



# Work 4.0

Hypothesis for a new modernity



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### Executive summary

The purpose of this report is to outline, in broad terms, the data collection of qualitative research and in field observation as well as best practices, suggestions and initiatives around industry 4.0 that emanate from the Portuguese territory, but have a global reach. The research process comprises following upon the extensive literature available, ranging from private companies, public sector and European Institutions, as well the data collection used from qualitative research namely: a set of interviews to relevant stakeholders and ethnographical surveys (observing the current interaction between mankind and machines inside several companies).

The process towards an implementation of Work 4.0 concept throughout the Portuguese industry reveals itself as complex to achieve as ever. Multiple combined variables with bilateral implications among them proved to be in action. However, research conducted clearly identifies 7 hypothesis with areas of change. When read through these 7 hypotheses uncover 14 crucial variables. Ultimately, these are the 14 variables that concur to a system approach and that enable mapping potential relations and alliances between them. Two of these factors clearly excel with potential to be actionable as key changing actors: “Ability to adapt to emergent working environments” and “Willing to Learn and Think”.

COTEC’s present aim is that the following pages can contribute to the amplification of the concept work 4.0, in-depth debate, and, ultimately, gather consensus agenda for policy makers on priorities for a new future.

# **Índex**

## **1. Flagships for reflection**

### **1.1. Inspiration**

### **1.2. Alliances**

### **1.3 Contributors**

## **2. Bibliography**

## **3. Research team**

# Flagships for reflection

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Contribing blocks



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## **INSPIRATION**

Entrepreneurial activities differ substantially depending on the type



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## **ALLIANCES**

Approach based on macro-variables introduced and discussed throughout the contributors



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## **CONTRIBUTORS**

Conducting 33 interviews with leaders of state-of-art companies and or transforming programs exploring their views and perspectives on the particular topic, either in small groups or individually

# INSPIRATION

Seven Hypothesis towards a new modernity

# From strategic politics to legacy heroes

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The complexity of contemporary societies is awakening the need for an increasing number of Politics and for a more structured Government intervention, so that a shared vision towards sense of an essential social cohesion can be achieved. The demographic challenges (age, gender, migrations) and the environmental challenges require effective answers, with broad spectrum. These can emanate but from the political power, for it is the only establishment endowed with the conditions to execute it.

Focused on conceiving and executing an Agenda for the Common Good, in the journey towards 4.0, Governments (national and supranational) is forced to start a double movement: to draft strategies and earmark resources which not only stimulate digital transformation, but also ensure the citizen's safety, anticipating and controlling personal risks which ultimately result in adjustments of social and business models.

In a 4.0 world, work will question the same old Social Question, forcing strong interventions in sectors such as Health, Justice or Defense, redefining the relationship between State and Citizen, from the successive incorporations of Digital, and its growing automation.

# From strategic politics to legacy heroes

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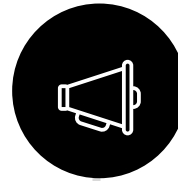
Evidence of a changing world

- ✓ France, Germany and Italy intensify their trilateral cooperation to promote digitization of manufacturing industry. Alliance Industrie du Futur, Plattform Industrie 4.0 and Piano Industria 4.0 agreed to cooperate to a trilateral cooperation in June 2017 in Torino. The committee decided to concretely move forward in the coordination of the national initiatives, for example by working on joint papers on standardization of the administration shell (common vocabulary to express functions in new industrial products) and on issues regarding industrial data ownership.
- ✓ Over 41% of EU companies have yet to adopt any of the new advanced digital technologies (source: The Digital Transformation Monitor 2017)

# From strategic politics to legacy heroes

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Quotes from our contributors



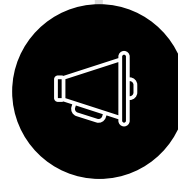
**Jan 2018**

"Legislative intensity can be useful to stop dangerous developments but also dangerous if it becomes limiting and reduces stimulus for new ideas."



**Jan 2018**

"As the consequences of digitization arise, legislative and regulatory intervention are necessary, even if it is always one step behind."



**Jan 2018**

"Regulation in a deregulation logic, for example, making our working terms more flexible."

# A big move for big data

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The presence of Digital is visible in all spheres of human life: on the individual one, propelled by mobile technologies; in the communities; and in the society and the economy, as a whole, at a global scale. This omnipresence has been seen and lived as story of success, of overall contentment and involvement by those who intervene, fostering a promising environment to its qualitative and quantitative expansion.

The understanding that this information runs “in line with willpower” in systems of biological intelligence, as well as artificial intelligence, goes without saying. Data acquires a status of essential prime matter and performs on a stage of overall collaborative logic. The massification (still quite incomplete) carries the exponentiation of inputs, contents, opening ways to an even finer and more fertile investigation. The “algorithmisation” of everything becomes appealing, truly irresistible, creating successive layers of theory and of applied knowledge. To be aware of the sheer size of this Revolution, to encounter its corresponding impacts as soon as possible, to formulate scenarios of tendency development and to look for public debate around the current main topics. All are unmistakably wise and looked-for (likewise irreversible) Journey towards 4.0.

# A Big move for big data

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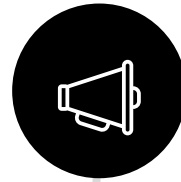
## Evidence of a changing world

- ✓ Smart Industry is an initiative for digitizing industry and business and its mission is presented as a common and strategic vision for the future Dutch growth. It envisages the use of a network-centric approach to production, building on intelligent and flexible network approaches. In particular, SI focuses on helping businesses to offer flexibility in production, volume, resource efficiency, costs and adaptability to customer needs as well as to integrate entire value chains in value creation. The Dutch model supports itself in the development of a network-centric approach and a digital transformation of companies. The Dutch “polder model” for consultation and deliberation in decision.
- ✓ Society 5.0 was proposed in the 5th Science and Technology Basic Plan as a future society that Japan should aspire to. A human-centered society that balances economic advancement with the resolution of social problems by a system that highly integrates cyberspace and physical space. In Society 5.0, a huge amount of information from sensors in physical space is accumulated in cyberspace. In cyberspace, this big data is analyzed by artificial intelligence (AI), and the analysis results are fed back to humans in physical space in various forms. The government is encouraging businesses to share Big Data and promoting cooperation to drive innovation. Japan’s Society 5.0 is not just about the technology, but the policies and regulations that shape its development.
- ✓ Around €25 million for 2014-2017 period complemented by co-financing from industry, were raised by Smart Industry Program

# A big move for big data

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Quotes from our contributors



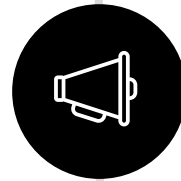
**Jan 2018**

“What is different now is that knowledge doesn’t reside only in people.”



**Jan 2018**

“Codified knowledge has become a tradable good.”



**Jan 2018**

“We have now, as most important factors of productive work, somethings that are neither capital nor work: Knowledge and Human Capital.”

# Skills: hard soft and its beautiful combinations

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The growing significance attributed to the concept of “skill” in leadership practice, reflects the awareness of its profound complexity – summarized in a ratio of a very large scale times at a very high speed. Space comes in for new multiples social phenomenon and its manifestation towards a central idea that highlights the Paradigm Change framework where processes are as important as results are. The organization will unconditionally need Talent, defined, to a great extent, by the ability to adapt to change.

From each individual’s point of view, it’s about finding solutions to problems which result in a weight loss of the Social State, particularly in Europe, and assuming disintermediation of essential functions including work, which will, less and less, match the current definition of employment. Organizations and individuals, commonly foresee that a re-qualification of competencies is vital for Human to continue to be predominant in an ecosystem inhabited by (very) intelligent machines.

Working simultaneously and in equal parts both on hard and soft skills is wise. Likewise, one needs to invest in soft skills which can only be achieved with Hard effort, through programming and monitoring, instead of a casual letter of intention. Developing the best hard skills has in itself the acceptance the personality’s soft skills, which captures an unique qualitative dimension.

# Skills: hard soft and its beautiful combinations

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Evidence of a changing world

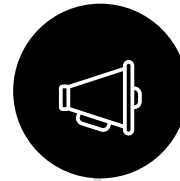
- ✓ Maryanne Thyssen, European Commissioner for Employment, Social Affairs, Skills and Labour Mobility, just recently announced the several initiatives focused on digital literacy and new hard soft skill combinations at the event “The future of work in Europe” that took place on the 29th of September 2017, in Turin.
  - Clustered as “Our Digital Skills and Jobs Coalition”, this brings together Member States, mobilizes businesses, national and regional governments, education providers and social partners who take action to tackle the digital skills gap in Europe Upskilling Pathways initiative which aims to improve basic literacy and numeracy and digital skills.
  - The intention of using big data to identify skill needs across Europe, hence helping educators, employers and employees alike
  
- ✓ The European Social Fund alone is investing €27 billion into education and training, in the Member States, in regions and communities.

# Skills: hard soft and its beautiful combinations

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Quotes from our contributors

**Jan 2018**  
“The proportion and balance between soft and hard skills is changing, emerging the need for greater investment in soft skills as a complement to hard skills.”



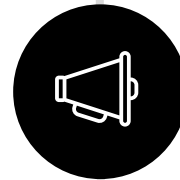
**Jan 2018**

“The main challenge will be to know how to think. Having the knowledge will not be enough and we don't know what will be needed to know in a few years.”



**Jan 2018**

“The important thing is to educate/train capable people. Skills are outputs when what counts is to build people's capacities.”



# Men and Machine: a new wellness concept

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We live in a time of large scale movements in the field of Work, due to the overall digitalization. Shifting movements have been massively registered: jobs which will disappear and jobs which will be created. Yet, these same changes were also aligned with new levels of specialization, implying constant requalifications.

We can also discuss the unfolding of other possible work configurations: in time (total/partial; regular/occasional), in space (present/at a distance; in the professional workplace, in another place).

All these aspects have impacts on the corporations which represent the workers' interests, forcing labour unions to rethink their ways of constitution and intervention, while new associative formats gain relevance, in line with project-based and multi-client service provision models. The lack of attachment to place and the new employer and client profiles, carries a strong detachment amongst workers, suggesting the reassessment of concepts such as those class-awareness like.

The cohabitation of man and intelligent machine will lead to successive role adjustments, being up to humans to take the most out of the experience and the expertise of their "new" working colleagues. New levels of knowledge can be achieved, deep innovations can take place – as long as virtuous cycles between both parties can be created.

# Men and Machine: a new wellness concept

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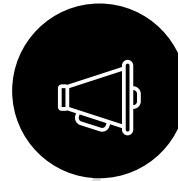
## Evidence of a changing world

- ✓ Malaysia Government targets to raise to 35, the percentage of skilled workers 35% by 2020. A recently launched programme named “Eleventh Malaysian Plan 2016-2020” identified six strategic thrusts to help Malaysia stay ahead of the challenges and opportunities and six game changers containing innovative approaches to accelerate Malaysia’s development. The thrusts include enhancing inclusiveness, improving well-being, accelerating human capital development, pursuing green growth, strengthening infrastructure and re-energising economic growth.
- ✓ The International Federation of Robotics predicts that by 2019 China will account for 40 percent of the worldwide marketplace for industrial robots, from only 12 percent in 2010.

# Men and Machine: a new wellness concept

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Quotes from our contributors



**Jan 2018**

“Machine and technology as an extension of people. I have to ask myself: how can the machines help me to work better?”

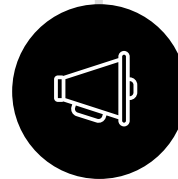
**Jan 2018**

“As we move into scenarios of uncertainty, the adoption of new spatio-temporal configurations of work is critical to the transition to a more digital work environment.”



**an 2018**

“There is a danger of being dazzled by the machine's possibilities.”



# Ongoing deep cultural changes

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The system of beliefs, behaviors, artistic expressions of a society constitute the concept of culture. The changes brought by the generalization of Digital and Web, and the vision of what the future might be, has been provoking significant cultural changes in European societies, when global and local (creative) tensions constitute a relevant topic in itself.

We consider two types of culture, both of them undergoing deep metamorphoses. The first one, designated by a more anthropological nature, includes the key dimensions of human life: the sense of belonging and the need for safety. The second type of culture appears to be more functional and points to a renewed demand for a predisposition to constant learning (including to learn), as a constitutive trait of the contemporary human identity.

It is possible to observe some shifts of power, from the old to the new generations, in terms of setting the tone and rhythm for the evolution of current societies – a consensual shift, given the natural technological superiority of the younger generations, along with another level of worldliness and education. New languages, new symbolic references are marking the cultural landscapes.

# Ongoing deep cultural changes

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## Evidence of a changing world

- ✓ The Federal Labour Minister of German Government launched a White Paper on the future of work (Arbeiten 4.0), calling for an end to regulations that stipulate an eight-hour-day and summarizing the various viewpoints on ideas about how working time might be regulated in the future.
- ✓ Alliance pour l'Industrie du Future, launched by the President of the Republic Francaise plays a central role in steering the second phase of the New Face of Industry in France programme. It aims to encourage all companies to modernise their production base and use digital technologies to transform their business models. The five areas of action are: Develop cutting-edge technologies; strengthen international cooperation around standards and promoting the French industry of the future.
- ✓ Approx. 10 billion from public sources, for the Alliance pour l'Industrie du Future were invested

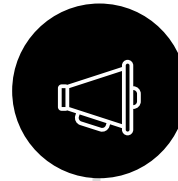
# Ongoing deep cultural changes

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Quotes from contributors

**Jan 2018**

“If we don’t invest in education and training the machines will catch us up.”



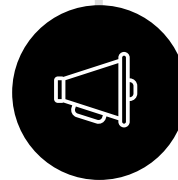
**Jan 2018**

“The maturity required to face possible futures depends on a sense of personal, family and cyber security, where predictability and adaptation to new realities are essential



**Jan 2018**

“Each person can improve each function and process in which it is involved if there is a culture to identify what can be digitized.”



# Cities as launch pad for transformation

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The cities have the uncanny capacity to create favorable ecosystems that nurture modernization. This dominant typology of habitat reinforces its strengths creating a clear predictability and assumes its position as trend setter. At a time that calls for multiple competences, only the city is endowed with suitable critical mass, with speed (and quality) for talent overhaul. It is where all human types converge and learn to cultivate diversity as a means to create added value.

The Journey towards 4.0 implies urban qualification and its effective sustainability. In addition it requires intelligently digitalized public services for and effective allocation of public funds, which one knows to be scarce. For all COTEC countries, there is matter of particular acuity: Tourism. The activation of macro and micro self-regulation mechanisms is key to ensure the balance of the urban ecosystem. All biological and artificial intelligence must be called upon to think, organize and monitor collective life, in a context a growing flow of population. The quality, quantity and actuality of Data is crucial for the mission of managing and enhancing public space.

# Cities as launch pad for transformation

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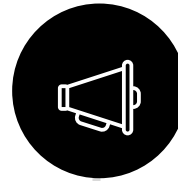
Evidence of a changing world

- ✓ Plataform Industrie 4.0 is a national strategic initiative from the German government through the Ministry of Education and Research and the Ministry for Economic Affairs and Energy. It aims to develop a consistent overall understanding of Industry 4.0 through dialogue with stakeholders, to draw up recommendations for action and to demonstrate how industrial manufacturing can be digitized. As part of the government's Action Plan High-Tech Strategy 2020 from March 2012, ten "Future Projects", were developed to support it.
- ✓ Approx. 200 million from public sources, complemented by financial and in-kind contributions from industry

# Cities as launch pad for transformation

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Quotes from our contributors



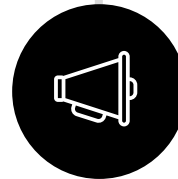
**Jan 2018**

“The relationships among the various stakeholders that influences planning are essential for the quality and suitability of cities.”



**Jan 2018**

“The predictability of the work ecosystem affects the quality of spatial planning.”



**Jan 2018**

“The quality of infrastructure and the mobility facilitation, could have a negative impact on the geographical demographic balance.”

# Popping up new business models

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The shared digital transformation is characterized by its impact on the systemic interaction: social, economic and cultural. Businesses are experimenting with new mediation models, which represent a crucial element dictating to unprecedented levels the client's perceived value, and subsequently the Demand. This new client's digital nature requires a Supply which is not yet totally fulfilling this dimension, and in addition it is not yet able to recurrently exceed expectations and, consequently demonstrating innovation.

The value chain is subject to analysis, deconstructing and reconstructing products and services which can satisfy the market's emerging needs. Up until now, these same features that enable the innovation factor had been hidden in a single and satisfactory cohesive one. New partnerships will arise as new businesses arise from this process.

Along with this greater agility and openness to the flows and rhythms of a plural and geometry-changing world, another trend starts to bloom: that which concerns more ponderation upon production's targets, less dependent on the purely technological possibilities and more grounded on the company's concrete reality. The true nature (qualification and skills) of the human resources and the way the relationship with intelligent machines is performed ascend as vital essences in this new changing world . The complexity created by the overall Digital movement forces one to look for the highest existent predictability scheme, and, consequently to treasure new ways to surpass the ever relevant context costs.

# Popping up new business models

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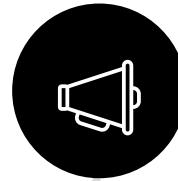
Evidence of a changing world

- ✓ The UK Government supports an innovation programme, named Innovate UK's National Catapult Programme, of which the HVM Catapult forms part. This institution –the HVM Catapult - works with companies from all parts of the country. The ambition is to provide an overarching framework under which local, regional and devolved nations' priorities can be defined and ultimately be incorporated as key drivers for the national industrial strategy. This framework defines how the public authorities at all levels from national to local will interact with industry, giving a consistent overall model. Key industrial sectors for the nation should be identified at the "headline" level.
- ✓ €164 million invested by UK Government over 2012 – 2018 period; for 2015/16: €79.7 million commercial income was obtained against €61.3 million public funding;

# Popping up new business models

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Quotes from our contributors



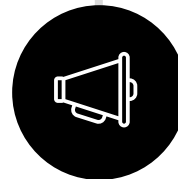
**Jan 2018**

“The difficulty in adopting technologies typically has to do with issues of scale.”



**Jan 2018**

“A greater ability to define scenarios (predictability) could clarify new business models.”



**Jan 2018**

“It only makes sense to rethink the skills needed in the future if companies rethink their business models by looking at the processes with focus on the client and on efficiency.”

# ALLIANCES

Shapping a thinking system

Variables	Hypothesis
Feeling of belonging (community)	On going Deep Cultural Transformation
Ability to adapt to emergent working environments	Men and Machines: a new wellness at work
Priority in digital investment	Popping up of new business models
Feeling of Safety	On going Deep Cultural Transformation
Perception of benefits of digitalization	A big move for big data
Soft Skill Development	Skills: hard, soft and its beautiful combinations
Mobility and adequacy of urban planning	Beyond large cities
Matching digital skills	Skills: hard, soft and its beautiful combinations
Willing to Learn and Think	Ongoing deep cultural transformations
Demographic balance	From strategic politics to legacy heroes
Market	Popping up of new business models
Expectation towards recognition / return	Ongoing deep cultural transformations
Sustainability	Beyond large cities
Governmental regulatory action	From strategic politics to legacy heroes

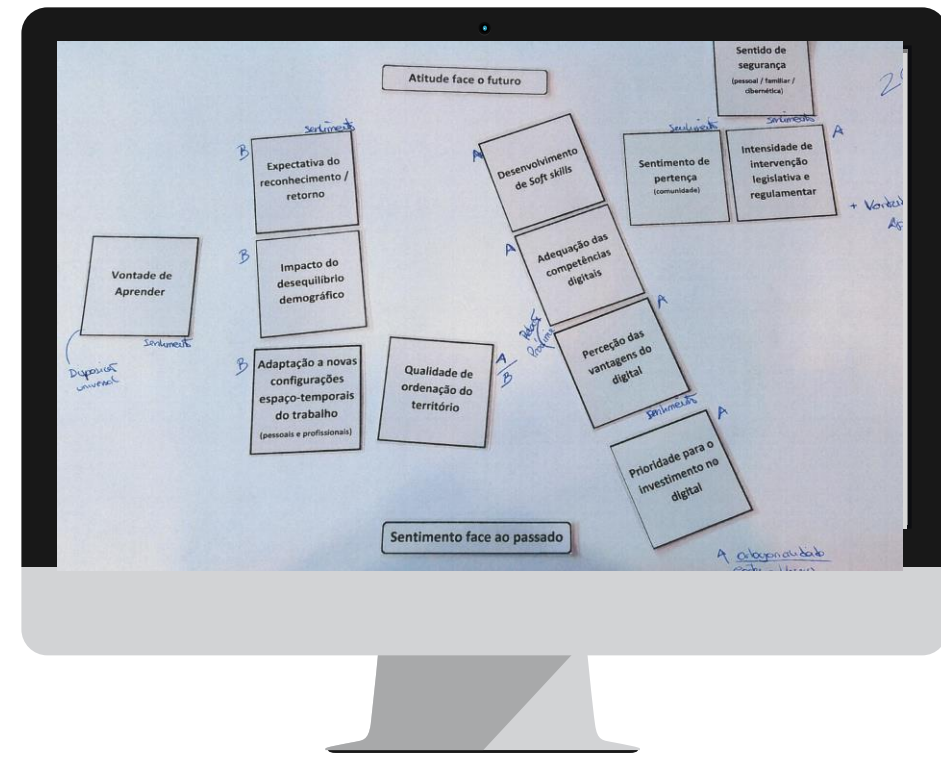
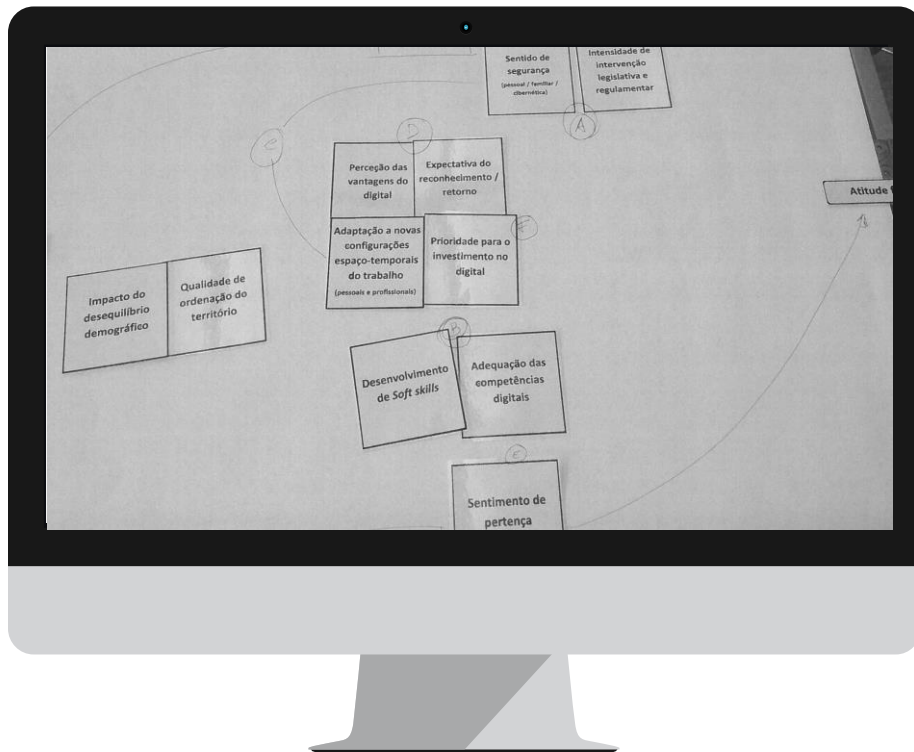
# FEATUREDED WORK

7 HYPOTHESIS; 14 VARIABLES

The seven inspirations threads, discussed above, degenerate in a large amount of variables that would ultimately describe the core issues around the Future of Work. They all form uncertain alliances, for the task of understanding how the coupled social-economical system works, what are its main archetypes and how can one nudge the system into a faster and leaner adaptation to the emerging technologies falls into the category of a Volatile, Uncertain, Complex and Ambiguous (VUCA) problem.

# FETURED WORK

7 HYPOTHESIS; 14 VARIABLES



# THE VUCA MODEL

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## MAKING THE CASE FOR A SYSTEMS APPROACH

Addressing complex social systems in a comprehensive way calls for a novel holistic approach, as opposed to a linear problem-solve methodology, which falls short of shedding light to emergent and unpredicted patterns and behaviors. Systems approach encompasses a variety of theories and methods having in common the ability to promote an integrated vision of all the parts involved (singular elements or sub-systems) highlighting their interconnectedness.

The case for a systems approach has been growing together with the perception of the need to cope with crucial changes and adaptation of the most diverse sectors such as health, education or environment, just to name a few. The public sector, in its role of stewards of shared social systems, is one of the agents that will benefit the most from a systems perspective and the breakthrough innovations that it potentially uncovers. Moreover, a systems approach is more relevant as it strives on the effort of more participatory and understanding decision-making processes, and helps achieve higher levels of engagement by inviting all stakeholders to participate in the systems mapping process.

An admonition regarding the two main components of a systems approach and the road ahead:

On the one hand there is the systems thinking component, understood as a way of collectively thinking and understanding complex, wicked interrelated problems implying or suggesting a shift in mental models by broadening the limits of one's own reality and ways of seeing the world.

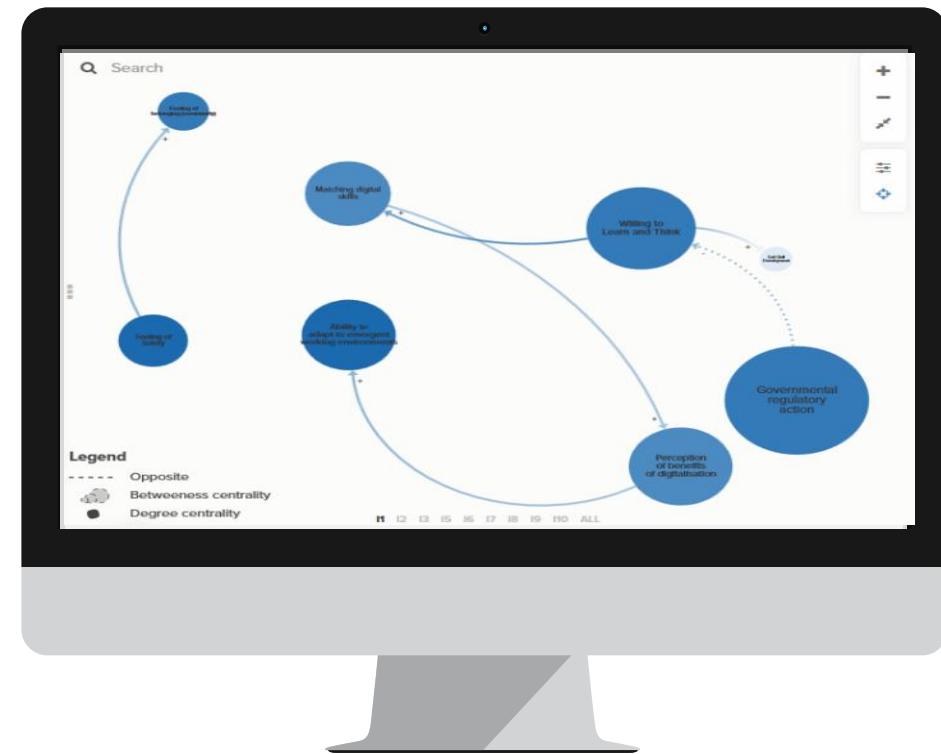
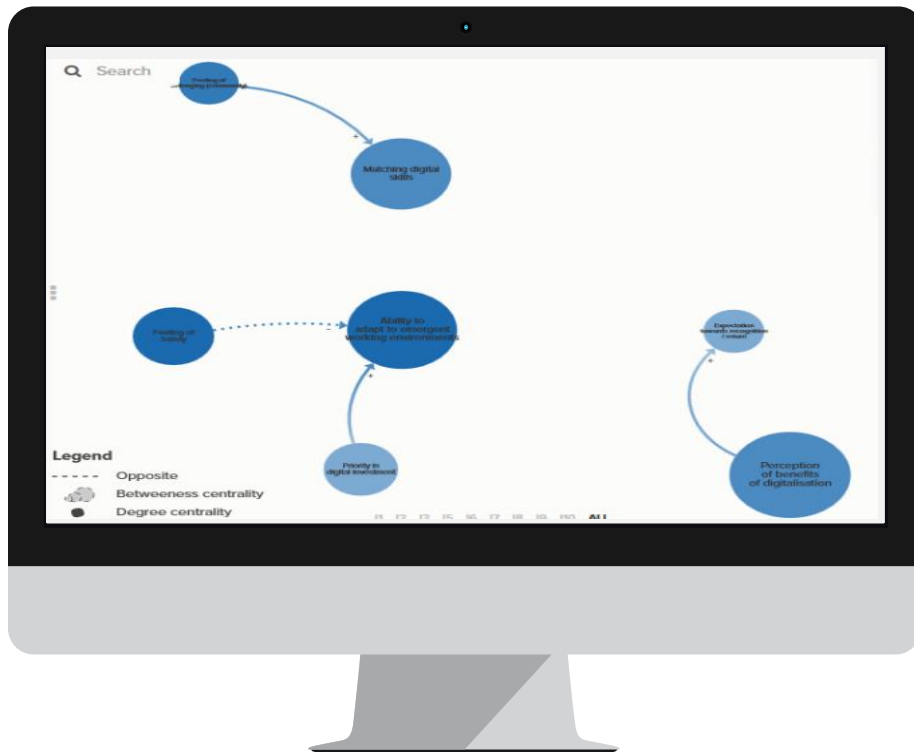
On the other hand, the systems practice component calling for specific intervention towards a systems change, which implies new ways of doing and the courage to take innovative actions on elements of the system different from the traditional ones, carrying with it the uncertainty of the long-term results.

OECD Observatory of Public Sector Innovation released in August 2017 the book "Systems Approaches to Public Sector Challenges - Working with Change", available at:

<http://www.oecd.org/publications/systems-approaches-to-public-sector-challenges-9789264279865-en.htm>

# INTERPRETING THE SYSTEM

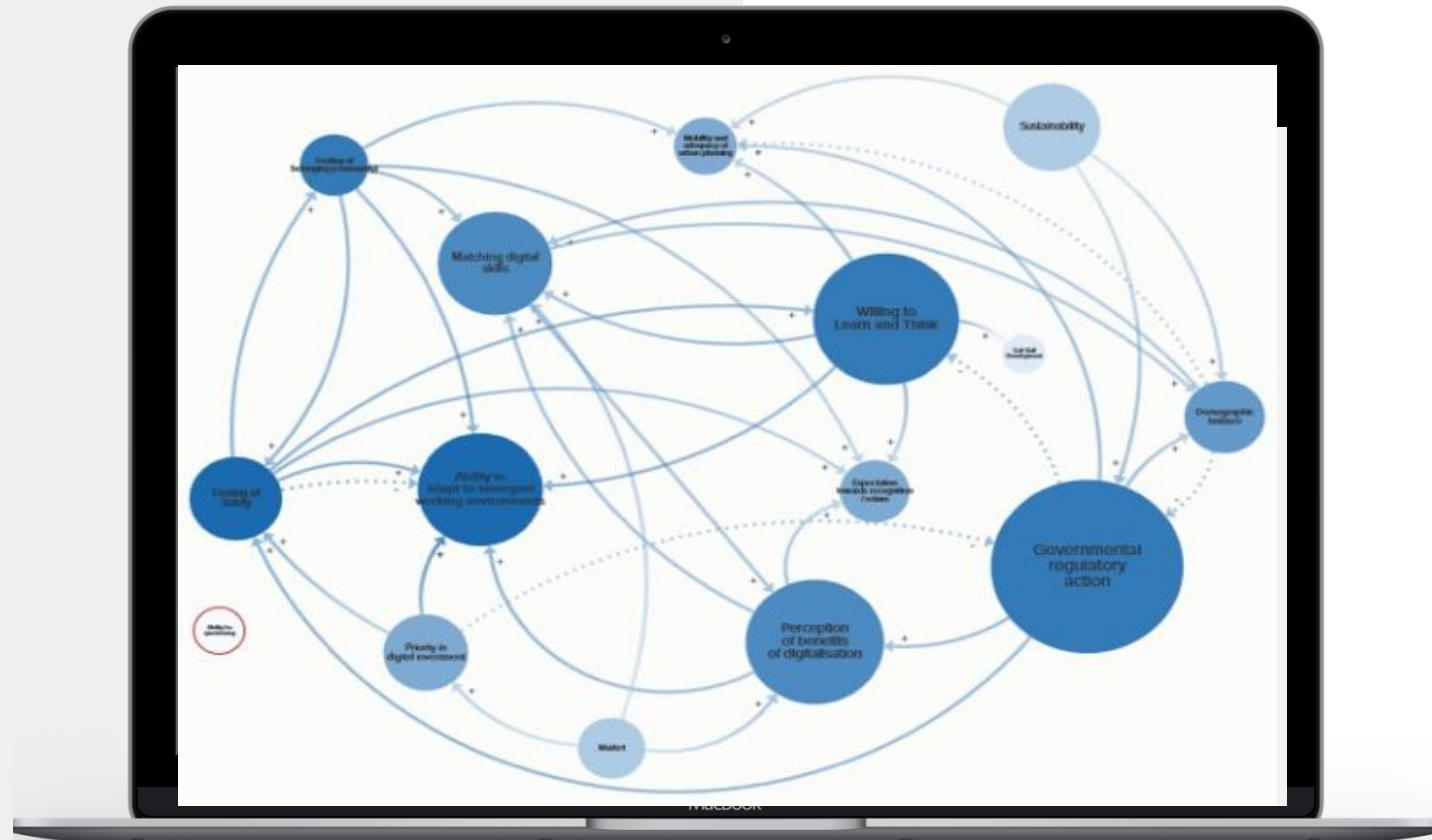
EXPRESSING A GRWOING NUMBER OF COLLECTIONS



For the fifteen variables in the interviews, where each variable can be connected to 14 other variables, the maximum number of connections to be established is 210 connections. However, during the exercise, the higher number of connections established among the variables in individual interviews was of 15 connections, with an average of 7 connections by individual exercise.

# INTERPRETING THE SYSTEM

COMPLETE SYSTEM INTEGRATING



When all the layers (interviews) are overlapped on a single system map, what looked simple starts to transform on a more complete and complex map, in a total of 42 connections established amongst the 15 variables (see Figure 2). It is also interesting to notice that, from the 39 connections established, the vast majority (33) connects positively the variables, pointing out for a possible unbalanced system.

# Decision Making Process

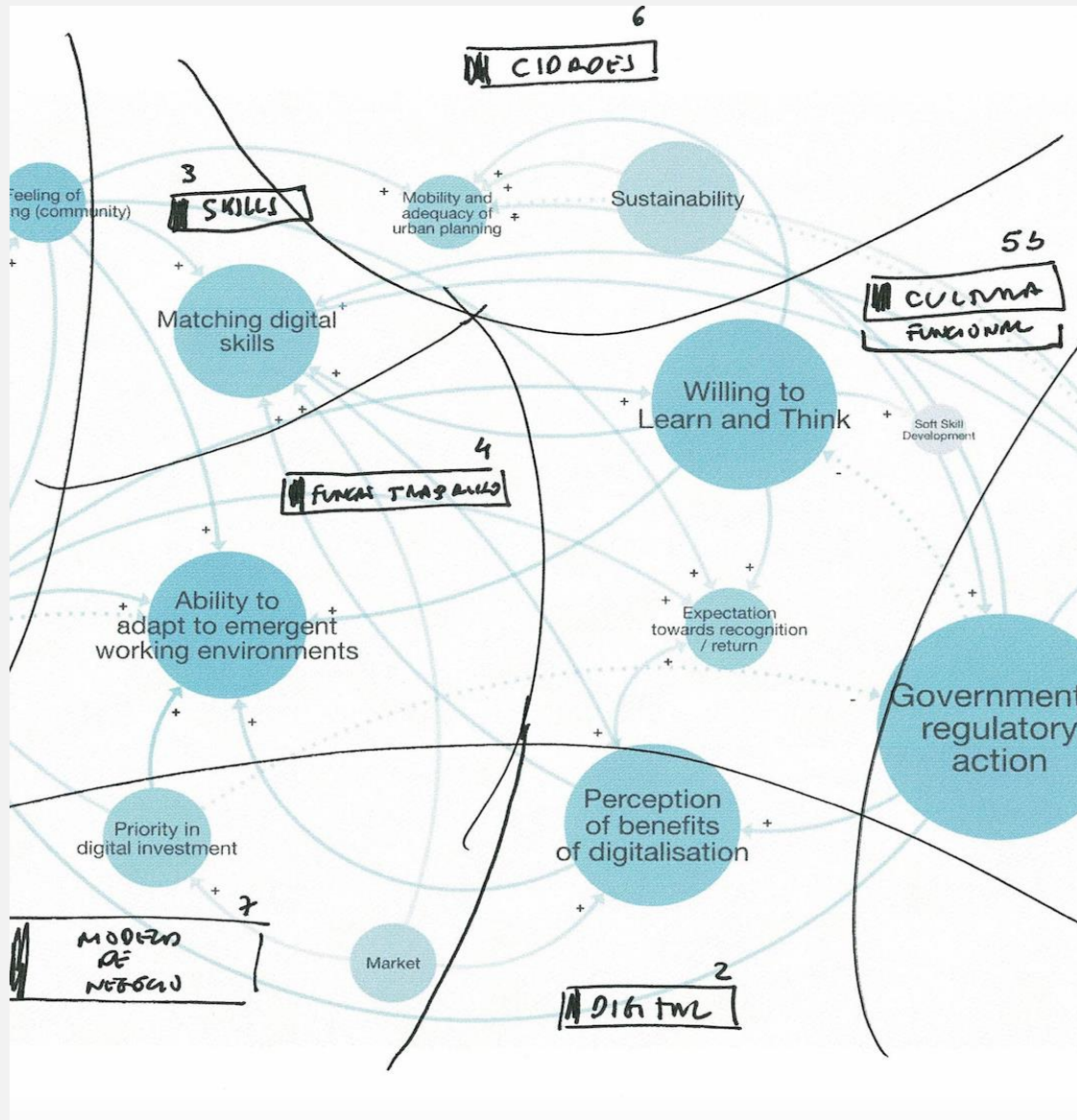
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## DIRECTIONS TO POINT TO

Notwithstanding its preliminary essence, this study allows the mapping for 3 basic concepts – **inspirations or hypothesis**, basic **relations** between factors and drivers for **change**. Hence, the VUCA model, which has been adapted and simplified for the purpose, can be used to identify root causes of problems, in order to spur a thinking process about exploratory journey towards a new concept of work

# SCENARIO BUILDING ANALYSIS

## FOSTERING NEW DIRECTIONS



Centrality metrics allow to disclose the variables that are leverage points of the system, i.e., the variables that being tuned can contribute most significantly to the system's transformation. Table 2 shows the eight most influential variables of the system according to the different centrality metrics.

This analysis is of particular importance to feed and to make more expeditious the modelling exercise and scenario building to find new solutions and support the decision making process.

The variables "Ability to adapt to emergent working environments" and "Willing to Learn and Think" appear on the top 5 of all the centrality metrics, drawing attention to their importance as convergence points, meaning that they will be focal points in the Future of Work to which the agents of the system will be drawn to and search for.

The negative impact that "governmental regulatory action" and the "priority of digital investment" have in the system is also to be looked up on.

# SCENARIO BUILDING ANALYSIS

	Degree Centrality	Betweenness Centrality	Eigenvector Centrality
#1	Ability to adapt to emergent working environments	Governmental regulatory action	Ability to adapt to emergent working environments
#2	Feeling of Safety	Willing to Learn and Think	Feeling of belonging (community)
#3	Feeling of belonging (community)	Perception of benefits of digitalisation	Feeling of Safety
#4	Willing to Learn and Think	Ability to adapt to emergent working environments	Expectation towards recognition / return
#5	Governmental regulatory action	Matching digital skills	Willing to Learn and Think

Table 2 – Top 5 of the systems’ variables according to centrality metrics (Degree, Betweenness and Eigenvector)

# SCENARIO BUILDING ANALYSIS

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## THE ROAD AHEAD

This first exercise of adopting a systems thinking lens to understand the social, economic and political dynamics that shape the emerging future of work, revealed several insights:

- A generative dialogue with the stakeholders, where they are invited to not only share their view but also to construct a model, revealed a number of unexpected unknown unknowns.
- A systems perspective provided a glimpse into the complexity of what preparing for the future of work actually means in terms of interconnected variables.
- The analysis of the resulting map revealed a collective intelligence about what are the variables that most likely define how the systems will evolve.

# CONTRIBUTORS

Dialogues towards 360° understanding



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Manuel Reis  
19 JAN 2018



João Carlos Costa e João  
Resende  
16 JAN 2018



Margarida Segard e João  
Pedro Taboda  
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