ation system is so designed that it allows access to new-comers and avoids any undue entry barrier. Such a development would severely undermine and contradict the most basic idea of this book: the aim of opening up strategies and operations for the publicly funded EU R&I. Such a negative development would then overshadow any other potential and intended benefit.

However, there is nothing fundamentally difficult in avoiding such an entry barrier; it is a matter of careful design. This design should aim at weeding out opportunists and providing a leverage to good performers. New-comers should even be encouraged and promoted; incentives should be created to incentivise their accommodation in consortia.

It is the more experienced participants that will be mostly affected by the revamped evaluation practice. For them, the more intense their participation record, the greater the expectation would be that they will deliver and that they will make this delivery tangible and public. That would be an important condition if they wish to maintain a competitive position in the evaluation ladder and remain attractive partners for future applications.

Action 2: The dual use of performance tracking

From the discussion above, it follows that reorienting the strategy in the directions I have suggested in Part 1 will also provide for easier, more transparent and more natural impact monitoring and registration. The evaluation system that will track the performance of the R&I practitioners will also be the basis for the FP impact monitoring and assessment at the micro (project) level.

Of course, one will need to extend this latter functionality also in the direction of the more classical process and product

innovation. There should be no doubt: most of R&I activity will continue to have the stamp of the pre-Fourth IR era. The majority will not excel for its openness and collaborative potential, but for more vertically oriented product and process innovations. Something, of course, that is welcome and useful.

This more classical innovation will not be registered as naturally and seamlessly as its Fourth IR peer. Organisations in possession of results of this type will be inclined to protect them and not to bring them to the awareness of the broader public. They will be hesitant to register them in an evaluation system as naturally as in the case of Fourth IR innovations. Besides, this is one of the reasons why currently there is such poor visibility of results, which are predominantly of a process and product innovation type.

Arguably, there are counter incentives for registering and communicating such R&I success cases. This is something that will persist in the future and, of course, there is no systematic way to force practitioners to move out of a situation that they consider beneficial to their case.

However, an ability to freely register and communicate results, to the extent this is linked with your track record and evaluation ranking and will therefore directly affect your future success rate and your attractiveness to other R&I practitioners, is something that should not be underestimated with regard to its potential. Indeed, it is a clear incentive to diligently study the potential trade-offs of such a decision and seriously consider taking advantage of this new opportunity; bringing your results into the spotlight and getting the credit you deserve.

If all this is to take place, one should not underestimate the time aspect. Even if impact will be visible and measurable, it may take time to manifest; time that exceeds the three to four years

of a typical R&I project lifetime. But this should not prevent the stakeholders from communicating this impact and crediting it to their account, even if it occurs a long time after the project completion. Result tracking should by no means span only the project lifetime. In this timeframe, the full impact will rarely ever fully manifest, even in the case of market generation innovation and open and collaborative schemes. Thus, the technology should be there to constantly register results and credit them to specific accounts, following control and validation. In the cases of open and market generating innovations it will not be difficult to do, nor to validate. The possibility, however, of proactively registering tangible impact should be there for all cases of innovation, open or closed, market or product and process focussing.

As we will see below in Tier 3, any scientific approach for true, meaningful and micro level FP impact will require hard data. Allowing R&I stakeholders to register such data in an evaluation system will enable them to know who-is-who and credit them appropriately. This hard data will also allow us to build an impact measuring strategy with a sound scientific basis; the more of such data we enter in our R&I evaluation system, the more our overall R&I impact uncertainty will narrow down.

It is for this dual purpose that one must consider such an evaluation system. It will provide both a means of participant ranking and a basis for assessment of the overall EU R&I activity.

There is no doubt that it would be a significant task to put such a sophisticated result registration system in place, with all principles and operations for validation, approval and eventual use of its entries. Yet, will this not radically leverage the quality of the FPs overall? Will it not allow true and unique assessment

to emerge? Will it not increase transparency of the whole process? Will it not filter out opportunists and drastically reduce the costly, burdensome and inefficient auditing procedures to track them?

In summary, the evaluation system I am suggesting here is not there just to rank R&I stakeholders. This is a vital first service. Its second equally important service is to collect hard impact data. The more of such data we collect, the more we narrow down uncertainty.

And, in doing so, we will be essentially doing something very important: measuring impact, true FP impact.

Action 3: Providing for transparency towards society

I already touched upon this issue above. The third beneficiary of this evaluation system, besides academia and business, would be society itself.

How does society really relate to all this?

A couple of decades ago I was participating in a panel that was convened to design an evaluation framework for the performance of university education in Greece. At an early point I asked the president of the panel how our results would reach society. He seemed to be surprised and he responded that there was not really any such intention; the whole exercise was to "make us better", as he put it, and not to communicate anything to the public.

Soon after, I resigned from the panel. For, in my view, a primary purpose of any such evaluation should be communication to society and not merely internal optimisation. Or rather, to be more precise, my belief was and has remained (and intensified) ever since that society communication was not only an important issue of democracy but also a very safe mechanism

to optimise the quality of the process. Because, simply put, an informed society would most certainly shift demand towards the "good" and away from the "bad". Indeed, I can see no better method than this mechanism for raising quality.

This, of course, is no big news; it is already a successfully tested hypothesis. Public university rankings are a long established practice and one that has put in very successful motion the above mechanism. It is there that any ambitious prospective student, anywhere in the world, would start his search: from how universities rank. It would be the most meaningful information for him. More than the layout of courses, laboratory infrastructures and the professors' CVs. All this would come later, after ranking has allowed him a first orientation and a realistic selection against his own interests, ambition and performance records.

In the end, this is how he would define transparency.

If we seriously wish to move beyond noble aspirations and practically engage society in the EU R&I activity, such a ranking would serve a similar goal; it would provide the same service. Truly, education is a much more requested service than R&I participation. But the principle would be equally pertinent and the method would be equally resourceful. Further, it would constantly gain in momentum and significance, as we move in the direction of the Fourth IR, touch upon the potential and embrace more and more the practices of social innovation and co-creation.

Transparency, however, is not only in the interest of society but also in the interest of the rest of the R&I stakeholders. For example, currently the consortia are built under conditions of significantly imperfect (low) and/or asymmetric (unbalanced) information. This severely impacts upon the eventual effec-

tiveness and good skill matching. It also provides manoeuvring ground for opportunists, as I have described previously. Transparency upgrades the quality of information available when decisions are made and this is directly reflected in the quality of ensuing transactions, whatever these may be.

The second tier of impact management: Measuring true FP impact

It is the mark of an educated mind to rest satisfied with the degree of precision which the nature of the subject admits and not to seek exactness where only an approximation is possible.

Aristotle, Nicomachean Ethics, 1094b

I've stressed in several instances that any measurement scheme should be linked to the strategy and one or more decisions that are to be made in its light. If this is not done, measurements will often seem impossible. However, the possibility of a measurement can only be assessed when the object of the measurement is clear. And this is where definitions, strategy purpose and decision intent become important.

In addition, there are two ways to conceive a measurement. In the broad sense, as a means to increase our knowledge about a specific issue. And in a more narrow interpretation, where measurement is seen as the attachment of a value to an object. Of course, a deeper knowledge of things essentially invalidates the difference between these two interpretations and leaves us only with the former one. This is what Heisenberg proved with his principle of uncertainty, fully confirming what Aristotle could only suspect in ancient times. Uncertainty is always there and exactness is only an illusion. Therefore, there is no inherently broad or narrow view of measurement. What happens is that in the pseudo narrow approach one feels comfortable

with the value and remains indifferent and therefore unconscious of the underlying level of uncertainty it corresponds to. And just because an individual's particular situation is serviced well by the measurement accuracy attained, she considers her specific accuracy to be something like an objective reality. She tends to forget that, yes, it is still there! Uncertainty is always in the background.

I experienced this discovery in quite a personal way. As a high school student I was very good at maths and physics. Some years later, as an engineering student, I went through a subtle and mild depression – one that only quite a while later, and in retrospect, could I call and reflect upon. What had happened was that all those wonderful and perfect concepts of our high school text books were not really directly applicable to the engineering problems in which we were now being instructed. We had no way to solve equations and design aeroplanes as I would have, deep inside, hoped for in those days. There were so many sources of uncertainty, of imperfection. Our perfect theory was able to tackle only trivial problems of no real practical use. Such as the flow around a spherical object that experienced an ultra laminar, a so-called creeping flow. Now, imagine the distance between a sphere exposed to a creeping flow and the turbulent and high air speed patterns that interact with an absolutely non-spherical airplane. A distance great enough to shatter my trust in my beloved theories that, alas, could not be used for any practical purpose. Early on, I came to understand engineering as the art of approximation. And more than this, my high school world value system would gradually turn upside down. I would come to enjoy this feeling of a non-accurate and imperfect world.

Thus, a measurement scheme is essentially one that reduc-

es our uncertainty. Even more, it is often surprising how just a simple new piece of information or observation may have an impact on this uncertainty and drastically reduce it.

Douglas Hubbard[54] provides a very good illustrative example of this power of observation. He asks a number of people to provide him with a 90% confidence interval (CI) estimation of the weight of a jelly bean. He gets a number of responses ranging between 0.5 and 15 grams. He then takes a sample jelly bean out of a bag and places it on a set of digital scales. The scales show 1.4g. He then asks the people to reconsider their CI value in the light of just this one measurement. The new CIs given are in their total very much narrowed, as the uncertainty has been very much lowered. One observation alone was enough for this to happen! Of course, as he weighed more and more beans, the ranges were further reduced. However, the largest reduction was made with the first one. Which clearly implies that the larger your uncertainty the greater the impact of your measurement. Or seen from a cost point of view, the cost of measurement increases as the uncertainty decreases.

Indeed, making a measurement to support well defined decisions comes at a cost. And they only make sense if the cost of the measurement generates a value that exceeds it.

Very often it is also said that strategies are not to be measured; they stem from an incontestable need and are, therefore, beyond measurement. Only performances and efficiencies should be measured.

I disagree. The only thing that cannot be measured is something that has no alternative. If a strategy is conceived as some decision that for some reason is not to be challenged, then, in-

54 Douglas Hubbard, "How to measure anything", John Wiley editions, 2007, page 132.

deed, any measurement, even if possible, would be essentially useless. If the strategy has alternatives then, yes, a measurement scheme can and must always be devised.

In the context of the EU R&I, the measurement of research is typically done in terms of paper publication and perhaps also patent production. All this presents no great difficulty in its measurement; I believe to some extent this is already done, although the information is not really taken account of or explicitly credited to its owners in the evaluation process. Such a provision would act as a further incentive to increase this production.

Of course, things become far more complex in the case of direct innovation that is taken up in markets and society. Indeed, innovation has many impacts that are not possible to enumerate in the way you can with patents and publications.

One may find the mission impossible. One may ask: "But is it ever possible to measure the full impact of the innovation activity?"

Of course it is! The real issue, again, is not that the measurement is impossible. It is that the "full impact" idea is unclear. This is the only way to look at it. Indeed, this full impact includes many different components each requiring a different measurement scheme. To start with, it needs to be broken down into components, each of which can be then put under a separate measurement scrutiny.

For example, there is the direct economic impact of the activity seen in the narrow perspective of sales, exports, profits etc. of the R&I practitioners owning the innovation.

Then, there is also the socially relevant economic impact, the one reflected back to the host societies, primarily in terms of GDP increase and employment generation. An impact now bet-

ter understood, via accurate and data driven micro and project specific approaches and not dubious macro level predictions.

Direct and socially relevant economic impact would also massively result from openness and collaboration activities, provided they receive the required strategic focus and are given enough attention. Also, in the case of market creating innovations one would in addition need to measure the infrastructure investment the innovation would pull in to support the newly created market. This is a most important benefit in this case. Additionally, as discussed in the Tier 1 actions, open, collaborative and market generating innovations would present a key advantage for our measurement strategy, as they would be able to offer a much greater and a more natural visibility of their results. And, equivalently, the cost of their measurements would be much less.

Of course, impact is not just about the economic dimension; there are environmental issues, EU cohesion aspects etc. Also, openness and citizen engagement will have a different kind of impact: behavioural change.

It may sound daunting, but the principle is the same; everything, if correctly defined and framed in terms of decisions, can be amenable to analysis and measurement. For everything, we are able to reduce our uncertainty and the only true and pending issue is whether the cost to reduce this uncertainty is compensated by the value generated by its reduction.

Again, clarity will be highly important; this is why I believe even some definitions need to be overhauled. You will never measure the impact of market generating innovation if you don't even recognise it as a distinct entity, particularly relevant for the EU for its R&I capacity as well as its global agenda, for the many reasons I have laid out in Part 1.

Clearly, I am not in a position to make any further suggestions and provide any more technical detail. For example, as to what probability distribution better models the many above dimensions of the R&I impact (although I am fairly sure that it would be highly skewed and far from any Gaussian simplification). Nor can I say what is the best approach going forward and how impact can be prioritised in its measurement.

But there is literature evidence[55] that all this is not really impossible, despite a still prevailing idea of intangibles not being amenable to measurement.

My value adding point to this discussion is one alone: the R&I evaluation scheme I proposed and sketched above. This will allow for data to flow and it is these data that will gradually squeeze and attack our uncertainty from all points we choose to go after it. An offensive that can then be launched under AI, traditional statistics or any of the other wonderful decision support strategies available in our time.

For now, the first step is to build the enabling data infrastructure. And it is key to realise that the Fourth IR makes this task far easier than any time before.

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55 Indeed, Hubbard Decision Research (HDR – www.hubbardresearch.com) includes a wealth of practical examples, from globally renowned institutions, where intangibles were brought to the light of measurement. All this is also encapsulated in a theoretical framework, in an approach labelled by the author as Applied Information Economics. As the developer of the approach quotes, *"AIE is a theoretically well-founded set of techniques, it is a practical approach that has been applied to over 80 major investment decisions in a variety of industries. Every proper application of AIE keeps the bottom line squarely in mind, and the output from the AIE project supports practical business objectives".*

I have personally benefitted from the application of the methodology in a couple of business projects. It has undoubtedly broadened my horizons and reinforced my problem solving tool kit.

We must develop this intent, we must design and deploy the enabling instruments; macroeconomics is no substitute. We need to track data, communicate them and make use of them to build true confidence, change attitudes and behaviours, and shape the future of the EU R&I.

Yes, it can be done!

"Everything can be measured", as top strategist and decision support expert Douglas Hubbard would say, reiterating the global experience of many dozens of the most diverse assignments.

The third tier of impact management: Retuning the process

This chapter will suggest a re-consideration of some current practices and processes. This is far from exhaustive: it is about some relatively minor issues, in the sense that they are not as tightly integrated and streamlined with the strategies, as the two above tiers. I do, however, believe they have a special interest as they affect the quality of the process.

Reconsidering a dominance of quotas

As described above, the key issue with the current evaluation system is that it is memoryless. I described above some ideas for a significant reform that will cause it to track performance and make a multifold use of it in due course. I'd like, however, to point out here one further evaluation practice that I think may need some reconsideration. For, I have often felt that it compromised the quality of the exercise.

I am referring to what might be called a quota culture: the many quotas that are taken into account when selecting the evaluation panels. A balance between north and south, old and

young, women and men, business and academia, and possibly other pairs beyond my imagination. More than merely suspecting this, I have witnessed it in several instances: where people of low competence and insignificant knowledge issued decisive verdicts on the allocation of millions of Euros. It always made me wonder why being a young lady from the East gives you some special power to suggest throwing significant amounts into the dustbin.

Such practices are truly controversial and there are arguments on both sides of the line. In my view, excessive fervour in respecting these quotas can only come at the expense of the quality of the process. This is sheer causality. Ideally, one would have preferred not to be obliged to make a selection between the quotas and the quality of the process; to have them both fulfilled. But, in practice, this cannot happen; there is an antagonistic relationship. A pool of evaluators ranked in terms of quality will produce a list; if they are ranked in terms of a joint scheme, including both quality criteria and quota requirements, this will produce a different list. This second list, built on a number of criteria, compromises quality and meritocracy. There may be good reasons for doing so, but it compromises them both; there is no way out of this rationale.

The only exception I can see is the need to renew panels and introduce new, younger people. Indeed, this is a requirement for the very process to exist. Even if, seen as a snapshot, this may also undermine the quality of the process at that instant, in the long run it will uphold it and will render the process sustainable. Indeed, working with the same panels all the time is no realistic option.

Going one step further, I would dare say that I see all this quota fervour as a display of what I would call political correct-

ness. By this term, I mean an appeal to great and wonderful ideals as if they were realities you could reach out and touch. Take for example "open borders"; this may have haunted our imagination when we were small children and even later when singing the famous "Imagine" of John Lennon. Only to realise later that our imagination was a personal inner need and did not serve any other broader, more realistic purpose. Indeed, no progressive agenda has ever been built on sweet fancies.

Yes, FPs should contribute to gender equality. They should strive to engage women as they do men and report on this effort and its achievements. They should try to set an example that could stimulate others as well. In cases of a similar quality and availability they could give preference to a woman rather than a man. Gender equality policies could be part of the applicant track record and, thus, could be taken into account in his or her evaluation. There are many ways to account for such issues without resorting to a compromise of the quality of a critical and judgemental evaluation for the sake of some other great but untimely ideal. This can be fully and fervently exercised in other, less critical contexts.

And bidders should always be granted the right to just and merit based evaluation, by the best available experts in town and not by quota-fulfilling panels.

Empowering management

I've always found it surprising how little use is made of interviews for the evaluation process. Both experience and literature highlight the prominent role of leadership and the human factor. Yet, this is something that in FPs goes by largely unattended. Only recently, and only in some limited schemes, has there been some emerging interest in this otherwise long

standing idea.

Not only do I see interviews as an absolutely essential, unique and non-substitutable instrument of evaluation, but I think that successful bidders should be committed to deploy their interviewees in the task force. Indeed, this is the true purpose of the interview: to evaluate the fitness of key managers for the task. If they are to be later substituted, this largely destroys the whole idea and makes it useless.

One would perhaps think of this as something self-evident but it is not at all. In fact, it is very rare that the people developing the bid are those that will eventually staff and manage it. When I first noticed this, it greatly surprised me. In time I became accustomed to it, to some extent. Yet, this is clearly a bad and unusual practice in comparable private settings, where it is more consistently asserted that it is people that make the real difference.

So why does this happen? Why do organisations typically use one set of people to develop the proposal and another to implement the contract, if successful?

I would sum it up by saying that FP projects are not managed as typical business projects. Perhaps because of the public funding, project managers enjoy no empowerment similar to their peers in business projects. For example, they will never be able to flexibly move funds across the project tasks, to support new and dynamic patterns of requirements. They will have no say on the staffing of the project by the rest of the partners. And so on.

What this results in is a relatively enfeebled project manager and project management scheme. He is more like a kind of administrator than a proper project manager. Not irrelevantly, he is typically referred to as a coordinator and not as a manager.

This is what he really is: a coordinator and not a true manager. Void of true empowered management, it is not unusual for bid writers to be more senior than coordinators! For a bid developer will need to have as much deep knowledge of the issues as possible; one can more easily afford a junior project coordinator who will step in later with a mandate to coordinate and not really manage.

All this has made the interview unnecessary, and even the requirement to keep in the project roll out the same key people described in the bid.

Now try to imagine this awkward division of labour in the case of a VC funded project. It would simply be unbelievable. If a project is mostly its people, how on earth can you ever put money in the hands of a bunch of people for ideas worked out by some others? It would stand no chance, would be completely impossible!

One way or another, she who dispenses public money on R&I needs to know who is going to manage it and not simply who rolled out the ideas. These former individuals need to be interviewed and they need to be there throughout the project.

Of course, things happen. These key managers may leave for other pastures. A VC faced with such an event would most likely reconsider the whole thing from scratch. Perhaps this may not be as easy in the case of public R&I. Yet, it is not something that can go by unattended. It is something that must be documented and go in your track record. So it can be used at a later event, when you perhaps show up again in the public funding queue.

Projects cannot run without managers; leadership is essential. Vast amounts of literature and empirical evidence attest to this fact.

Going from a coordinator to a manager is a multi-step pro-

cess. After a few steps, such as those described below, a new vantage point will emerge and new opportunities will be seen.

The first step could be to give the manager the ability to change the time-plan of a project. She should be able to change the implementation details of various tasks, expedite some, delay some others, merge or split. And all this without the need to mobilise the whole system and go into time-consuming procedures which may conclude after the critical moment when the action is due. Then the ability to reshuffle the human resources; to ask a partner to provide a specific skill or to move out some person who is not up to the task. I think these changes would suffice for initiating the empowerment of management.

Clearly all this would mandate a somewhat different approach to the project roll out. Unfortunately, projects are perceived and designed as if they were of a fixed trajectory, passing through some points that are well defined at the beginning and never really contested and adapted thereafter. These points are called deliverables and they are something like the Holy Grail. Absolute truths – even if they have been designed three years in advance, in circumstances that may have radically changed in between.

Of course, from an administration point of view it is much easier to run a static project and assess how well it passes between these pre-fixed points. This is the main reason why things are so designed, statically. However, administration is there to serve the core project purpose and not to limit it. Losing flexibility and the ability to adapt to change and learn from new information is the worst thing that may happen to an innovation project. Thus, administration needs to compromise its desire for convenience and adjust to this essential adaptability requirement.

Last, I emphasise here that I deliberately referred above to the manager and not a management team. It is the project manager that needs to be re-established, not a vague team, which is more or less there. Indeed, companies and projects are run by managers and not by teams. Teams are good for design, consulting, advice, recall, promotion, but not really acting. Acting is for individuals alone. The idea that we can, somehow, act together is a typical illusion that often also serves as a good hideout for incompetence and laziness. Maybe this explains its persistence in time.

Result visualisation

The ten points below are the synopsis of the discussion in Part 2. They do not stand alone but remain tightly and causally linked to the strategic approach laid out in the first part. They assume meaning through it and outline an enabling operational setup for it.

1. Revamped project evaluation framework that takes account of the tangible results produced.
2. Evaluation framework pro-actively and continuously fed by verifiable performance data whose communication is now of clear interest to their developers.
3. Elucidation of impact, design of policies and setting of priorities by means of data-based decision support systems and state of the art risk analysis.
4. Ranked track record for all participants, fully open to society.
5. Fostering a culture of transparency, a passion for impact and a trust in measurements.
6. Eradication of instances of funding opportunism.
7. Tangible, measurable, bottom-up and long-term, open

and collaborative schemes, increasingly taking shape[56].

8. Traceable and measurable instances of co-creation and citizen engagement.
9. Easy to step in and low entry barrier, as currently the case[57]. Far more difficult, however, to stay in: depending substantially upon tangible, long-term, verifiable result registration and communication.
10. Fostering true project management and leadership skills, and introduction of personalised evaluation: a concept well known and widely practised in the world of VCs and privately funded innovation.

56 There are currently some instruments fostering mobility, albeit in a top-down way, and therefore unrelated to the current definition of "collaboration". Such as, for example, the Marie Curie programme, where the idea of secondment (mobility of people between different organisations) is very much emphasised. Secondments, however, are inflexible formal obligations and they do not result in any natural bottom-up way. They are perceived as the goal and not the means; in this way, they do not even remotely approximate the idea of open, collaborative and laterally scaling-up networks. Mobility and value network development are essentially very different concepts.

57 Indeed, at the moment there are no entry barriers or other undue modes of discrimination for accessing and participating in the world of the EU FPs. For example, whether you are a big or a small player, a business or an academic unity or an NGO makes no difference per se; just as it makes no real difference in the real world. I see this as a major and insightful implementation and I think it should be well safeguarded and preserved into the future.

Epilogue

A very long time ago, Socrates was one of the first to understand the importance and systematically preach and practise the art of questioning. Ever since, this unique skill has barely ever been followed up to any significant degree. Authority was the rule in the societies that followed and authority had no big appetite for questions; neither to ask nor to be asked. The very contrary, in fact! Authority was there to provide answers and enforce solid rules of action. And the masses needed to pay heed to the answers and follow closely the rules, with very limited and often perilous manoeuvering space.

Indeed, this command and control model, dominant over the centuries, did not need questions; it was built on answers and discipline alone.

Moving closer to our time, the ideals of self-determination, individualism, and democratic rule and debate were rediscovered, sparked by a series of spectacular shifts, starting from the Enlightenment, into the Industrial Revolution and up to our contemporary age; these ideals began to pick up speed again. Command and control started being criticised and challenged more and more. In 1936, in his famous best-seller[58] Dale Carnegie suggested: "Ask questions the other person will enjoy answering". He also advised: "Be a good listener".

Today, command and control is losing ground to flat and less

58 Dale Carnegie, "How to Win Friends and Influence People", Simon & Schuster, 1936, page 123.

hierarchical models, at an unprecedented pace and in such a dynamic way that nobody can really predict much about where the equilibrium between these two worlds will eventually settle. The importance of questioning is more and more restored as a unique means toward establishing powerful bonds, trust, recognition, true understanding and empathy. Additionally to all these, in our innovation context questioning is now widely perceived as the first and most important step to innovative undertakings.

Yet, how much is it really and in practice appreciated as such? How well is this skill mastered? For example, how many university courses exist under the title "The rare skill of questioning" or similar? It must be very few. I could even add that developing such skills would require empathy and mentoring. Thus, such topics would not be appropriate to delegate to some high quality e-course; they would require live classroom instruction. In contrast, topics such as mathematical analysis or machine learning, which are no doubt important and highly useful analytical skills, can be, with little compromise, developed in a self-teaching context.

A similar shift holds true in the case of transparency. See how the concept of an open kitchen has become widespread. People visiting restaurants just love open kitchens; they admire their transparency, as they add to their relaxation and are received as a genuine gesture of welcome and a clear sign of quality.

No doubt, this applies far beyond kitchens[59]. I think every

59 Indeed, the concept of operational transparency is receiving significant interest in diverse business sectors. A very good review can be found in the Harvard Business Review: Ryan Buell, "Operational Transparency", March–April 2019.

company that could offer such operational transparency to its clients would benefit. For the very same reasons. Because, if appropriately set up, it would be a means of connectedness and could unleash unique value. Not to mention the dialogue and feedback that such practices may stimulate. Just as with questioning, transparency is also a means of forming unique bonds and a safe condition for win-win set-ups. Even more so in the case of publicly funded R&I activities, where transparency, in the fully-fledged, deep, impact- and participation-oriented, and interactive perspective that has been presented in this book, is not just a powerful add-on but also a responsibility and a commitment towards society.

Transparency triggers collaboration and collaboration feeds back to transparency in a virtuous circle; collaboration can be nothing but transparent. In its emerging paradigm, it transcends beyond strict value chain lines and their many obscure confidentiality underpinnings. It is out in the light and cannot be hidden; in fact, it gains its value exactly because it now makes no sense to hide.

There is indeed one technology that incorporates, in an impressive way, these powerful enablers; a technology where peer collaboration, transparency and distribution converge in a purely technical and not just a conceptual or operational way. It is blockchain, and all experts predict it will have a transformation impact exceeding that of the Internet. It is a foundational and not simply a disruptive technology, one that will require many years to establish and require a great deal of changes at the business, government and society levels. Perhaps, currently, blockchain conjures up just the idea of bitcoin and, at its extreme, smart contracts. But it would be simply naive to think that this is everything about it.

From a different angle, blockchain clearly illustrates what the future holds. What the new business models will be about.

Talking about business models, I have often felt awkward at how often people engaged in EU R&I talk about collaboration and new business models. Somehow these expressions are seen as key to a competitive advantage. No doubt they carry some positive significance and convey the feeling of change, deep change, one would only expect from innovation. But I am soon frustrated to see that the perception of the "collaborative new business model" is degenerated to some "value chain" or "outsourcing" or "partnership" variant that has been around for a few centuries. And I am equally disappointed hearing people boasting about some commercial agreement they signed within such a supposedly new business model. Indeed, I am unable to see any new business model unless it reflects the Fourth IR collaboration, co-creation and peering principles. Perhaps with some touch of their technological complement: blockchain.

This underlines, once again, from the perspective of collaboration now, the great inertia that is in place, pulling us forcefully back to the era when it was just about answers and not questions, about closed frontiers and not transparency, about value chains and not networked ecosystems.

And to an era also, where the amount of data was sparse and not as massive as it is today, opening the door to a new and high resolution world, where human collaboration is now extending also to include machines and artificial intelligence, harnessing their powers and even collaborating[60] with them.

60 I am referring here to the emerging trends in AI interpretability; in principle these approaches seek to combine the human and artificial skills in one powerful environment.

Malcolm Gladwell, named by Time magazine as one of its 100 most influential thinkers ever, explains[61] his own perspective and positive outlook for individualised and micro approaches, and his deep suspicion of aggregates: "science is not about universals but about variability: genetics has opened the door to understanding of variability". I would add that a similar point applies to innovation impact assessment, to link to the related discussion in Part 2.

Just as with the skill of questioning, transparency, peer collaboration and data-driven, individualised, micro-impact approaches are all poorly practised and clearly still out of the mainstream. It is the mindset that is missing, not the purpose or the tools. Innovation, Fourth IR era innovation, is powering the purpose and providing the tools. Yet, though we are going through a disruptive era, and an era of non-linear change, minds, strategies and operations are often stuck and continue to respond in a linear way.

First and foremost, this change will require a change of minds; a new disruptive thinking is where it will first take place and assume its shape. Disruptive thinking, whereby small and silent changes, not revolutionary jumps into the void, may open in front of us a brand new world. Like the world of Richard Leftley[62] who was trying unsuccessfully for many years to introduce low-cost insurance schemes for the Zambian poor. And who one day realised that the limited response was only due to the fact that the three information fields requested for registration to his service were too much, and that people in that part

61 https://www.theregister.co.uk/2008/11/30/malcolm_gladwell_no/

62 Clayton Christensen, Efosa Ojomo and Karen Dillon, "The Prosperity Paradox: How Innovation Can Lift Nations Out of Poverty", Amazon, 2019, page 76.

of the world were not at all comfortable disclosing their age. This slight change came with some small operational risk, but opened up a huge market in front of him. This is an example of what I would call a true disruption: a spectacular case of a market generating innovation, one that created 55 million new consumers in the broader region and also pulled in social infrastructure for their support. This powerful dipole of the new market generating innovation and its linked support infrastructure may result in a unique impact on poverty relief.

I have no doubt that issues such as openness, collaboration, transparency and all the other traits of the Fourth IR will sooner or later be established in the context of the EU R&I. In time, a new type of innovator profile will emerge; a globally minded, market aware individual with an inquisitive and extrovert mentality, a hard-wired democratic attitude and an ability for lateral thinking and fast association. An individual who will see above and enjoy venturing beyond linear continuity; to the realm of challenge and disruption.

There is a great inherent value in all these ideas, while they are also the soul of both the rapidly developing IoT technology and the emerging, distributed energy model for the post-carbon era. Eventually they will prevail over the forces of inertia.

Society should come at the forefront of the R&I activity, as a protagonist. I could even expect that in the case of the EU its globally admired social model could provide an additional stimulus to this shift. There is a rich tradition of this model to build upon, stretching many centuries back. Seneca was the first in history to provide an illustration of *liberalitas*, the great, new, freedom-centred society, introduced some decades before him by Roman Cicero and followed up by Graeco-Roman Plutarch.

Seneca borrows[63] from the Greek stoic Chrysippus and offers an allegory of the virtue of the new-born *liberalitas*[64]:

The dancing Three Graces, giving, receiving and returning benefits; what a magnificent illustration of the essence of social interaction!

This special and rare competitive advantage we Europeans enjoy has not yet been tapped into; as regards innovation, we still lag well behind the USA and SE Asia. We need to gradually leave behind us the current, unfortunate, so-called European paradox[65] and announce an era where the gap between us and our major global competitors will start closing.

For all this, we will need to constantly challenge and counteract, with any power we possess, the forces of inertia that are still in play.

This has been my ambition and hope behind this book.

63 Seneca, "De Beneficiis", 1.3.3.

64 Helena Rosenblatt, "The Lost History of Liberalism", Princeton University Press, 2018, page 25.

65 This term showed up in a European Commission report in 1995 to highlight the poor performance of Europe in turning research results into innovative products and services. The report "Green paper on innovation" can be found here: http://europa.eu/documents/comm/green_papers/pdf/com95_688_en.pdf. Unfortunately, it maintains its relevance despite the 25 years that have elapsed.

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