



Can Blockchain Technology Help Regulatory Science?

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Outline

- What is Blockchain?
- What are the big promises?
- How can it help the food sector and society?
- What are the risks, challenges & uncertainties?





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So, what is Blockchain?

- A **digital ledger**, distributed between members of a community and their computers, which records the history of **transactions** and enables transactions to take place securely
- Participants need a cryptic **key** to record a transaction. The record must then be **encrypted** via an **algorithm** and shared with everyone's computers for validation, before being stored on the blockchain
- When a record is updated, information from the previous record and the new one are combined to produce a new 'hash', creating a **co-dependent chain** of records
- If someone tries to change a record the algorithm will spot the difference. Since everyone has a copy of the 'true' record, this can substituted for the doctored one
- **Different types of blockchains** - some can record more information (e.g. images for copyright) or enable '**smart contracts**'



What's so great about it?

- Transactions recorded on the blockchain are **immutable**
- Verification devolved to computers/algorithms => **'trustless'**
- Information is **secure** and **verifiable**
- Records are **transparent** (everyone has a copy) but **anonymous** (they don't know what it means)
- **Accountable** because changes are visible to everyone and historical records and changes are **traceable**
- May allow **peer-to-peer** transactions without institutional middle-men like banks, lawyers and governments
- Can prevent **identity theft**, as IDs are encrypted
- May be linked to **devices (IoT)** or **biometrics**
- **Automates** processes necessary for verification = Faster administration & lower costs

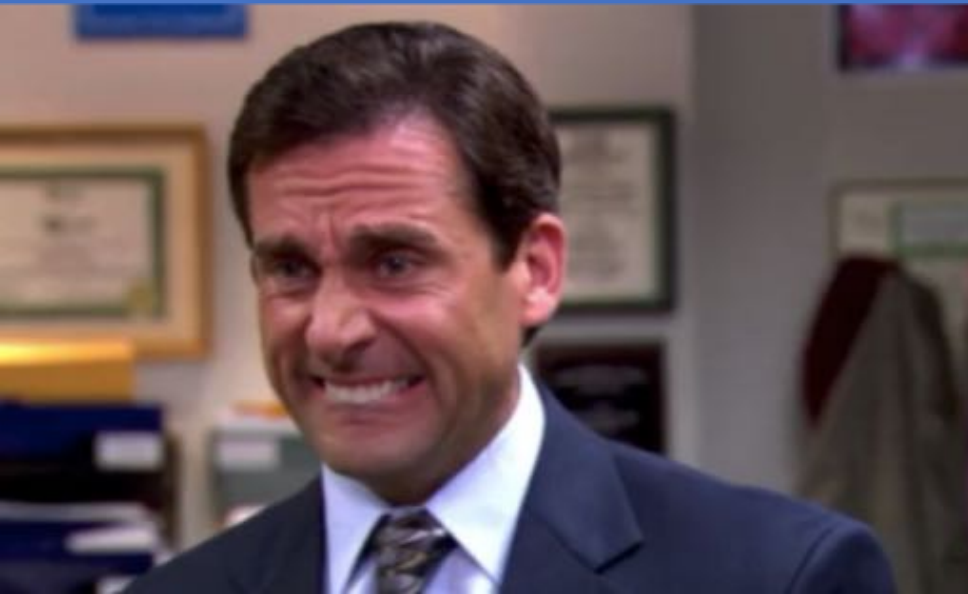
“ Simply put, the blockchain is a machine for creating trust. ”

—The Economist



Public vs Private Blockchains

- Public blockchains, like Bitcoin, are fully decentralised, disintermediated, can be joined by anyone and are anonymous
- Private (corporate) blockchains are restricted to known members of a permissioned network
- ‘Blockchain as a service’ = cloud-based platforms which businesses or communities can rent to build or host blockchain apps



Gartner Hype Cycle for Emerging Technologies, 2017



- Still few actual use cases in biomedical research or the food sector
- Many innovations 'in progress'
- More caution since cryptocurrency hacks

Challenges for biomedical research



Efficient Management – Smooth trial conduct, reproducibility, effective data sharing, patient enrolment etc.

Effective Governance – Transparency, Informed Consent, Accountability, Harm (physical, psychological; current vs future). Integrity of purpose. Manipulation, Incentives, Crime

Similar issues for the food sector, although medicine is more concerned with patient confidentiality

Good Governance

Usually reserved for conversations about global development, the term Good Governance is useful in this context

Key features:

Consumer Participation, Rule of Law/Regulations, Transparency, Responsiveness, Consensus Orientation, Equity, Effectiveness and Efficiency, Accountability, Strategic Vision

UNDP (1997) *Governance for Sustainable Human Development*. United Nations Development Programme



- > **Ethics**
- > **Integrity**
- > **Processes**

Electronic supplementary material:
The online version of this article contains supplementary material.

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Digital technology for health sector governance in low and middle income countries: a scoping review

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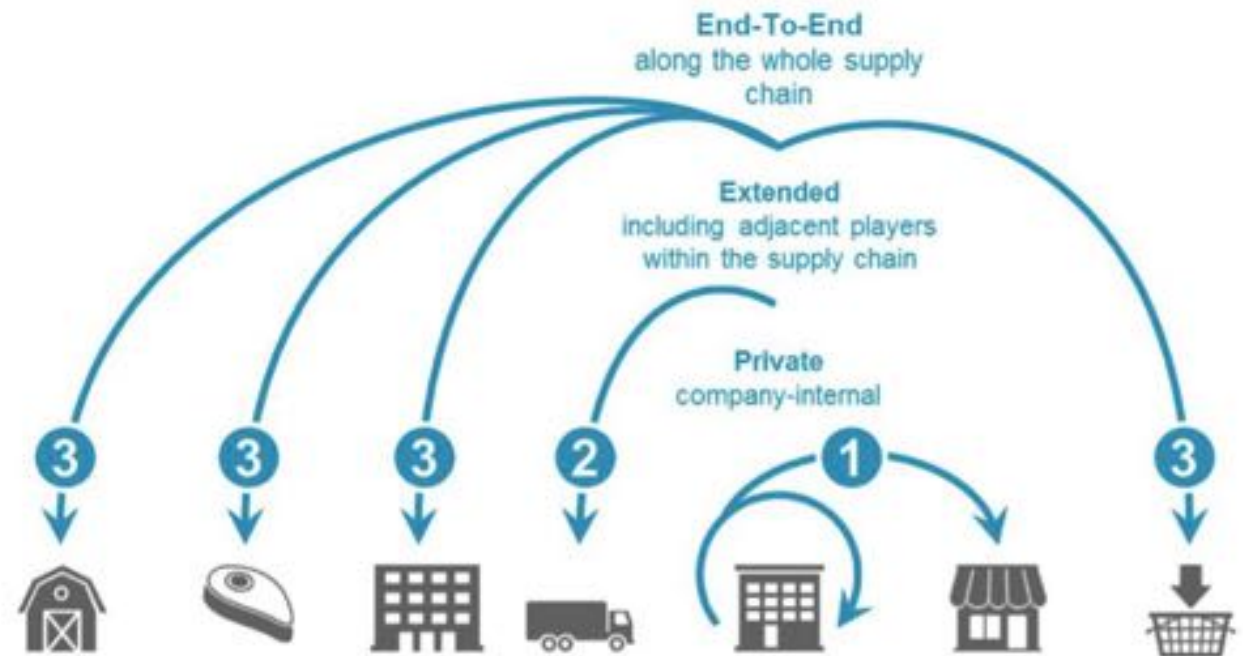
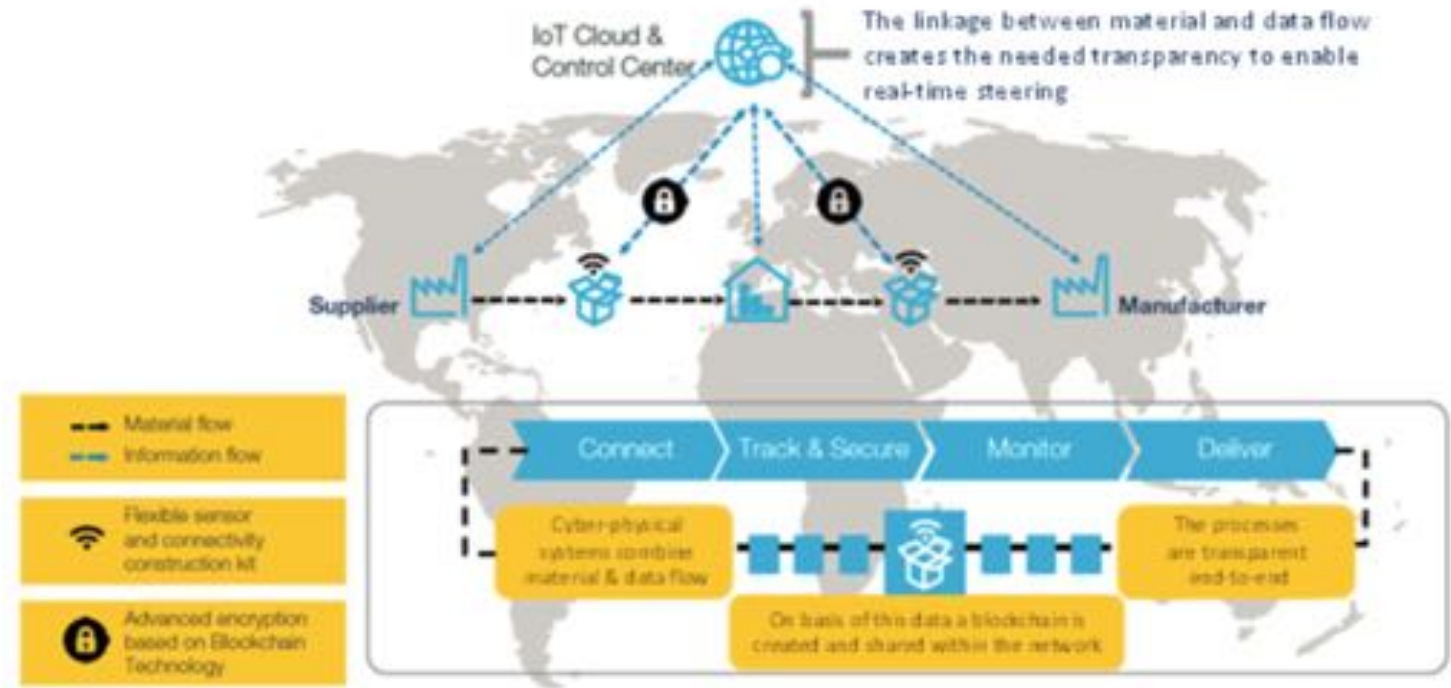
³ Edinburgh Global Health Academy & Usher Institute of Population Health Sciences and Informatics,

Background Poor governance impedes the provision of equitable a cost-effective health care in many low- and middle-income countr (LMICs). Although systemic problems such as corruption and in ficiency have been characterized as intractable, "good governan interventions that promote transparency, accountability and pub participation have yielded encouraging results. Mobile phones

Strawberries in December



“Backbone of Supply Chain Digitisation”



In supply chain applications, blockchain has already taken off its Sex Pistols T-shirt and started wearing a cardigan

CP Quoted in Chemistry World, Aug 2018

Counterfeiting

Fake medicines are rife in LMIC. Fake malaria and tuberculosis drugs alone cause c 700,000 deaths p/a

Sproxil - Scratch code reveals a QR or SMS which can be sent by SMS or App, to a call centre or checked on the web. Now blockchain backed

Blockverify targets pharmaceuticals, luxury items, diamonds & electronics. Every product has its private key stored in blockchain. With a track and trace number it is possible to trace change of ownership

“Adding scannable blockchain-connected tags, tamperproof seals or imprints to products is one of the most convincing use cases of distributed ledger technology in fighting counterfeits” WIPO, 2018

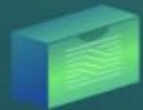
Manufacturer



Adds information about the product to the database



Attaches a QR code or Digmus NFC tag to a product



Adds a one-time verification code to the product, so that the user can register a purchase

Customer



Reads a QR code or Digmus NFC tag to verify if the product is genuine or counterfeit



Authentic

If the product is genuine then a customer buys it and notes the purchase as successful with a one-time verification code



Counterfeit

If the product is a forgery then the customer doesn't buy it



Substitution



Fifth of meat tests reveal unspecified DNA

bbc.co.uk

Mis-labelling



Country of origin. Organic. Wrong Species.

Food fingerprinting

*“As the fruit grows, it’s picking up a unique signature at the isotopic level. These **chemical barcodes** can help us prove that the product comes from a specific location. If that orange travels to a factory in another state, it is logged in the system and its place of origin recorded. If it’s made into marmalade, that’s also logged in the system. If we picked that marmalade up at the supermarket and tested it, we could still confirm the fruit’s place of origin ... If the test failed, we could easily look back through the chain to see where things went awry” (Not yet in place)*

Australia’s Commonwealth Scientific and Industrial Research Organisation (CSIRO) Sept 4th, 2018 on the use of blockchain in food counterfeiting

Preventing Food-Borne Illness



CIO JOURNAL

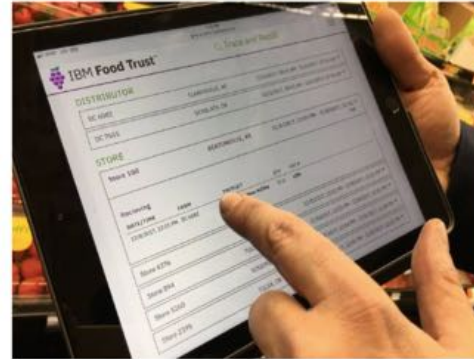
Walmart-Led Blockchain Effort Seeks Farm-to-Grocery-Aisle View of Food Supply Chain

The grocery giant, together with Nestlé, Dole and others, wants to set new industry standards on food tracking

By Kim S. Nash

Jun 25, 2018 1:05 pm ET

5 COMMENTS



A Food Trust trace of a shipment of strawberries in early December 2017 shows that they traveled from two distributors, in Clarksville, Ark., and Ochelela, Okla., to five Walmart stores. PHOTO: KIM S. NASH / THE WALL STREET JOURNAL

FINANCIAL TIMES

From farm to plate, blockchain dishes up simple food tracking

Technology promises to make provenance of goods and supply hiccups easier to pinpoint

Louise Lucas JUNE 6, 2018



Meat safe: Walmart is using blockchain to trace the origin of pork in China © Bloomberg

Blockchain Gains Traction in the Food Supply Chain

Forbes



Steve Banker Contributor

Transportation

I cover logistics and supply chain management.



After implementing blockchain Walmart went from needing 6 days to 2 seconds for tracing a contaminated product from shelf to source

Protecting reputations



Compliance, safety & IoT

Modium.io uses **Internet of Things** sensors to measure the **temperature** of medicines during transportation from source to retailer. Data is automatically sent to the blockchain creating immutable and transparent records

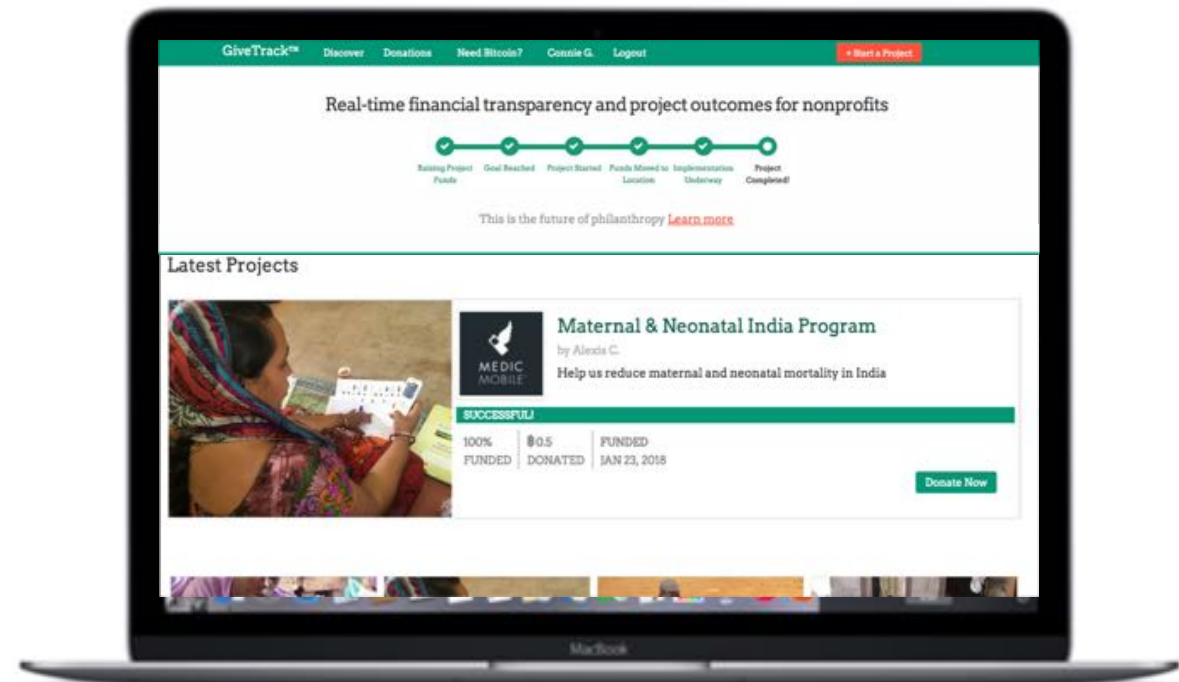
This **automatically audits compliance** with the “Good Distribution Practice of medicinal products for human use” (GDP 2013/C 343/01), which requires proof that shipped medicines have not been exposed to conditions that may compromise their quality



Engaging the consumer

“The way we produce food is sometimes hidden from the consumer. Without real transparency ...we will be producing our own scandals”

Bernhard Url, Opening this meeting



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Regulatory Innovation

- Automating regulation?
- Digitisation ->
- Automation ->
- Codification
- Smart contracts

Blockchain Technology as a Regulatory Technology

From Code is Law to Law is Code

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²Universidad Complutense de Madrid & Berkman Center for Internet and Society, Harvard University



Bernhard Url
@BUrl_EFSA

Looking at the speed of change outside our domain of [#FoodSafety](#) I ask myself: how can we keep pace with [#Innovation](#) & keep our methodologies up to date? How can we keep a small organisation like EFSA agile enough to be able to absorb the complexity of future challenges? [#EFSA2018](#)



The Challenge of Incremental Innovation



Regulating incremental innovation in medical devices

BMJ 2014 ; 349 doi: <https://doi.org/10.1136/bmj.g5303> (Published 09 September 2014)

Cite this as: BMJ 2014;349:g5303

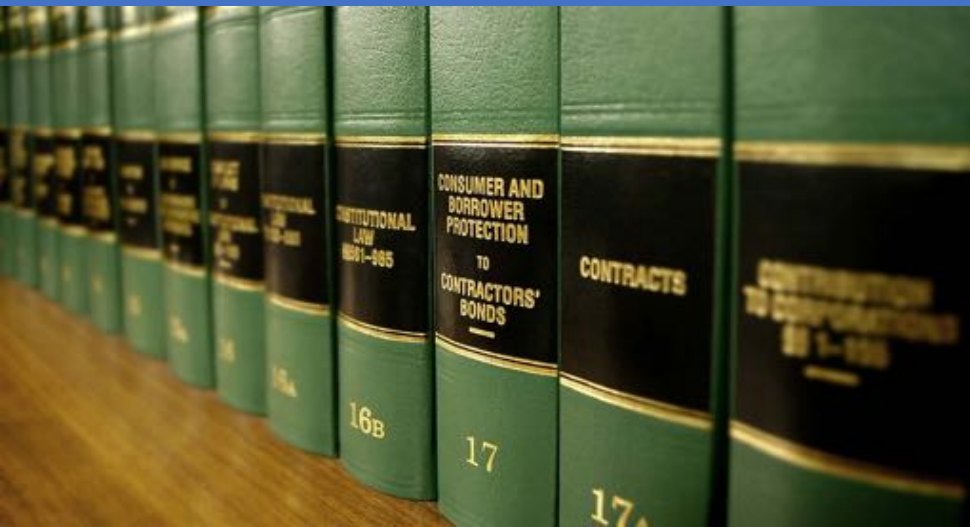
Unlike drugs, medical devices can evolve rapidly in basic design or technology. This is largely unregulated (by FDA)

'The competitive position of the European food and drink industry' report states that most innovations can be characterised as 'incremental innovations or imitations' (European Commission 2016)



Copyright & Intellectual Property

- Copyright, Intellectual Property, Knowledge Capital
- Could blockchain enable more agile and adaptive IP/copyrighting?
- Risk of complexifying copyright beyond human ability to understand?
- New report on Blockchain from the World Intellectual Property Organisation 2018
- EU Commission plans a blockchain observatory. US Congress recently created a Congressional Blockchain Caucus. Global standards for self-executing contracts are being discussed by various organizations



Scientific currency?

- Unpublished negative research
- Blockchain solutions exist
- Could aid open science for better decision making
- Potential provenance tool for academics to record their micro contributions



TECHNOLOGY

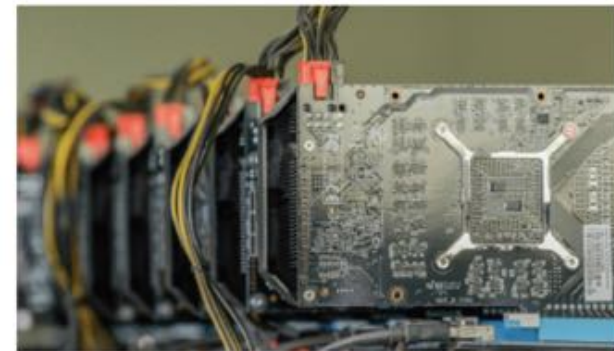
Blockchain moves to science

Proponents say the system behind Bitcoin could lend security measures to the scientific process.

BY ANDY EXTANCE

The much-hyped technology behind Bitcoin, known as blockchain, has intoxicated investors around the world and is now making tentative inroads into science, spurred by broad promises that it can transform key elements of the research enterprise. Supporters say that it could enhance reproducibility and the peer-review process by creating incorruptible data trails and securely recording publication decisions. But some also argue that the buzz surrounding blockchain often exceeds reality, and that incorporating the approach into science could prove expensive and introduce ethical problems.

A few collaborations, such as Scienceroot and Pluto, are already developing pilot projects to use blockchain for science. Scienceroot aims to raise US\$20 million, which will help to run both user interfaces and authors within its



Mining for bitcoins creates a large computational demand.

Security & Secrecy



Hackers are stealing food science data. With blockchain it's distributed & connections are protected

Securing the data may lead to cost-efficiencies e.g. automated due-diligence

However future decryption technologies (e.g. quantum) may threaten information encrypted and stored on public blockchains

“The agri-food business is filled with secrets, so blockchain technology could be problematic for many companies”

In high accountability sectors, balancing confidentiality with transparency is a challenge

Challenges: Maintaining Data Integrity



How 'immutable' are the data?

Need to understand how *human error* might play a role and how to deal with this

What happens if erroneous data ends up in an immutable BC?

Oversight, Trust, Power



Who is really 'in charge', is it always the community or is there a core party?

Government vs corporate values

Companies like Walmart, have more power and influence over other companies within the same supply chain

Private vs public blockchains

CHEMISTRYWORLD



Businesses use blockchain to take on trustlessness

BY ANDY EXTANCE | 14 AUGUST 2018

Territories



Multiple blockchains and BC types

Mega-corporate local or
community-owned

Laws & regulations vary across
regions

Philosophical & cultural factors

Environment



New forms of energy consumption

More of an issue for cryptocurrency requiring computer-intensive 'mining'

The energy sector itself is attempting to use Blockchain to decrease consumption

- Carbon credits as a social machine

Private BC are less energy-hungry

Could reduce waste in the supply chain, potentially -> carbon neutral

Privacy and Confidentiality



Zero knowledge
protocols?

*Information on a
public blockchain may,
in fact, be hackable*

Conclusions & Conundrums

Potential benefits: Transparency, accountability, efficiency, safety

Business case still unproven, aside from supply chain logistics

Hack resilience not yet fully tested (bad actors)

Decentralised, democratic vision may be disrupted by powerful platform controllers

Private blockchains aren't fully anonymous

International blockchain governance is needed

But let's not give up the baby with the bath water!



Thank you



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