

Foresight Brief

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Technological revolutions and societal transitions

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Are we currently living through a new industrial and technological revolution? Does it differ qualitatively from similar revolutions in the past? How can we gauge its political implications? Researchers working within the school of evolutionary economics, in particular those who embrace the concept of techno-economic paradigms, regard the ongoing digitalisation of the economy not as a new revolution, but as the turning point between the installation period and the deployment period of a paradigm based on information and communication technologies. It is not the innovations which determine the form taken by the turning point and its duration, but instead our capacity to couple them with ambitions for economic and societal growth on a scale similar to those which served as guiding beacons during the deployment period of the previous paradigm, in the aftermath of World War II. This type of growth is qualitatively different from what we have seen before, being both socially inclusive and ecologically sustainable, and therefore involving a convergence of the digital and ecological transitions.

Are we in the Second Machine Age (Brynjolfsson and McAfee 2014), defined as crossing a threshold in the exponential growth of algorithm performance and big data? Or in the Third Industrial Revolution heralded by Jeremy Rifkin in 2011, based on low-carbon production, connected objects, nomadic work and 'lateral power'? Or in the Fourth Industrial Revolution, as claimed by the World Economic Forum in Davos in 2016, or even in the Fifth Industrial Revolution? As long ago as the early 1980s – 30 years before Rifkin's work – the Third Industrial Revolution featured prominently among the concerns of policy-makers working in the field of innovation. For example, the DIRV programme [Derde Industriële Revolutie in Vlaanderen, Third Industrial Revolution in Flanders] was launched in Belgium in 1983, following in the footsteps of similar initiatives in several other regions of Europe. One way of disentangling this chronological knot is to examine the scientific theories which identify a link between technological revolutions and long waves in economic development.

Exploring the past to understand the future

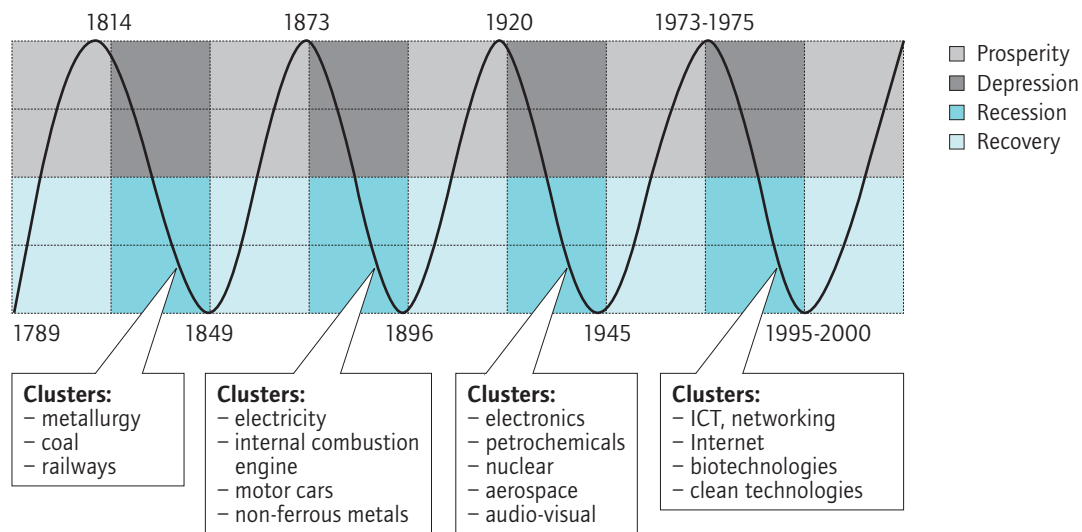
The concept of long (or Kondratiev) waves was introduced into economic theory by Nikolai Kondratiev (1892-1938), who noticed that periods of industrial revolution and the transitions between waves coincided, and that each wave – lasting between 50 and 60 years – incorporated both an ascending and a descending phase, with major innovations clustered in the decade or two before the start of a new ascending phase. Although he fell victim to Stalin's purges, Kondratiev was a Marxist economist who was particularly interested in analysing the recurrent crises of capitalism, with a less direct focus on innovation. Later Marxist theoreticians built on his work after World War II, in particular Ernest Mandel (1923-1995) and Jacques Nagels (1937-2014). A cause-and-effect relationship between technological revolutions and long waves was, however, first established by Joseph Schumpeter (1883-1950), who refined the idea of the long wave and identified four phases within it, namely recovery and prosperity (ascending), and depression and recession (descending).

By means of a process referred to as 'creative destruction', the period of recession promotes the convergence of innovations in mutually enriching 'clusters' around a smaller number of radical innovations; these clusters of innovation spread together through the productive fabric, cause major shifts in how goods are produced, marketed and consumed, and ultimately bring about economic recovery. Multiple clusters of innovation feature in the transition from one wave to another, meaning that powerful synergies emerge between them.

The Schumpeterian dynamics of innovation can be more easily understood with reference to Figure 1. The *recession* phase is characterised by a surge of interest in innovations which represent a departure from the technologies which have been present since the start of the wave and whose

Researchers building on the work of Kondratiev and Schumpeter believe that we are currently in the midst of the Fifth Industrial Revolution.

Figure 1 Long waves and clusters of innovation, from a neo-Schumpeterian perspective



Source: based on Valenduc (2002), p. 64, and Tonglet (2004), p. 15

lifetime is coming to an end. New clusters of innovations start to form within technology systems of all kinds, including machinery, energy, transport, materials and communications, and their cumulative impact on the economy is significant enough to halt the forces of recession in their tracks and trigger a recovery. During this *recovery* phase, the clusters of innovation mature and trickle through to the wider economy, transforming the ways in which people work, do business, and produce and consume goods. The subsequent *prosperity* phase is when the clusters of innovation continue to generate growth, but their impact starts to decline as a result of decreasing yield of innovations. During the *depression* phase, the clusters of innovation gradually lose their potency, and a shift takes place; technologies are increasingly used to save money, and modest innovations guaranteed to deliver short-term profits triumph over more radical ideas which are less sure of success. Depression becomes *recession* when overly enthusiastic cost-cutting measures disrupt the system and tip it into ‘abnormal liquidation’, to borrow the term used by Schumpeter himself. The following *recovery* can be triggered only by new clusters of innovation.

The chronological reference points included in Figure 1 are derived from the research of those working in the Schumpeterian tradition rather than Schumpeter’s own work (Boyer and Coriat 1984; Rosenberg 1994; Valenduc 2002; Tonglet 2004), and suggest that the juncture between the fourth and fifth long wave can be located in the years 1995-2000. This interpretation postulates that we are currently in the midst of the Fifth Industrial Revolution, with the associated clusters of innovation including information technologies, the Internet and other online services, biotechnologies, nanotechnologies, renewable energies and other sustainable development technologies.

Schumpeter's legacy and evolutionary economics

Schumpeter's writings leave many questions unanswered. Is economic development inherently cyclical? To what extent is the periodicity of long waves pre-determined? How do clusters of innovation emerge? Which policies can governments adopt to influence the way in which the transition from one wave to the next unfolds? The 'neo-Schumpeterian' school of research – or evolutionary economics, which is the term preferred by its main protagonists – has emerged to answer these and other questions, with *An evolutionary theory of economic change*, published by Richard Nelson and Sydney Winter in 1982, regarded as its seminal work (Arena and Lazaric 2003). Other prominent researchers working within this tradition include Giovanni Dosi, Christopher Freeman, Bengt-Åke Lundvall, Mariana Mazzucato, Keith Pavitt, Carlota Perez, Mario Pianta, Nathan Rosenberg and Luc Soete.

The concepts developed by evolutionary economists include systems of innovation and technological trajectories. A system of innovation, defined at national or regional level, is a network of institutions and actors in the public and private sectors who interact in producing, adapting, diffusing and using the new knowledge and new technologies which contribute to social and economic development. This is a broader concept than the Schumpeterian cluster, since it also incorporates those who play a role in innovation and the social relations which emerge between them. A technological trajectory retraces the history of a group of innovations with its associated twists, turns and forks in the road, dead ends and fresh starts, and demonstrates that technological innovations are always path-dependent – a path shaped by the interactions between economic, institutional and social stakeholders.

A number of authors working in the field of regulation theory have also drawn inspiration from evolutionary thinking, particularly in their analyses of the Fordist mode of regulation which is the hallmark of the 1945-1975 period of prosperity. The downfall of Fordism from the 1980s onwards can be interpreted as the decline of the techno-economic paradigm which shaped this period of prosperity (Boyer and Coriat 1984), and the very idea of a 'post-Fordist' revival implies the need for a new mode of growth based on a techno-economic paradigm newly forged from controversy and upheaval (Boyer 2002). Before going any further, however, we must define exactly what is meant by the term 'techno-economic paradigm'.

From long waves to techno-economic paradigms

Instead of focusing solely on a deterministic succession of long waves, evolutionary economists prefer to ascribe more importance to the tensions and political choices which appear during periods of transition by thinking in terms of techno-economic paradigms; these are defined as patterns of

A 'post-Fordist' revival implies the need for a new mode of growth based on a techno-economic paradigm.

continuous socio-economic development, with transitional phases ('technological revolutions') separating one paradigm from the next. The concept emerged in Brighton (Science Policy Research Unit, SPRU) and Maastricht (Maastricht Economic Research Institute on Technology, MERIT) from the 1980s onwards, with its most prominent advocates including Christopher Freeman, Luc Soete and Carlota Perez.

The transition to a new techno-economic paradigm stems from the convergence of several new technology systems, which act as vectors for multiple radical innovations that, in turn, give rise to structural changes in the global economy and the emergence of new social and institutional frameworks. The transition ultimately transforms the conditions and means of production, labour organisation, the labour market, channels of distribution and the way that people live their lives, and the new paradigm is diffused through the whole economy; the conditions under which this diffusion takes place are determined by political choices, social relations, the strategies adopted by economic stakeholders, how the labour market works and whether society's institutions manage to adapt. The technologies themselves determine neither the end nor the duration of the transition in advance.

Freeman and Soete published research in the 1990s referring to the current transition as the establishment of a new paradigm based on information technologies and networking, the development of a knowledge-based economy, a shift in collective service needs and a reconfiguration of social relations (Freeman and Soete 1994; Freeman and Louçã 2001).

This new paradigm replaces one based on cheap oil, the automation of high-volume production, the mass distribution of consumer goods and services, the boom in the chemical, aerospace, electronics and audio-visual sectors and a general increase in well-being in developed countries (the Fordist mode of growth, in other words).

Each paradigm differs in terms of the way in which the majority of companies are organised, the way in which social compromises are negotiated and the way in which international trade is structured. During the period of prosperity in the late 19th and early 20th centuries (the '*Belle Époque*'), business owners focused their efforts on large mechanised factories, particularly in the textile and heavy industry sectors. Mechanisation shaped the social and technical division of labour, social relations were characterised by inter-class conflicts and the appearance of an organised workers' movement, and colonisation globalised trade relations in a wholly novel way. During the 1945-1975 period of prosperity, the preferred vehicle for doing business was the Fordist company, based on the principles of mass production and consumption, economies of scale, automation-related productivity gains and a pyramidal hierarchy. It was Taylorism and automation which shaped the social and technical division of labour during this period, and social relations were characterised by the building of compromises between employers and trade unions and by a new dialectic

Technologies determine neither the end nor the duration of a transition, which is the outcome of their convergence with structural changes in the economy, society and institutions.

Social relations were characterised by the building of compromises between employers and trade unions and by a new dialectic of cooperation and conflict.

of cooperation and conflict. The new face of globalisation was that of a multinational company, following the example of the behemoths of the oil, electronics and automotive sectors. The following paradigm, based on digital technologies and networking, will truly take hold only once new ways of organising businesses and workers, achieving social compromises and institutionalising international trade, become generally accepted.

The new paradigm will not replace the previous one immediately or completely, however. The transition may stagnate as a result of the tardiness and timidity of the institutions called upon to make changes, and their tendency to remain trapped in short-sighted

strategies, even as the pace of innovation appears to be speeding up. A useful document to revisit in this connection is the report drafted in 1997 for the European Commission under the guidance of Luc Soete, entitled *Building the European information society for us all* (Soete 1997). As well as calling for the information society to have a social dimension and criticising EU policies for their failings in this respect, the report sets out a number of recommendations which demarcate the institutional changes which must be made as part of the transition towards a new paradigm, in areas such as the dynamics of innovation, education, the renewal of public services, the quality of jobs, social inclusion and cultural diversity. Were it published today, a more suitable title for this report might be *Remembrance of Things Past*.

Refined and updated evolutionary theories

The concept of the techno-economic paradigm has most recently been refined by Carlota Perez (Perez 2010), an intellectual heir of Christopher Freeman who is particularly interested in the unique role of speculative bubbles and financial crises in the development of techno-economic paradigms ('great surges', to use her terminology), and who has reinterpreted the periodicity of these great surges and the transitions between them, as summarised in Figure 2. Roughly speaking, the great surges described by Perez extend from the peak of one curve to the peak of the following curve, whereas neo-Schumpeterian waves extend from one dip to the next (as shown in Figure 1); Perez also dispenses with the idea of ascending or descending phases and replaces it with the concept of a growth regime.

What is innovative about this approach is the succession of installation periods, turning points and deployment periods in each great surge. The installation period is characterised by a triggering event and a phase during which new technologies emerge and transform the systems of innovation, followed by a period of bubbles, mania or even frenzy, typified by innovations which represent a departure in every sense of the word. The pace of innovation accelerates thanks to a context of financial speculation and market deregulation in which the States become ever weaker as they

Figure 2 Succession of great surges in economic history, based on Perez

	Installation period			Bursting of bubbles, recession	Deployment period		
	Trigger	Emergence	Prosperity based on bubbles		Turning point	Prosperity based on a 'golden age'	Maturity
1 st	1771 First Industrial Revolution	Canal mania		1793-1797	Great British leap		
2 nd	1829 Age of Steam and Railways	Railway mania		1848-1850	The Victorian boom		
3 rd	1875 Age of steel, electricity and heavy engineering	Mania of colonial empires		1890-1895	<i>Belle Époque</i>		
4 th	1908 Age of oil, chemicals and mass production	Mania of the Roaring Twenties		1929-1944		Glorious Thirty, post-war golden age, Fordist regulation	
5 th	1973 Micro-processors, ICT, biotechnologies	Internet and e-economy mania, emerging markets, casino economy (finance and real estate)		2000-2002		2008-20??	Towards smart, inclusive and green growth???

Overlap with the next great surge

↑

Dominant role played by finance and deregulated markets

↑

We are here

↑

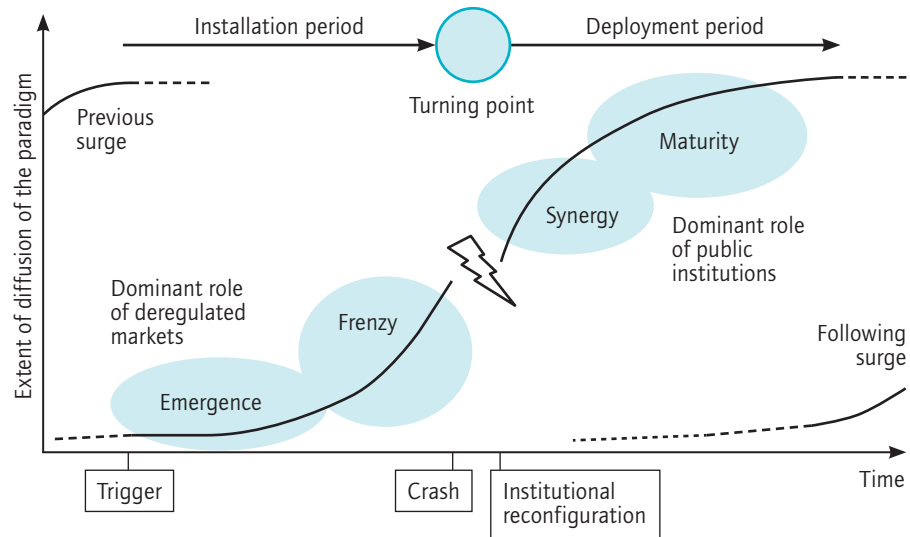
Dominant role played by state institutions in a steering capacity

Source: based on Perez (2016), p. 195, with certain modifications

lose control over this new modus operandi. Eventually the bubbles burst, a financial crisis breaks out and the economy enters a recession; this is the turning point between the installation period and the deployment period, or between an artificial prosperity based on bubbles and a more stable form of prosperity. Synergies are realised between the potential of the new technologies and societal transformations, ushering in a new 'golden age' and marking the maturity of the new paradigm. This period also sees the first hints of the innovations which will trigger the following great surge. The turning point may be brief (the period between the second and third great surges) or significantly longer (the period between the 1929 financial crisis and the end of World War II), or even uncertain and open-ended (the current great surge); its precise duration depends to a much greater extent on socio-political conditions than on the performance and availability of the new technologies.

Figure 3 describes in greater detail the stages of a great surge as a basis for better understanding the phenomenon we currently refer to as ‘digitalisation’.

Figure 3 The successive phases of a great surge



Source: revised from Perez (2004), p. 79

The current great surge was triggered by a number of radical innovations in the years between 1973 and 1975. The most important of these was the microprocessor, which heralded the miniaturisation of electronics and computing, but mention should also be made of the first forays into genetic engineering, which opened the doors to the field of biotechnology. It was during this period that crisis hit the Fordist paradigm as a result of the first oil price shocks, the weakening of the welfare state and criticisms levelled by social movements at various manifestations of the ‘damage of progress’¹, such as the dehumanisation of work, overconsumption and environmental degradation. It was not until the 1980s that this new great surge began to make inroads into the world of business in the form of personal computers, digitalised telecommunications, telematics, optical character recognition, digitalised sound and then images and the appearance of companies willing to sell and buy electronic data on a global scale. These emerging technologies rapidly diffused through all sectors of the economy, affecting a growing number of jobs, and it was from this point onwards that evolutionary economists began to think that a new paradigm based on information and communication technologies might replace the collapsing paradigm of ‘oil + Fordism’. ICT-related developments entered a period of frenzy from the 1990s onwards, in lockstep with the unification and enlargement of the European markets; the boom in mobile telephony started after the adoption of the GSM standard in 1992, and the Internet was opened up to companies and individuals from 1995 onwards, in a broader climate of communications

1. *Les dégâts du progrès [The damage of progress]* is the title of a book containing contributions by a group of researchers and trade union activists which was published in 1977 by the French Democratic Confederation of Labour [Confédération française démocratique du travail, CFDT] (Seuil/Collection Points). It represents a good example in the French-speaking literature of a departure from the Fordist consensus on the social merits of technical progress.

liberalisation. It was also in 1992 that the Rio Summit officially alerted the world to the risks of climate change, and certain researchers identified, even at this early stage, the potential of information and communication technologies to dematerialise the economy. ICT mania reached its apogee at the turn of the century, with a plethora of different activities being prefixed with an 'e' (e-government, e-learning, e-health, e-commerce, e-banking, e-work, e-Europe Action Plans, etc.), to the extent that controversy reigned over the dawn of a 'new economy' called the 'e-economy' (Boyer 2002; Gadrey 2000).

It was against this backdrop that the first warning shots which dampened the frenzy were fired when the speculative dot-com bubble burst in 2000-2001, heralding a much wider financial crisis. A frenzy for all things ICT-related led banks and stock exchanges – in a context of accelerated deregulation – to develop increasingly complex virtual financial products and increasingly opaque decision-making algorithms. The financial crisis of 2008 cannot be attributed solely to the collapse of the sovereign debt and mortgage lending markets; it was also the outcome of unfettered digitalisation of the financial system, with the 2000 crisis being fuelled by innovation *in* ICT and the 2008 crisis being fuelled by financial innovation *with* ICT (Perez 2013). This financial crisis in two acts, separated by an interlude during which the frenzy reached another brief apogee, marks the turning point between the installation period and the deployment period of the new techno-economic paradigm.

What we refer to as digitalisation of the economy is not, therefore, a new industrial revolution but the laboured and uncertain transition between the installation and deployment periods of this new paradigm (Valenduc & Vendramin 2017). Ten years have passed since the 2008 crisis, but we have not yet moved on from the turning point because the institutional, political and social conditions for transition have not been met, and we continue to be blinded by ICT mania.

Digitalisation of the economy is not a new industrial revolution but the turning point between the installation period and the deployment period of the great surge which started back in the 1980s.

Transition-related challenges

When viewed from this perspective, the turning point phase is characterised, first and foremost, by a growing awareness of the excesses of the installation period, and in particular the period of frenzy. As market regulatory mechanisms are eroded or destroyed, productive capital is neglected in favour of financial capital, and the features of a casino economy become ever more prominent. The outlook for investments in the new markets and their development becomes increasingly uncertain, but new start-ups take advantage of this uncertainty and of stock market bubbles. Productive capacities are restructured to accommodate speculative interests, leading to job losses, a persistently high level of structural unemployment, rising social inequalities and a laissez-faire attitude to the environment, while austerity

politics weaken government structures and therefore bring about a stalemate. A glance back at history reveals that similar findings can be made for the turning points of previous great surges², but simply criticising the excesses is not enough – particularly if critics content themselves with nostalgic reminiscences of an irretrievably lost golden age.

The main challenge faced during the transition to the deployment period is the identification of a purpose, or in other words both a focus and a meaning, for the potentials revealed by the phases of emergence and frenzy in order to create synergies between them. This vision of the future must be innovative, coherent and serve as a rallying cause – requirements which can be met only by a new model of growth which is both socially inclusive and ecologically sustainable (Jacobs and Mazzucato 2016). A model of this kind would be capable of reconciling the oft-siloed scenarios associated with climate change and the digital transition (Pochet 2017), and its meaning would be based on a new understanding of progress, quality of life and solidarity. This vision of the future overhauls the 1990s approach to the techno-

economic paradigm by boosting its ecological credentials, since the environmental problems acknowledged back then were very much a secondary concern (Freeman and Soete 1994). The prioritisation of environmental sustainability is absolutely imperative, since a period of sustainable and shared prosperity which ignores environmental and climate-related constraints is now unthinkable. This inclusive and sustainable golden age of the future must

not only involve a new model of societal living, but also provide answers to and move beyond the environmental problems which represent the legacy of the previous golden age, in particular built-in obsolescence, pollution, global warming and inefficient use of energy and raw materials.

Having identified the purpose (focus and meaning) of the transition, the question of how to embark on this path must be answered in the political rather than the technological arena. According to Perez (2013, 2016), two different kinds of political action are required; measures to modernise the States and their governments, and measures to restructure the regulatory and institutional framework.

The deployment period differs from the periods of emergence and frenzy in that the latter involve liberalisation efforts aimed at dismantling the institutional frameworks of the previous paradigm and therefore a weakening of the States' role, whereas the former requires government bodies to play an active and proactive role. This has been a persistent feature of each great surge, but far-reaching contextual changes mean that the States can no longer operate on the basis of the model which applied during the previous golden age (1945-1975). There is a need for innovative and networking-friendly forms of political involvement and public-sector governance, and government backing for research and innovation must prioritise the question of purpose (focus and meaning). Power must be redistributed both downwards (to decentralised local communities and regions) and upwards (to supranational institutions), and economists must harness synergies

The deployment of a paradigm based on digital technologies is given focus and meaning by the prospect of socially inclusive and ecologically sustainable growth.

2. The periods of prosperity during the Victorian era from 1850 onwards and the *Belle Époque* from 1895 onwards were also marked by crises which followed the bursting of financial bubbles after periods of frenzy (Perez 2004, 2013).

between the evolutionary approach, the Keynesian resurgence and ideas gleaned from ecological economics (Pianta 2017).

Both Perez and most of the contributors to the multi-author work *Rethinking capitalism* (Jacobs and Mazzucato 2016) have suggested other political measures for transforming the regulatory and institutional framework. These include a new system of growth and well-being indicators to replace GDP (an obsolete legacy of the previous paradigm), a genuinely green tax shift which prioritises sustainable and resource-efficient goods and services, strict longevity and repairability standards for products, support for a genuinely collaborative, peer-to-peer economy, a comparative appraisal of basic income systems (differing in their level of universality and unconditionality) with the end goal of replacing the social contract originally drawn up in the post-war period, a large-scale plan for international investment in lagging economies, government reinvestment in infrastructure (particularly information, communication and training infrastructures), a new model of life-long training and education, a refocusing of the financial system's investment capacities and the establishment of supranational tax regulations – all of which require the States to play an active and proactive role and thus to abandon austerity and deregulation policies which only prolong the period of weak growth, few jobs and zero prospects.

Historical comparisons reveal that these changes must be on a scale similar to those which occurred during the previous turning point, which led to the deployment of the Fordist paradigm and the 1945-1975 golden age. The periodicity of technological revolutions is therefore not merely a matter of academic interest, since it highlights points of comparisons in respect of political choices and societal transformations.

Economists must harness synergies between the evolutionary approach, the Keynesian resurgence and ideas gleaned from ecological economics.

Certain shortcomings of the evolutionary approach

The transition to a period of technologically smart, ecologically sustainable and socially inclusive prosperity serves as a rallying cry for evolutionary economists, but a critical examination reveals certain shortcomings that still need to be addressed.

The first of these is a mismatch between the idealised portrait of previous paradigms' golden ages and the actual state of society at the time. The '*Belle Époque*' at the start of the 20th century was far from beautiful for everyone, in either the colonising countries or their colonies. The 30-year golden age which followed World War II undoubtedly saw substantial improvements in terms of well-being and social protection, but these were coupled with bitter social conflicts and persistent inequalities, in particular across the gender lines. The term 'golden age' is nowhere near nuanced enough to describe the prosperity which is present during the deployment and maturity periods.

The environmental costs of digitalisation must be investigated with greater rigour, and a number of red flags have already been raised.

Secondly, it is not always easy to distinguish between the ‘disruptive’ and technologically innovative trends which form part of the synergistic deployment period of the current paradigm and those which represent the first swellings of the following great surge (Figure 3). This is exemplified particularly well by advances in the fields of machine learning algorithms and artificial intelligence agents, which have already filled many inches of column space even though the enormity of their impact is likely to become clear on a timescale of decades rather than years. The wide variation in timescales used as a basis by different authors serves only to confuse matters further (Brynjolfsson and McAfee 2014). Questions can, therefore, justifiably be asked about the criteria proposed by the evolutionary economists as a basis for distinguishing between disruptive trends at opposite ends of a great surge.

Controversy also continues to rage over the much-trumpeted ecological sustainability of digital services and technologies. Digitalisation may well be a way of achieving a simpler and more equitable approach to life and economic growth, but its environmental costs must be investigated with greater rigour, and a number of red flags have already been raised. Certain factions in the debate surrounding the ecological transition also stress the fact that it is not green growth which is the problem, but the prospect of what amounts to zero-growth prosperity (Pochet 2017).

It should also be pointed out that the evolutionary approach – despite the fact that it represents a clear departure from technological determinism and acknowledges the pre-eminence of social, political and institutional factors – pays scant attention to the influence of these factors on the nature and focus of technological development, or in other words the social shaping of technology. One of the reasons for this may be the gradual narrowing down of the evolutionary approach to fit more neatly under the umbrella of economic sciences, rather than cutting across a wide range of disciplines (including sociology, history and the political sciences) as it did in the period between 1985 and 1995.

Finally, greater attention must be paid to the various stakeholders in the transition and deployment periods. Although the evolutionary approach offers an exciting alternative to the hegemonic school of economic thought, it still lacks a theoretical framework which could be used as a basis for conceptualising the roles of the different economic and social players, the tensions and conflicts between them and the way in which they reach agreements and compromises; a multidisciplinary approach would therefore be useful in this respect too.

Conclusion

The phenomenon currently referred to as ‘digitalisation of the economy’ is not a new technological revolution – neither is it Brynjolfsson and McAfee’s Second Machine Age, nor Rifkin’s Third Industrial Revolution, nor the World

Economic Forum's Fourth Industrial Revolution, nor even the Fifth Industrial Revolution (which started as long ago the early 1980s). What we are living through is the transition to the deployment period of the fifth great surge, and this deployment period will commence in earnest only once we have managed to extricate ourselves from the current crisis, which represents not only the dying throes of the fifth great surge's installation period, but also a turning point between the turn-of-the-century frenzy for all things ICT-related and the realisation of urgently needed synergies between innovative potential and society's end game – all on the basis of far-reaching institutional upheavals. The motivating force behind this transition is a new model of growth which harnesses the potential of digital services and technologies without forgetting the importance of social inclusion and ecological sustainability.

Society does benefit in at least one way from debates centring on the supposedly disruptive nature of the changes we are currently experiencing; at an early stage of the game, questions are being raised about the quasi-imminent emergence of a sixth great surge, whose timescale – according to the theory of techno-economic paradigms – is likely to be long. For the time being, however, that is a whole other story which remains to be written. ●

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Foresight Briefs already published

Shaping the world of work in the digital economy

#01 – January 2017

Christophe Degryse

In June 2016, the ETUI's three-day conference in Brussels brought together the best experts on social issues related to the digitalisation of the economy, a theme that is still difficult to grasp in terms of its specific implications. In dedicating its first issue to this conference and its conclusions, this *Foresight Brief* offers more than a mere summary of the debates. It instead aims to draw out vital points concerning the strategic challenges that we believe the world of work faces in this new 'digital revolution'.

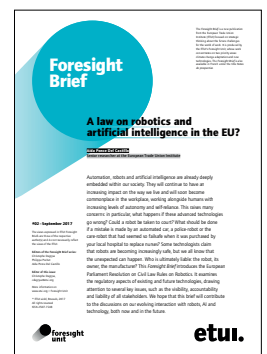


A law on robotics and artificial intelligence in the EU?

#02 – September 2017

Aída Ponce Del Castillo

This *Foresight Brief* introduces the European Parliament Resolution on Civil Law Rules on Robotics. It examines the regulatory aspects of existing and future technologies, drawing attention to several key issues, such as the visibility, accountability and liability of all stakeholders. We hope that this brief will contribute to the discussions on our evolving interaction with robots, AI and technology, both now and in the future.



Two futures and how to reconcile them

#03 – November 2017

Philippe Pochet

Although there is little argument about the fact that climate change and the digitalisation of the economy are the two main trends that will matter most over the coming decades, to date they have predominantly been considered separately rather than together. The aim of this *Foresight Brief* is therefore merely to initiate a debate. The author firstly analyses the different versions of these two narratives, before examining their potential formulation and ranking and then exploring the emergence of digital and green capitalism and its consequences. He concludes by proposing a scenario involving a two-step approach to change.



All *Foresight Briefs* are downloadable from www.etui.org/Publications/Foresight Briefs

Additional reading



HesaMag #16

Autumn-winter 2017

Special report: The future of work in the digital era

The *HesaMag*, the ETUI periodical dealing with occupational safety and health, has recently investigated the impact of new technologies on working conditions and workers' health and safety.

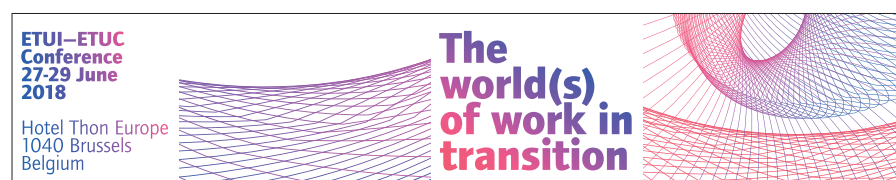
G rard Valenduc assesses the consequences of digital technologies on workers' health and safety, in areas where they face psychosocial risks, musculoskeletal disorders, and other work-related injuries.

The *HesaMag* special report on digitalisation also includes various news reports covering the development of the 'fake news' industry in Macedonia, the introduction of Google glasses in DHL warehouses in the Netherlands, the safety risks encountered by Brussels bike couriers working for food delivery platforms, the use of exoskeletons to prevent musculoskeletal disorders in the French building sector.

In the face of these trends, people working in this 'new economy' have begun setting up initiatives to represent their collective interests, as shown in an article co-authored by Six Silberman, an expert in new technologies.

To download these articles: www.etui.org/Publications/Periodicals

ETUC – ETUI Conference



The world(s) of work in transition

27 – 29 June 2018

Hotel Thon Europe, 1040 Brussels

The world is being transformed in ways that will profoundly challenge human society. The free movement of capital, services and people is altering the allocation of jobs. Climate change and energy transition are making many occupations obsolete, while at the same time creating new 'green' jobs in emerging sectors and industries. The demographic transition is changing the structure of the labour force and challenging social security systems. Finally, the digitalization of the economy is set to disrupt the processes of production, employment and work conditions on an unprecedented scale. These are some of the questions the 3rd ETUC/ETUI conference on the future of work will deal with.

To register: www.etui.org/Events

