EHESS

8 Juin 2018, Paris

Sens Artificiels
Mesurer l’économie dans l’âge digital
—
vision, architecture, infrastructure

The views expressed in this document represent the personal opinion of the author, not necessarily the positions of the ECB or the ESCB.
the brain, language, data, technology
We live in Richard Dawkins’ “middle world”

Biologist Richard Dawkins defines the “middle world” we live in:

• The light spectrum our eyes can see
• The frequency range our ears can hear
• The time scales and speeds we can sense
• The number of items we can handle at a time

Evolution shaped our brains for the narrow range we need for survival in nature
Object recognition and identification in a complex environment

- Object X
- Mr. A
- representation A(X)
- perceive
- identify
- name
- sign, language, document, data
- conceive
Recognition and identification of material objects

representation $A(X)$

object $X$

representation $B(X)$

Mr. A

Mrs. B

name, sign, language, document, data

listen

see, read

identify?

perceive?
Recognition and identification of abstract objects

Abstract Object X

representation A(X)
representation B(X)

Mr. A

Mr. B

name, sign, language, document, data

see, read

listen
Human-to-human, machine-to-machine: two very different conversations

People exchange words.
If words are unclear
people can talk, ask, adjust.

Machines exchange data.
If data is unclear
machines don’t talk, ask, adjust;
they behave differently, e.g.
they simply stop or, worse,
they continue somehow.
US military doctrine, Directive 3000.09 from 2012:

- “human-in-the-loop”: a human has the last call in a decision

When human brain capacity is dwarfed by machines’ speed, data volumes, AI:

- How do we keep the “human-in-the-loop”?

DARPA’s “Mosaic Warfare” foresees complexity itself as a weapon:

“An orchestrated multitude of systems overwhelm the enemy by creating a range of simultaneous dilemmas in multiple domains”
Human-to-human, machine-to-machine: two very different conversations

Technology has shifted the human-machine interface

Technology used in finance is now far beyond the human “middle world”
Machines execute cascades of networked actions too complex, too fast for us
Ten years of further AI growth: where will we be? “human-in-the-loop”: HOW?

Can we change fast and decisively enough?
Languages reflect human diversity

- Language shapes and expresses the identity of people and groups
- There are no limits to diversity in concepts and languages expressing them

Three fundamentally different approaches to language…

…and there are and were many more.

Data is language!
…as diverse as human language…
…but computers need it clear and homogeneous
Data as an obstacle to the delivery of the technology promise

Technology increases social complexity by connecting more diverse people

• more / more diverse data practices now interfere in larger networks…

• …making agreement on standards

Technology creates a “Data-Tower-of-Babel” that impedes effectiveness
Digitisation connects – cheaply and fast – real time – irrespective of geography.

It creates a single, fast space on a territory occupied by separate, slow spaces.

“New Tech” Business

“Legacy Tech” Data

Law
Culture
Language

collision

Business and Technology rush ahead, assuming that legacy is fit or will follow. Instead, the new single, fast space finds that land under its feet is fragmented.

Digital integration creates cost and risk by quickly widening the gap between slow-moving data reality and fast-moving data needs.
The challenge:

• To access with our senses an abstract system far outside our “middle world”
• To control with our brains a system far too complex for it

We manage well with matter, outside our range, although it is infinitely complex

Three components could keep the human in the loop:

• **Perception**: “Artificial Senses” at the scale and speed of the relevant system
• **Analysis**: reduce information to brain size, tailor it to the problem at hand
• **Action**: design what action and build the tools to do it
The Thomas Kuhn moment

We can’t cope “by hand” anymore, but…

… efforts to accelerate the old ways, just faster, more automated…

… are doomed to fail, ultimately, as technology races on

We must aim for more and drive a deeper movement

Three strategic moves towards a new paradigm:

• **Vision**: revisit our world view and theory of the matter we study

• **Architecture**: imagine the system as it could work, the “endgame”

• **Change**: practical, feasible, beneficial to all, with transformational power

Academia and public powers must lead an intellectual and policy push,

Markets will do the rest: creativity will be unleashed, in an evolving frame
statistics

and

the digital age
The report shows a growing gap in value chain and globalisation statistics:

- More demands on statistics as the world grows more complex and globalised
- Shrinking capability to capture the finer details needed to build a bigger picture
  - Statistics improve, but while we keep improving the world changes even faster

“Data gaps lead to policy gaps”:

“Because the picture of economic globalization provided by current official statistics is incomplete, the causal links to economic welfare indicators such as employment and wages tend be weak and unconvincing, allowing a set of highly charged, politically motivated, and unproductive debates over the basic facts”

The report concludes that progress requires data, old and new, to be:

“all tied together by enterprise identifiers that make ownership clear, even when it extends across borders”, calling for an “integrated international data platform”, “international business registers” that identify the ownership structures of enterprises across borders”
• The world we measure is globally integrated at micro-level, in real time;
• Many systems exchange data, across borders, sectors and functions.

• Multiple ways to refer to a same object harm quality and cost of data.
• When things get faster, more global and complex, feasibility suffers, then stops.
• If we all refer to an object the same way, processes are faster, safer, cheaper

• For legal entities, that points to a need for globally unique identification,
• For use by all, across all sectors: business, administration, statistics, etc

• Ideally, statistical data systems should all use the same entity identifier that businesses (reporting agents) and administrations use in their systems. Globally.
Vision
Vision: technical tool, not flight of fancy

- A way we choose to view the world
- A representation that structures our perception, shapes our action

The solar system
heliocentric (right)
vs.
Geocentric (left)
In red: orbit of Mars

- “All models are wrong; some models are useful” George E.P. Box, statistician
- “It is the theory that decides what we can observe” Albert Einstein
- “Combining visions gives us more possibilities” Hans Poser, philosopher
<table>
<thead>
<tr>
<th>Vision 1</th>
<th>Vision 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A set of</td>
<td>VS.</td>
</tr>
<tr>
<td><strong>Closed Systems</strong></td>
<td>A Global Network</td>
</tr>
<tr>
<td>(national economies)</td>
<td>of</td>
</tr>
<tr>
<td>with</td>
<td><strong>Contracts</strong></td>
</tr>
<tr>
<td><strong>Perturbations</strong></td>
<td>among a</td>
</tr>
<tr>
<td>(international trade and investment)</td>
<td><strong>Global Population</strong></td>
</tr>
<tr>
<td></td>
<td>of</td>
</tr>
<tr>
<td></td>
<td><strong>Agents</strong></td>
</tr>
</tbody>
</table>
**Vision 1**

A set of **Closed Systems** (national economies) with **Perturbations** (international trade and investment)

* cash, goods, services
Vision 2

A Global Network of Contracts among a Global Population of Agents

Measurement under Vision 2

* cash, goods
An abstract thing becomes real when all across society agree upon it.

The most powerful and constant engine of social consensus is law:
- Law confers a quasi-physical quality of reality, also on abstract objects
- Law can mandate the way to represent such abstract objects
- Law confers existence and identity upon parties and contracts

**Parties and contracts are abstract objects,**

yet law makes them **socially real** – they are **facts**
The “mechanical skeleton” of the economy and finance - facts in the abstract system

**Mechanical skeleton**

- parties
  - LEI
  - ID
    - digital representation
- contracts
  - ID
    - digital representation

*ISIN is not enough, DLT is not compatible with fungibility*

Contracts are the Relationships among the Parties

Blue in the graph: registers making up the mechanical skeleton system.
the theoretical possibility
of a unified, machine-compatible
language for describing contracts
Algorithmic Contract Type Unified Standard – initially designed for financial contracts

The ACTUS logic:
• The contract seen as a mathematical function that represents parties’ agreement about who pays how much to whom, when and under what circumstances?
• The ACTUS logic is here generalised to cover all types of contracts (goods, services)

* delivery of a service can be seen as an event in this conceptual framework

for more on ACTUS: www.actusfrf.org
ACTUS: representation of contracts

- ACTUS could represent a diverse population of contracts in a single language

- ACTUS could complete the Skeleton infrastructure

for more on ACTUS: www.actusfrf.org
Architecture
for making the
economy and finance
more
measurable
in the
digital age
What do we measure for?

Control

Real World System

Action

Measurement

Analysis
The San hunter shoots his arrow, kills the prey.
His senses are sufficient.
He doesn’t need measurement.

The pilot of a night flight sees airport lights,
Yet he needs measurement of altitude, speed, etc. to land safely.
His senses need to be augmented through measurement.

Our senses don’t perceive finance at all,
We need artificial senses.
We need measurement, i.e. statistics, and more.
Four additional specifications for statistics and measurement:

• Global integration of measurement
• Speed of measurement near real time
• Flexibility, to remain effective when surprises happen
• Fast drill-down to enable fine diagnostics & surgical intervention

Available to all in the market

➤ Existing means don’t stretch that far.
➤ Radical departures are needed, fast.
➤ Benefits are for all, including business.
The financial system is de facto developing into a global hyper-organism:

- integrated operationally
- but can destroy itself

and violently disrupt entire societies in the process

Effective control requires

- regulation,
- measurement,
- compliance,
- enforcement

to be fully integrated into the hyper-organism
Industry and its regulators operate from a single, shared data infrastructure

The shared infrastructure could start thin and grow over time as:

- industry structures evolve
- regulators evolve
- technology develops
- humans learn
Change
With vision and architecture in mind, what strategy for change is possible?

- The problem is deep, global, growing fast, potentially even to critical
- The problem is beyond a single solution

A possible strategy: **feasible measures with immediate benefits to many** transformational power

Market forces will do the rest

Standardisation is often at the heart of such deep transformational processes.
The

Global Legal Entity Identifier System

a good start
Identity of legally anchored objects as a starting point

We could begin with global, universal coverage, mandated by law, of

The Global LEI System is a Public Good Infrastructure that offers a globally standardised representation of the identity granted by local authority to a legal entity

and continue with contracts and their algorithmic representation, build other distributed ledgers required: assets, events and semantic infrastructures shared by authorities and industry
“The current situation is very costly for market participants. The many different proprietary identifiers and local identifiers cause difficulties as they are incomplete, overlapping, and insufficiently accurate and do not guarantee a level playing field. While the drawbacks of the current situation are known and undisputed, resistance to change by the markets is due to the fact that unique identifiers are a public good. They need to be introduced and maintained by legislation. The mandatory requirement to use the LEI should be extended to all financial instruments and not only to specific market segments.”

Keynote by Vítor Constâncio, Vice-President of the ECB, at the joint conference of the EU Commission and ECB on European Financial Integration, Brussels, 19 May 2017

Legal compulsion is essential for data quality and a level playing field among industry participants

Source: Financial Times; letter responding to an article by Gillian Tett «a bubble gum fix for finance»
Francis Gross

Senior Adviser
Directorate General Statistics
European Central Bank
Sonnemannstrasse 22, D-60314 Frankfurt am Main
off: +49 69 1344 7513
mob: +49 160 746 84 82
fax: +49 69 1344 7056
email: francis.gross@ecb.int