Use of blockchain applications in the agri-food sector: state of play

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Introduction

- BlkT can transform many aspects of our life
- It may also change the game in the agri-food sector (AFS)

- What advantage does BlkT brings compared to the existing processes and systems that we have currently in place?
  - It can collect more efficiently coherent information from multiple parties that do not know or trust each other.
  - Combined with Internet of Things (IoT), it can replace many current process that are paper based or manual.

- The effects of BlkT can be understood from two point of view:
  - **Innovation-centred perspective**: BlkT is a new technology that brings innovation and thus may lead to efficiency/productivity improvements.
  - **Governance-centred perspective**: BlkT may lead to change (and more efficient) of the organization and governance of supply chain.

Potential benefits of Blockchain technology (BlkT) for agri-food sector (AFS)

BlkT may contribute to addressing several challenges that AFS are facing:

Traceability

- tracks where food came from
- all players and stages of AFS
- from farmers to consumers

Transparency

- tracks how food was produced, stored, transported, etc.
- better access to information (nearly real time)
- potentially accessible to all actors
- secure faster transactioandns

Efficiency

- reduced transaction costs, delays, number of intermediaries
- more enforceable contracting (smart contracts)
- cheaper and new form of finance

Food security

- improved access to food to people in need (e.g. disbursement of aid)

Food safety

- contamination incidents can be easier prevented
- less costly and faster to track food safety breaches

Problem prevention

- cheaper/easier detection of problems by actors or regulators (fraud, delayed payments, contract breach, product damage)

Environmental & social concerns

- better tracking of environmental issues, ethical working conditions, etc.
- income (prices) distribution in AFS

Other

- can reshape organization and governance of AFS

Potential benefits

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Some more specific examples

❖ Land registration	❖ Crop insurance and risk management
❖ Facilitating international trade	❖ Traceability of product origins
❖ Access to finance and financial inclusion	❖ Cash transfers / Remittances
❖ Supply chain coordination	❖ Payment cards
❖ Digital identity	❖ Charities: transparency and linking donors and recipients
❖ Waste managements	❖ Management of common resources (e.g. water)

BUT BlkT is not a solution for everything (the adoption is costly). Situations when BlkT is more suitable:

- when information is shared among different actors
- when there is reduced trust among actors
- when accuracy and irreversibility/immutability of information is important

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Adoption of BlkT

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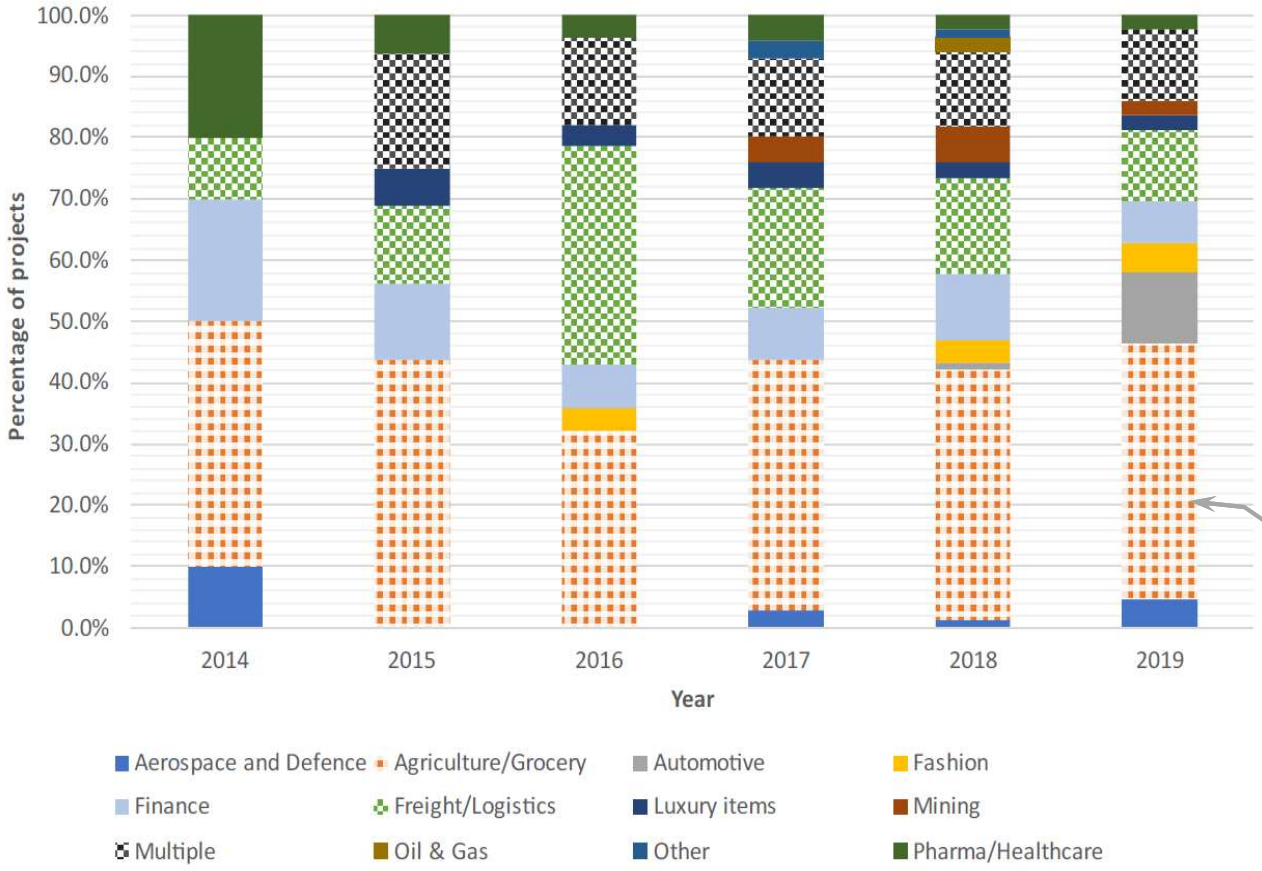
BlkT adoption in AFS relative to other sectors



- BlkT projects operating in Agri/Grocery account for around 40%.
- 271 investigated BlkT projects founded between 2014-2019 (Vadgama and Tasca 2020).

Agriculture/Grocery BlkT projects

Source: Vadgama and Tasca (2020)

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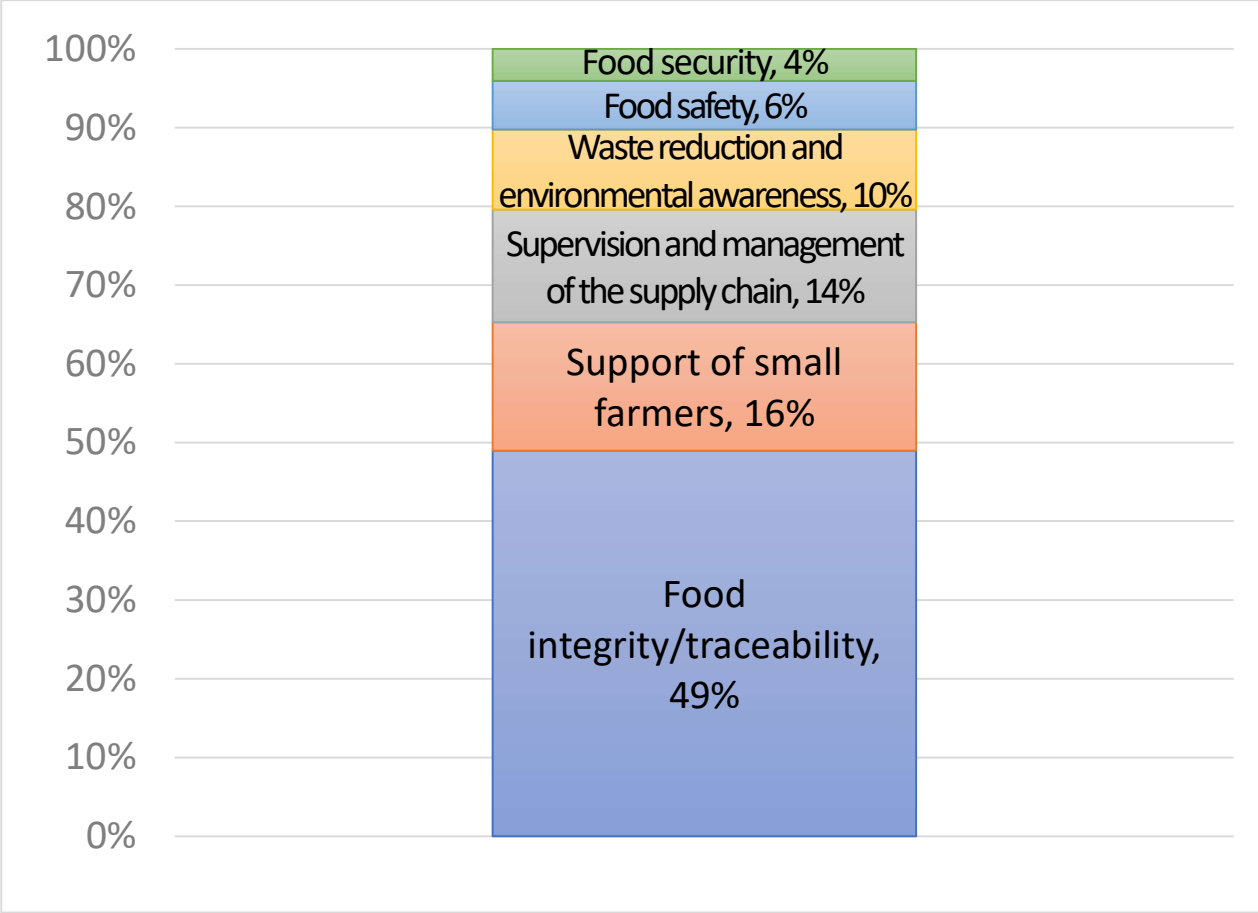
Adoption of BlkT

Areas of BlkT application in agri-food sector



- Based on 49 investigated BlkT project
- Most BlkT applications focus on food traceability.

Source: Kamilaris, Fonts and Prenafeta-Boldú (2019)

Adoption of BlkT

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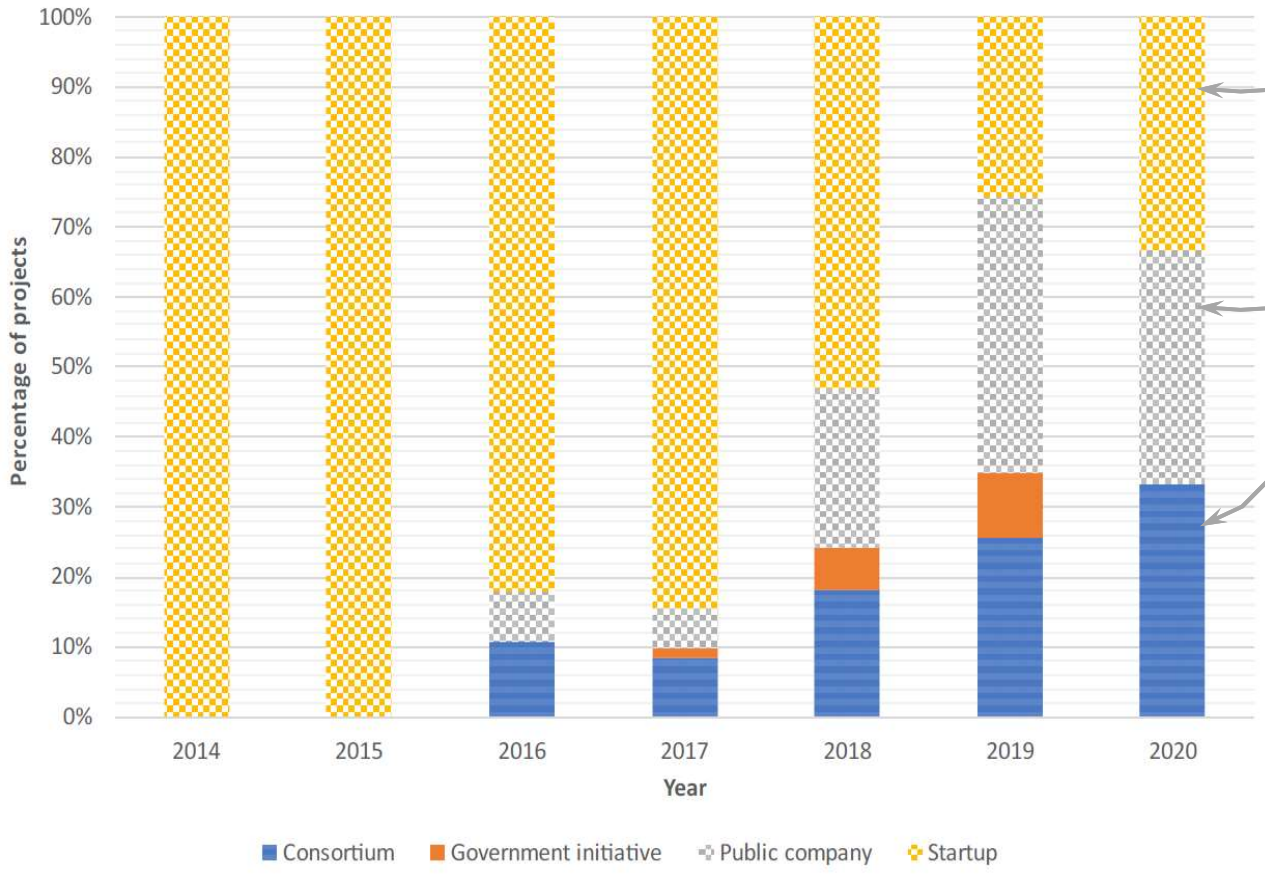
Type of organisation leading BlkT projects in supply chains



Private companies

Public companies

Consortia

- A shift in market interest from primarily private companies (startups) to public companies and consortia – all sectors (Vadgama and Tasca 2020).

Source: Vadgama and Tasca (2020)

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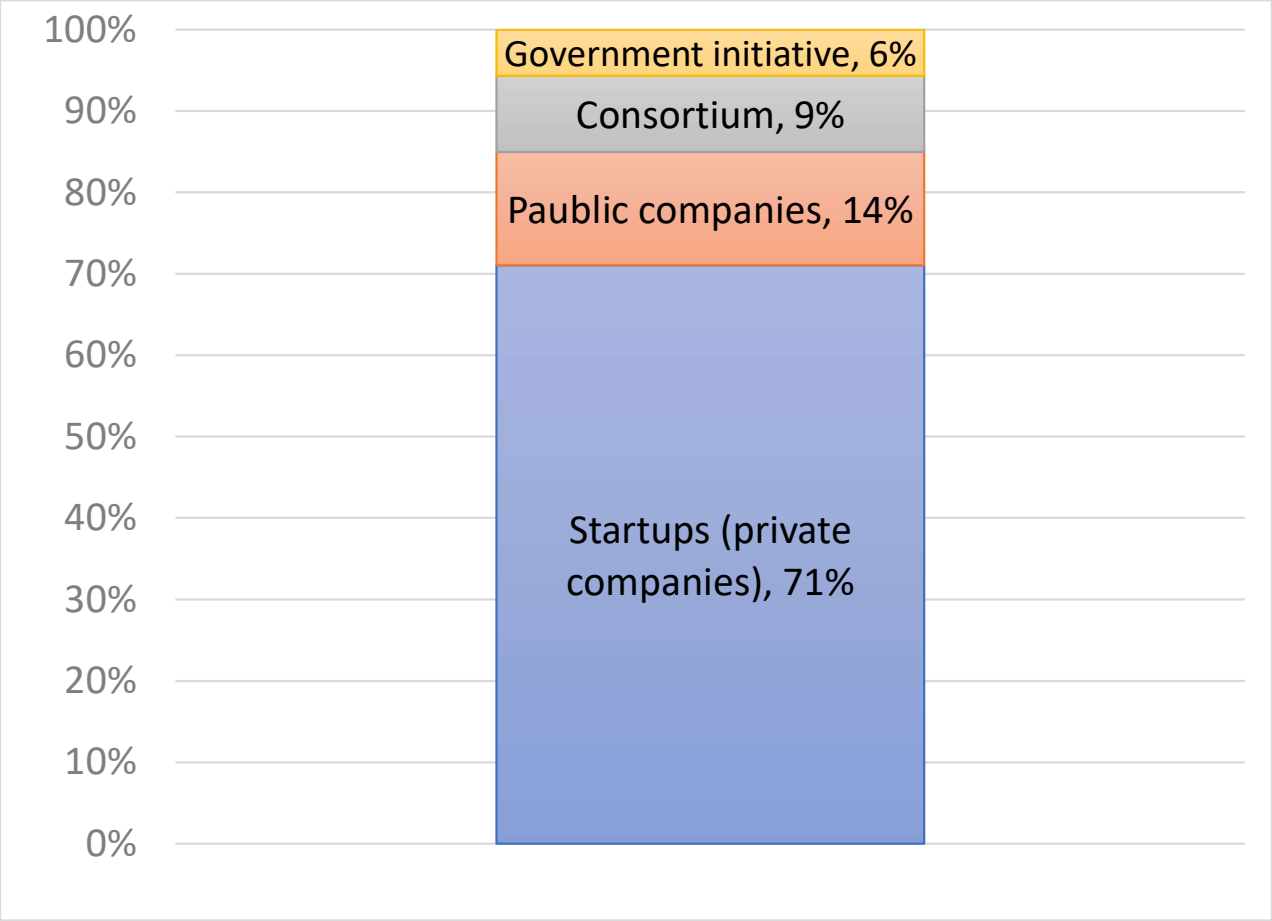
Adoption of BIkT

Type of organisation leading BIkT projects in AFS

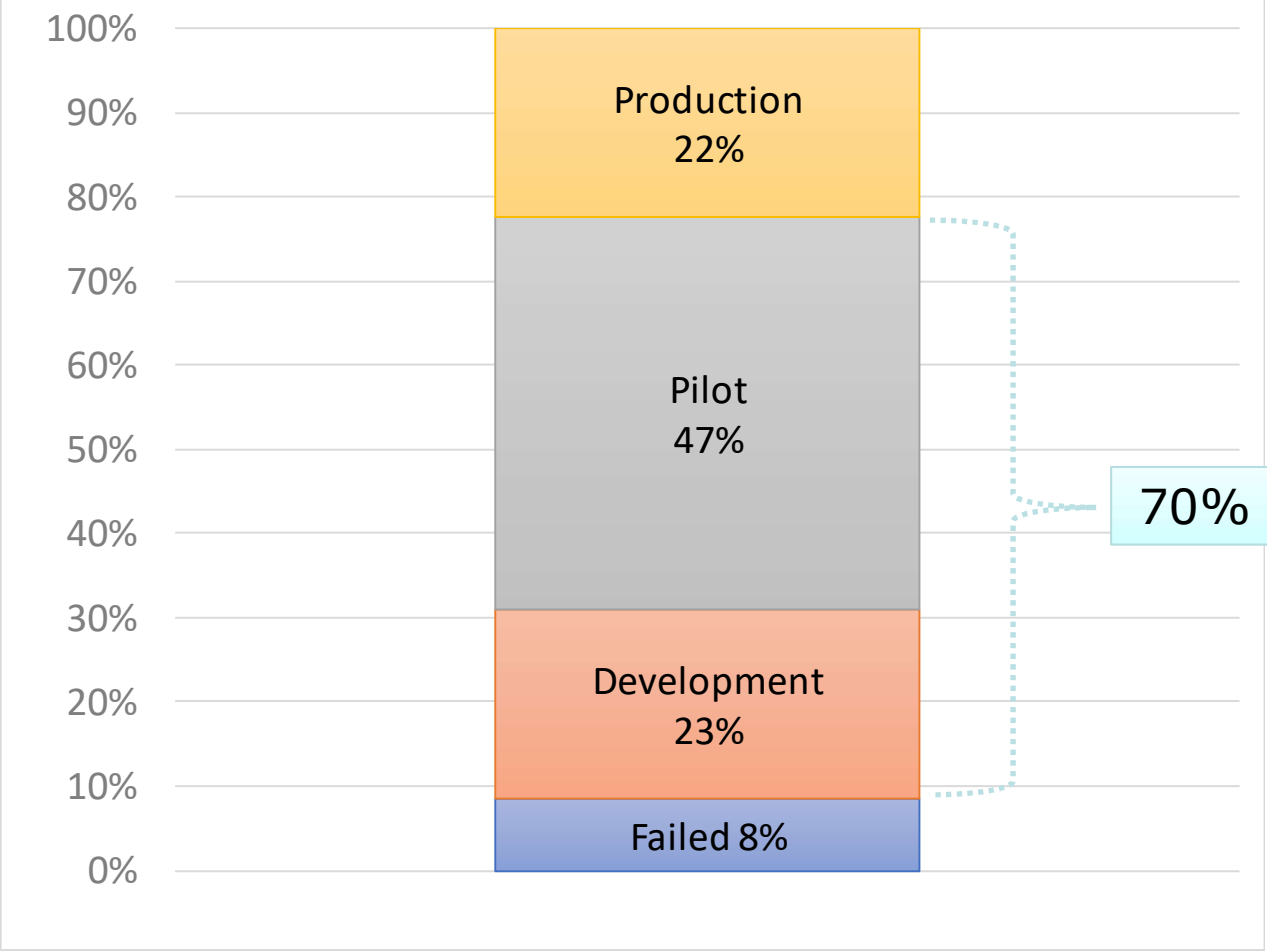


- Agriculture/Grocery for 2014-2019: private companies (startups) dominate (71%), followed by public companies and consortia (23% jointly) (based on Vadgama and Tasca 2020).

Source: Calculated based on Vadgama and Tasca (2020)

Stage of development of BlkT

Stage of development of BlkT projects in agri-food sector



2014-2019 for Agri/Grocery:

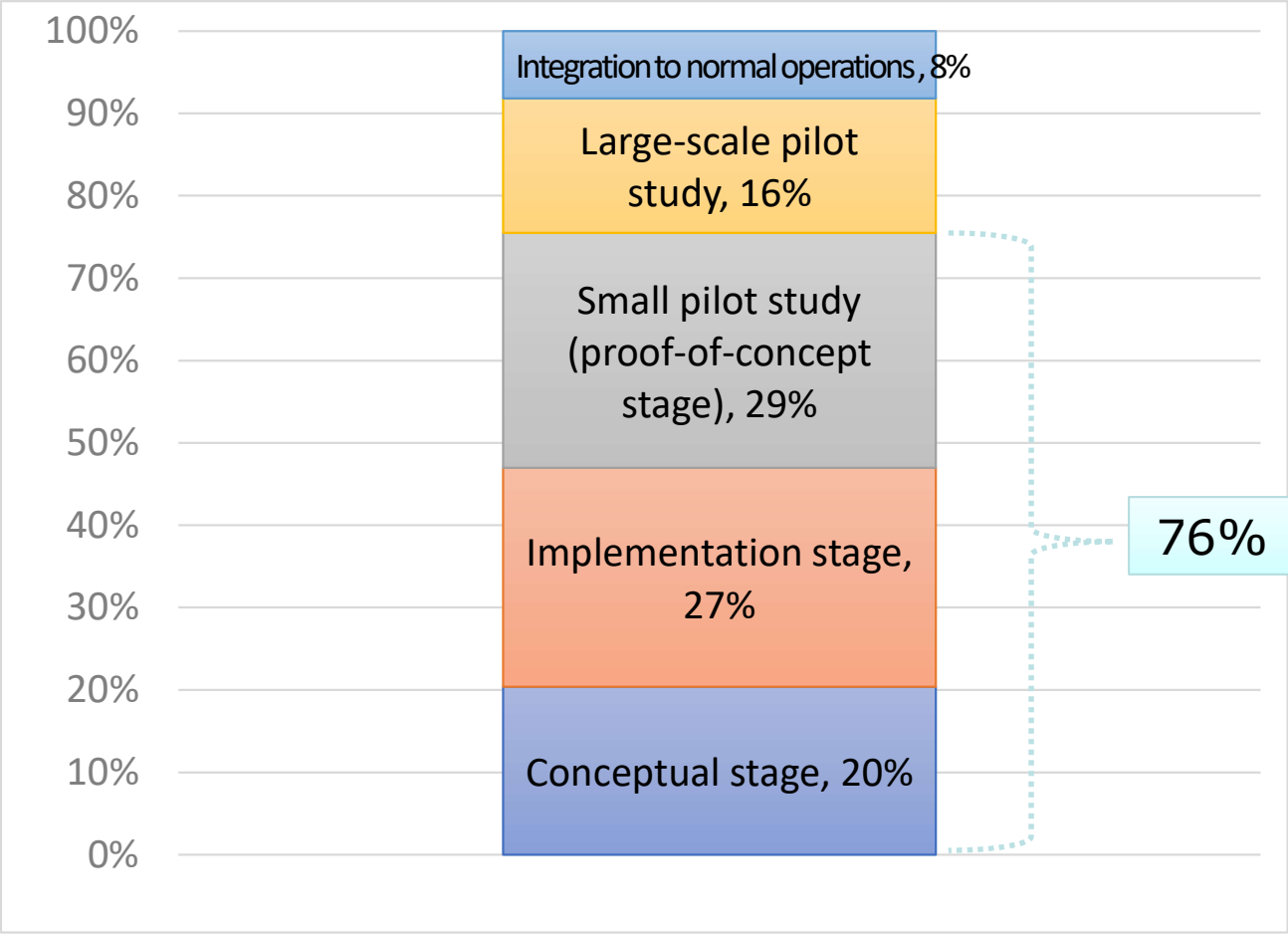
- Most projects (70%) are in development or pilot
- 8% projects have filed

(based on Vadgama and Tasca 2020).

Source: Calculated based on Vadgama and Tasca (2020)

Stage of development of BIkT

Stage of development of BIkT projects in agri-food sector

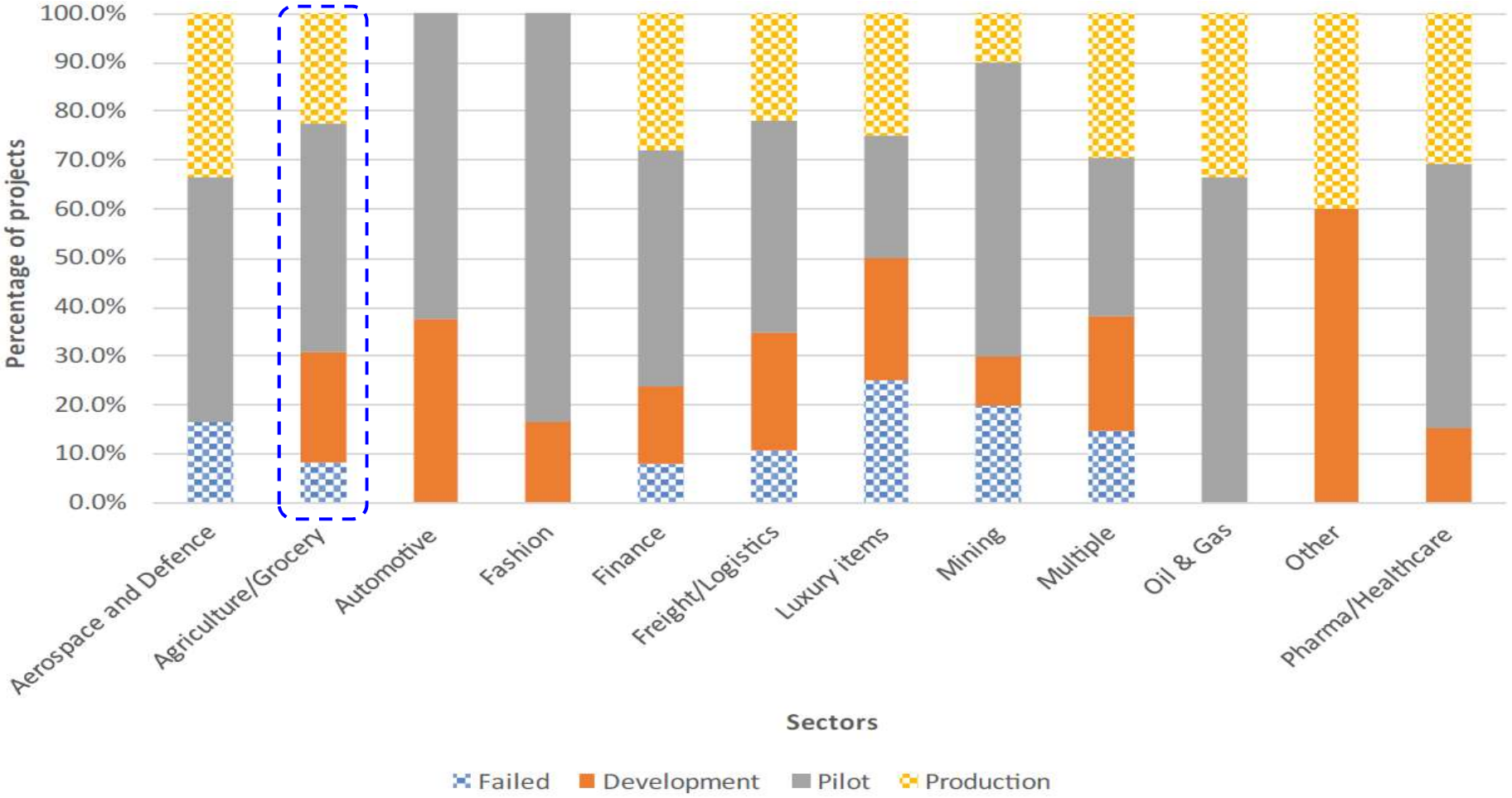


- Most projects (76%) are in conceptual stage, implementation phase or in a proof-of-concept stage (small pilot studies) (Kamilaris, Fonts and Prenafeta-Boldú 2019).

Source: Kamilaris, Fonts and Prenafeta-Boldú (2019)

Stage of development of BlkT

Stage of development of BlkT projects: comparison across sectors



Source: Calculated based on Vadgama and Tasca (2020)

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Challenges & limitations

- There is **limited benefit from BlkT when a single organization adopts it** ➔ largest gains are when adopted at inter-organizational (supply chain-wide) level ➔ this has implication for the BlkT adoption

- **Individual gains form BlkT adoption depend on the behaviour of others - the network effect:** the individual gains (and motives for the adoption) are proportional to the adoption of other actors in AFS.
  - it requires inter-organizational cooperation/coordination.

- For comparison, **the adoption of "standard"** (single-organisation) **information systems (IS) technology is based on individual choice determined by individual gains**
  - We observe significant challengers in the adoption of this technology
  - AFS is complex with different layers of players and many of them are small where the adoption of technology is not always straightforward.

Challenges & limitations (cont.)

- **Linking the physical to the digital is the key challenge** (IoT devices, sensors, biosensors are critical to providing physical verification)
  - digital needs to represent accurately the physical world (**1 to 1 correspondence**)

- **Quality of the data**: **automated (sensor-driven) recording is critical** to increase accuracy and reduce overload of data reporting for actors (given that BlkT collects a lot of information)

- **Blockchain standards not available yet**: Different protocols are used in practice ➔ Incompatibility between BlkT and the exiting IS.
  - Non-standardization ➔ reduces willingness to adopt BlkT because shifting to BlkT requires new investment and replacing the exiting IS
  - BUT we also do not know which approach will prove to be the best; we need different project to run in parallel

Challenges & limitations (cont.)

- The choice between **public vs. private blockchain**
  - **Private (permissioned) Blockchain** more flexible to tailor it to the needs, better scalability, better performance, better control of data access rights, but may be vulnerable to security breaches and cyber attacks, risk of centralization ➔ more likely future path
  - **Public (permissionless) Blockchain**: more secure; more difficult to control, lower performance, more difficult to update the algorithm

- **Internet connectivity is critical**: could be problematic for many places
- **Other challenges**: capacity constraints unable to serve large scale of AFS consisting of many players, security and confidentiality of private information – developments are needed in these areas
- **Promised/expected benefits of BlkT might not (fully) materialise** (at least in the short/medium-term) because of real world issues (e.g. motivation of actors to participate, automated solutions not available)

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Conclusions

- BlkT **not yet fully mature**: we are in the **early stage of development**
  - We are in the stage of development: testing and checking what is possible
  - But how things look now, **BlkT is here to stay**; there are many ongoing developments

- Comparing to internet development: we are in 1990s of internet

- Overall, BlkT is currently **perceived mostly as an experimental new and emerging technology with future potential**.
  - Many companies perform pilot studies involving blockchain for marketing reasons or to get competitive advantage in future.

- **Limited availability of consistent data on BlkT applications** (no standard statistical sources available, heterogenous reporting across projects) which limits conducting comprehensive analyses.

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Thank you for your attention

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