CiRACORE

รางวัลพระราชทาน
นักเทคโนโลยีดีเด่น
ประจำปี 2562

KMITL
พระจอมเกล้าลาดกระบัง

คณะเทคโนโลยีสารสนเทศ
สถาบันเทคโนโลยีพระจอมเกล้าเจ้าคุณทหารลาดกระบัง

TECHNOLOGY READINESS LEVELS : USED CASES

รองศาสตราจารย์ ดร. ศิริเดช บุญแสง

คณบดี,
คณะเทคโนโลยีสารสนเทศ
สถาบันเทคโนโลยีพระจอมเกล้าเจ้าคุณทหารลาดกระบัง

The Dunning-Kruger Effect

Pradeep Patel

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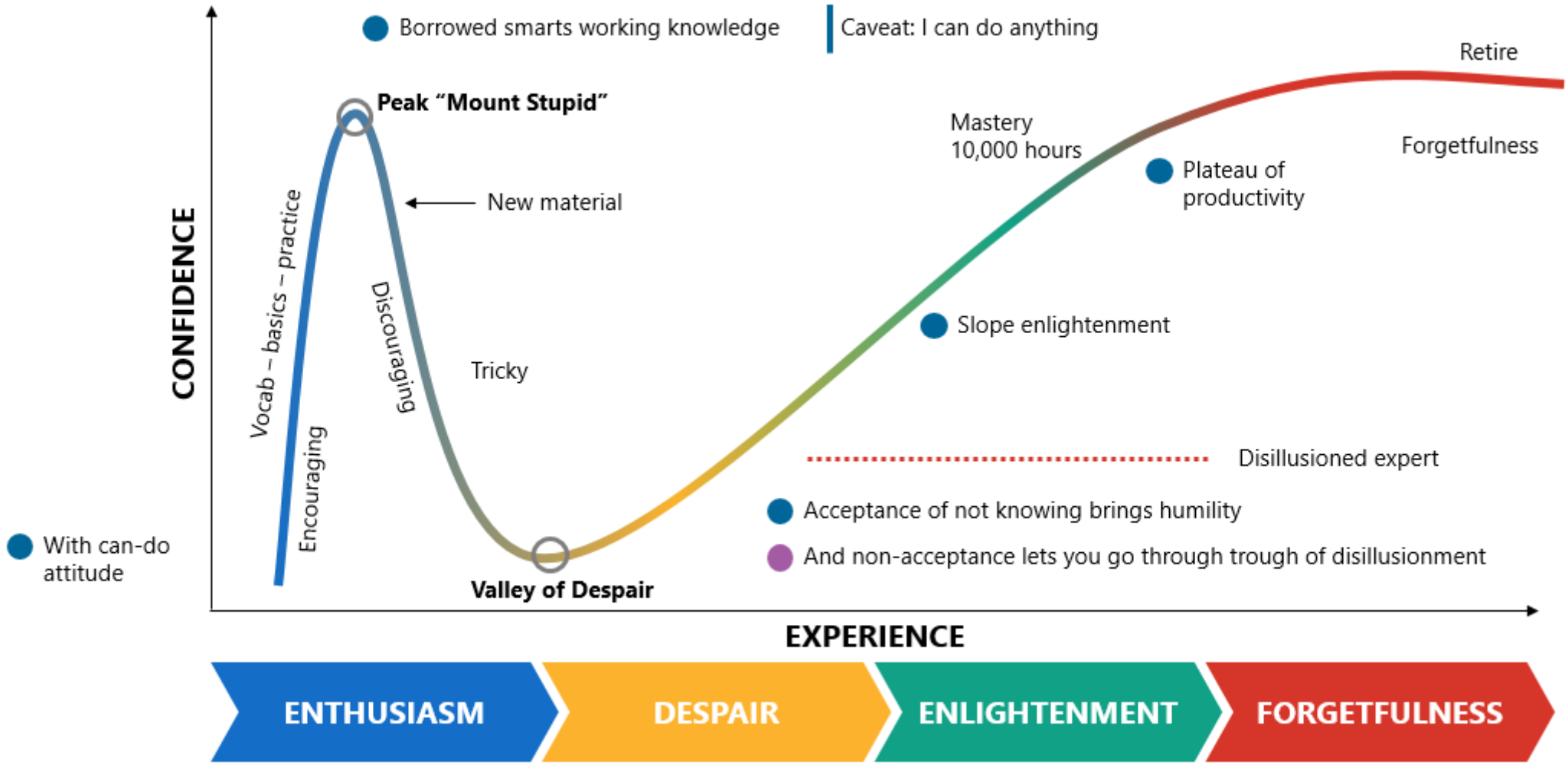
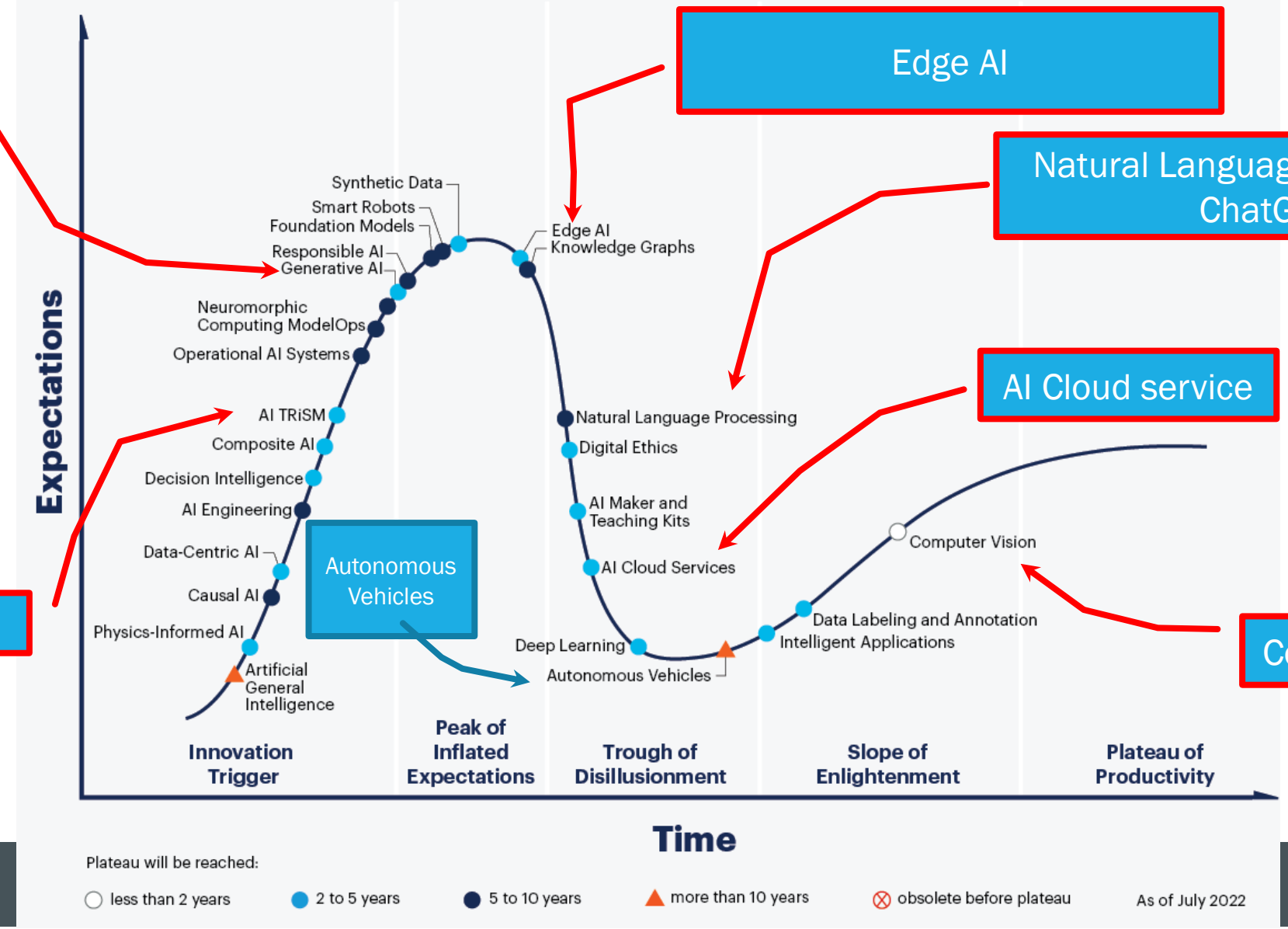


Gartner Hype Cycle for Artificial Intelligence, 2022



Generative AI

Edge AI

Natural Language Processing
ChatGPT

AI Cloud service

AI TrisM

Autonomous Vehicles

Computer Vision

FRONTIER SI

Technology Readiness Levels (TRLs)

FrontierSI Research and Innovation Ecosystem

ACADEMIA

INDUSTRY/GOVERNMENT

TECHNOLOGY READINESS LEVELS

TRLs were originally developed **by NASA in the 1970s for space exploration technologies**

TRLs have been widely implemented globally by a range of organizations across government and industry sectors

TRLs enable **clear communication** about expectations between various parties

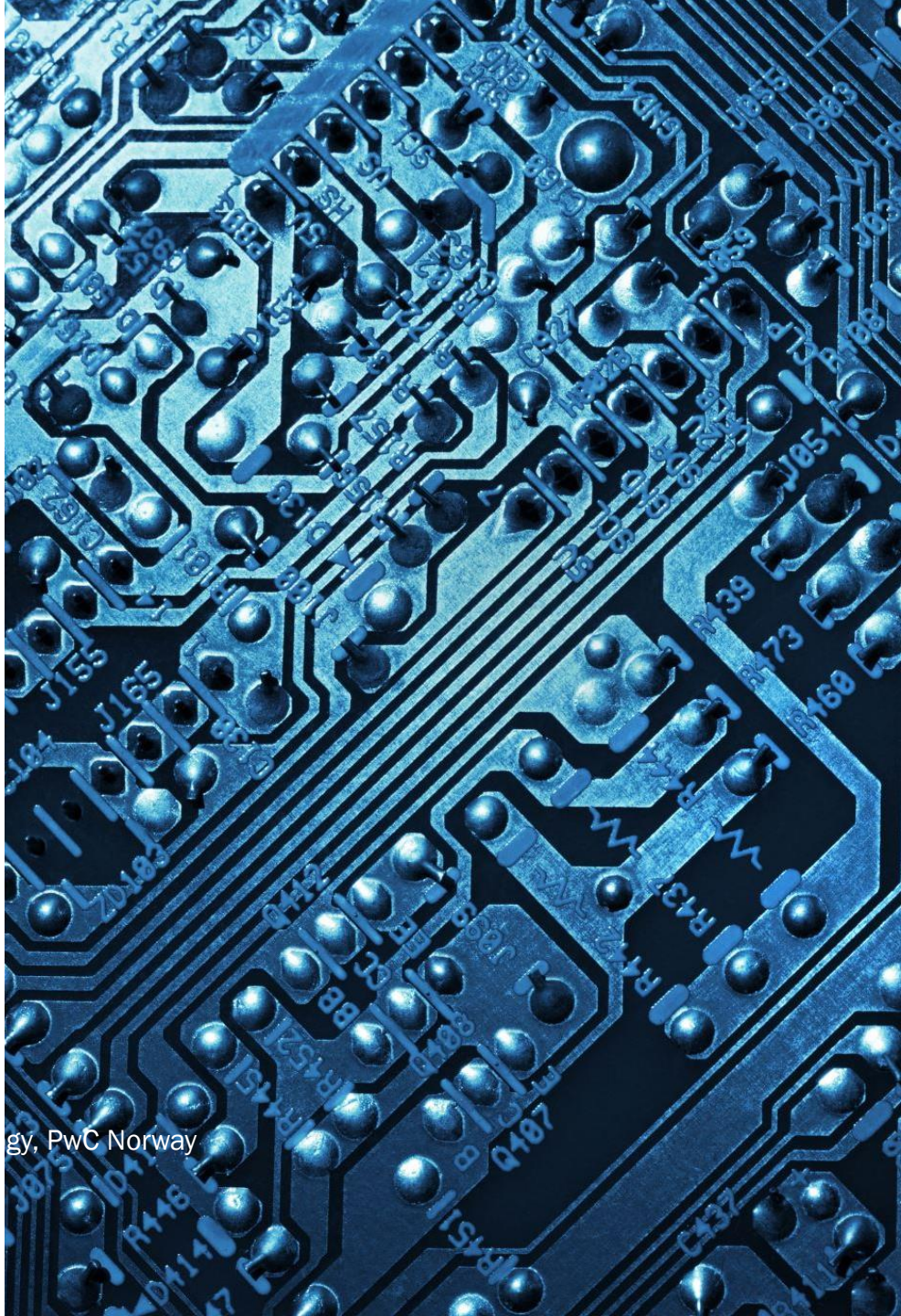
TRLs provide a shared language **for considering technology maturity and risk** between different stakeholders

TRLs offer a systematic approach to the system **development lifecycle** with clear guideposts and milestones.

TECHNOLOGY READINESS LEVELS

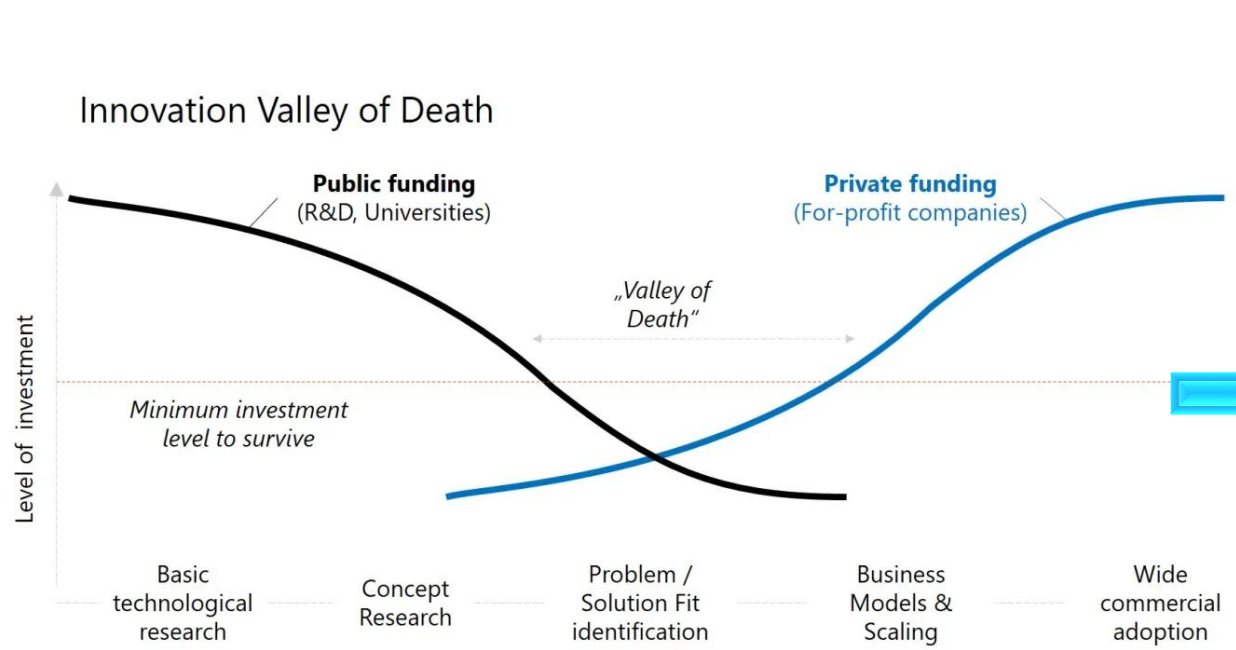
- Technology Readiness Levels (TRLs) assess and communicate the maturity level of a technology project
- The TRL system has nine levels split into three groups indicating different stages of development
- TRLs 1-3 are **the least mature** and indicate research stages of development
- TRLs 4-6 indicate **developmental stages** of development
- TRLs 7-9 are the most mature and indicate deployment stages of development

- Alessandro Rossini
-

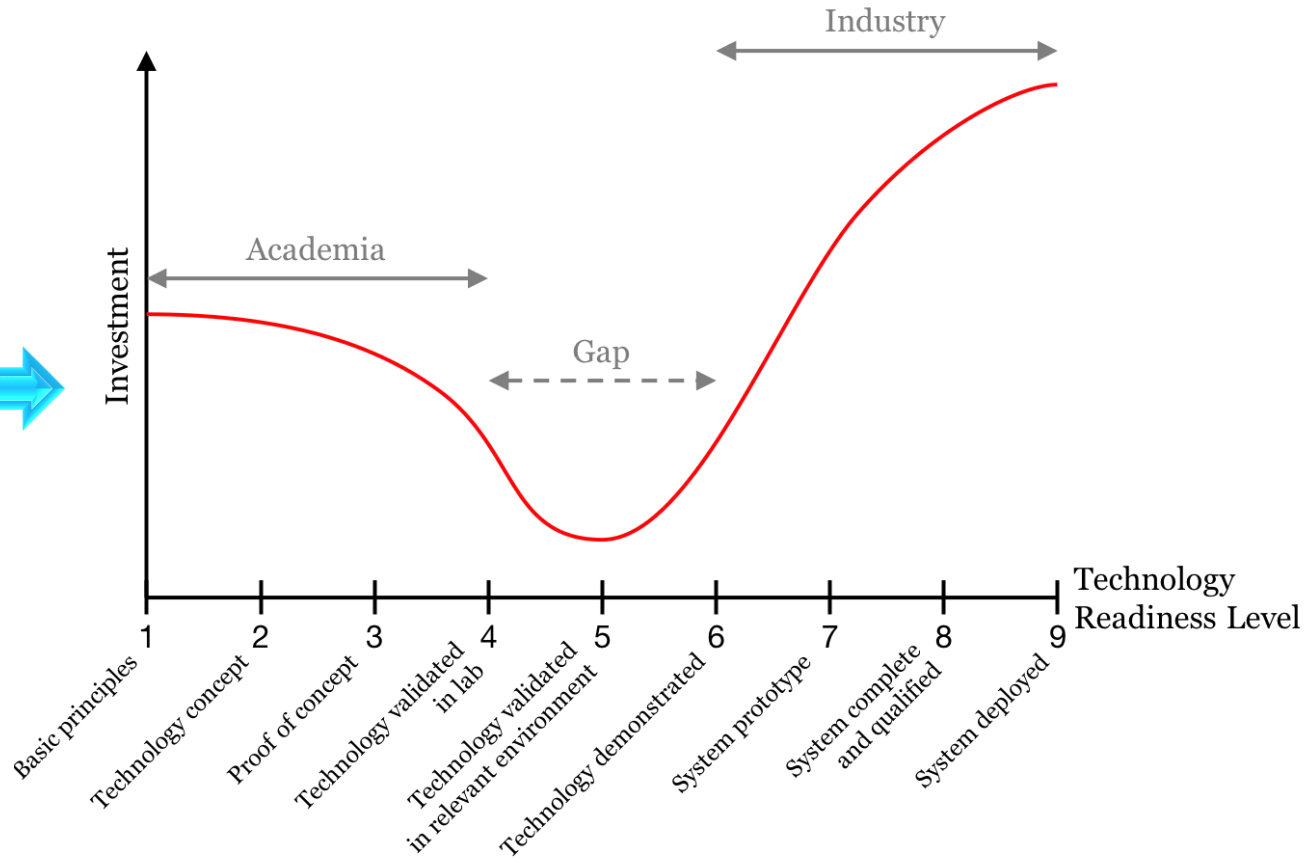


gy, PwC Norway

TYPICAL TECHNOLOGY FUNDING

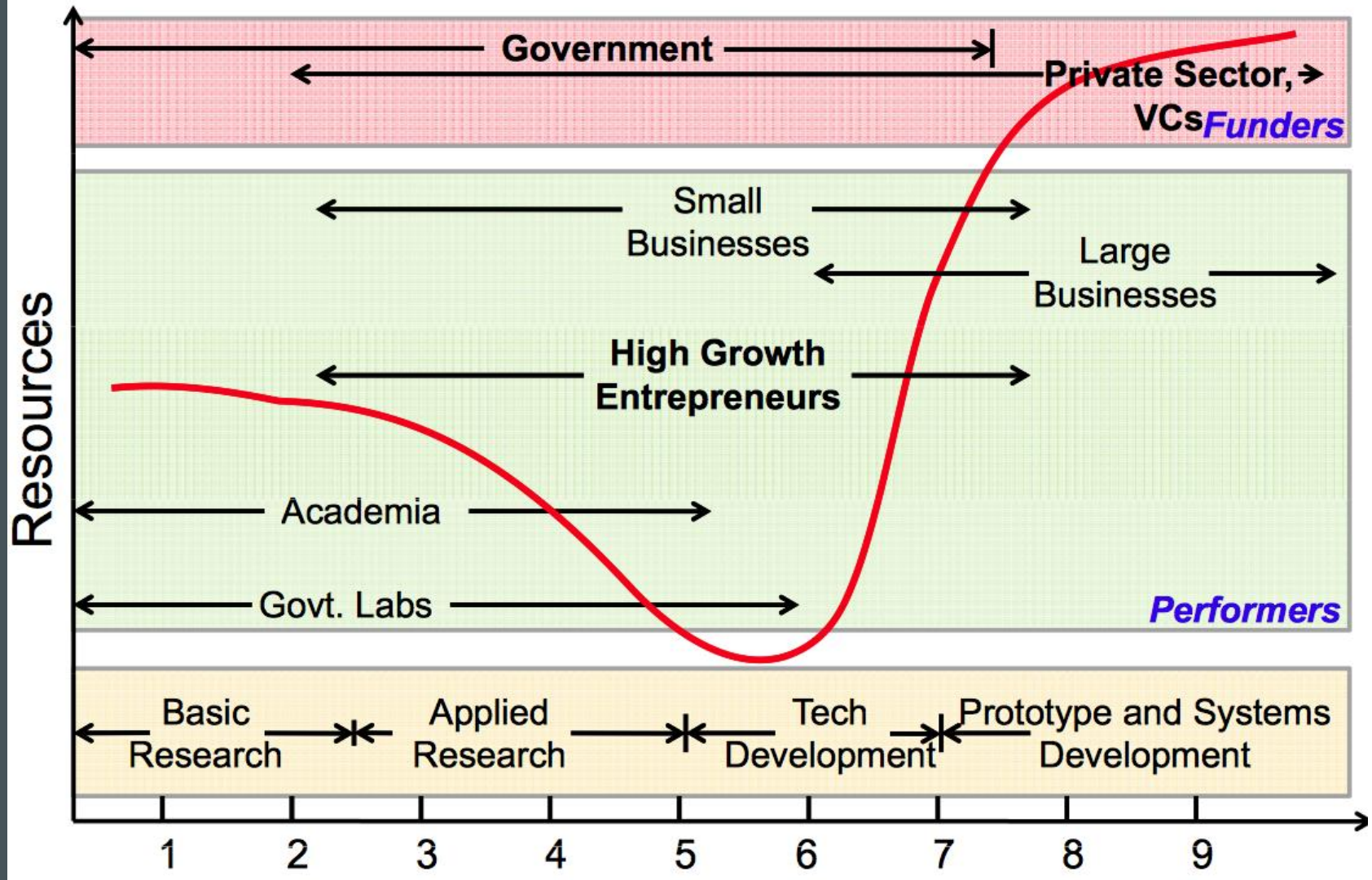


idea to value.com
The community for creativity and innovation

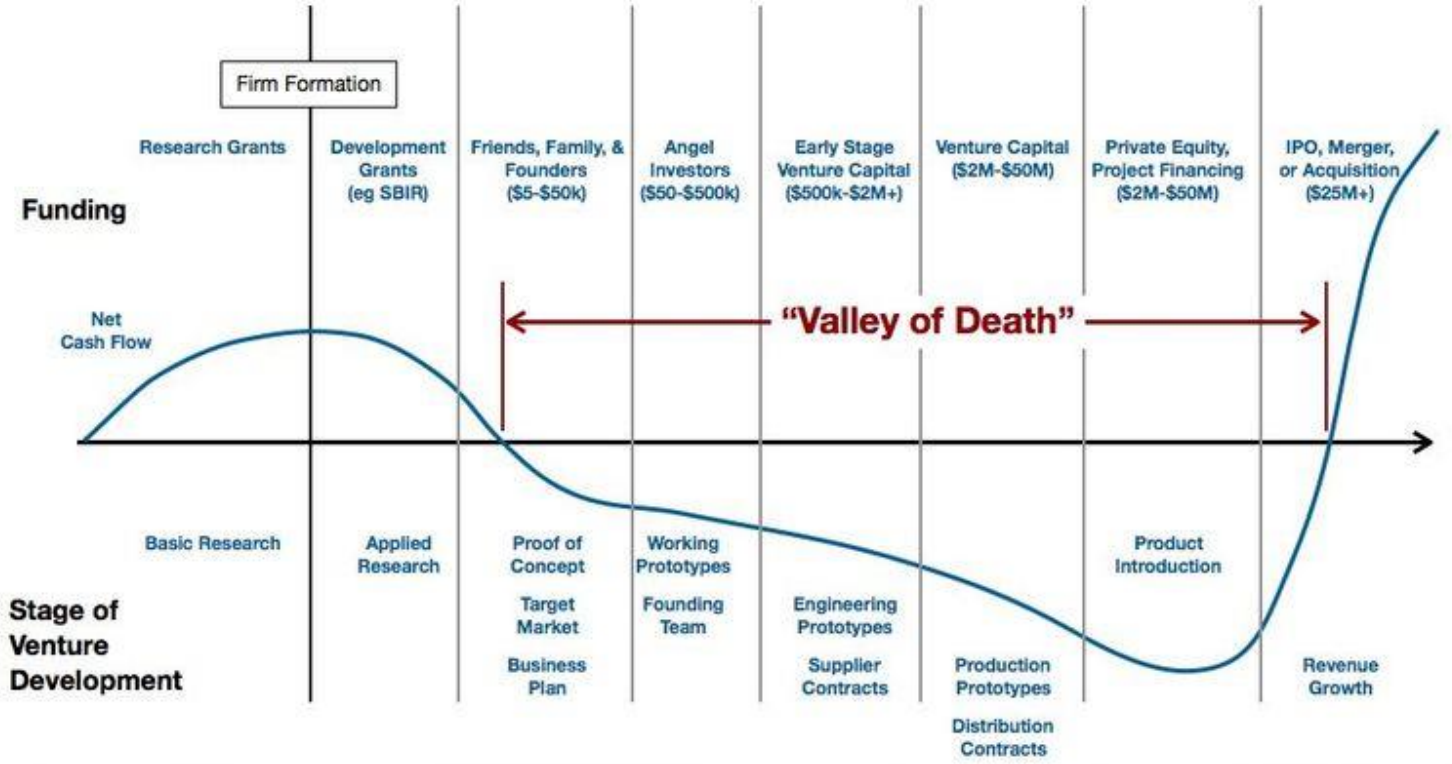


- **The academic** assumes that the company will be willing to pick up their stuff at TRL 4 (they won't).

- **The company** assumes they will receive technology on TRL 7 level (this won't happen either).



Lifecycle of a venture



UCDAVIS CENTER FOR ENTREPRENEURSHIP

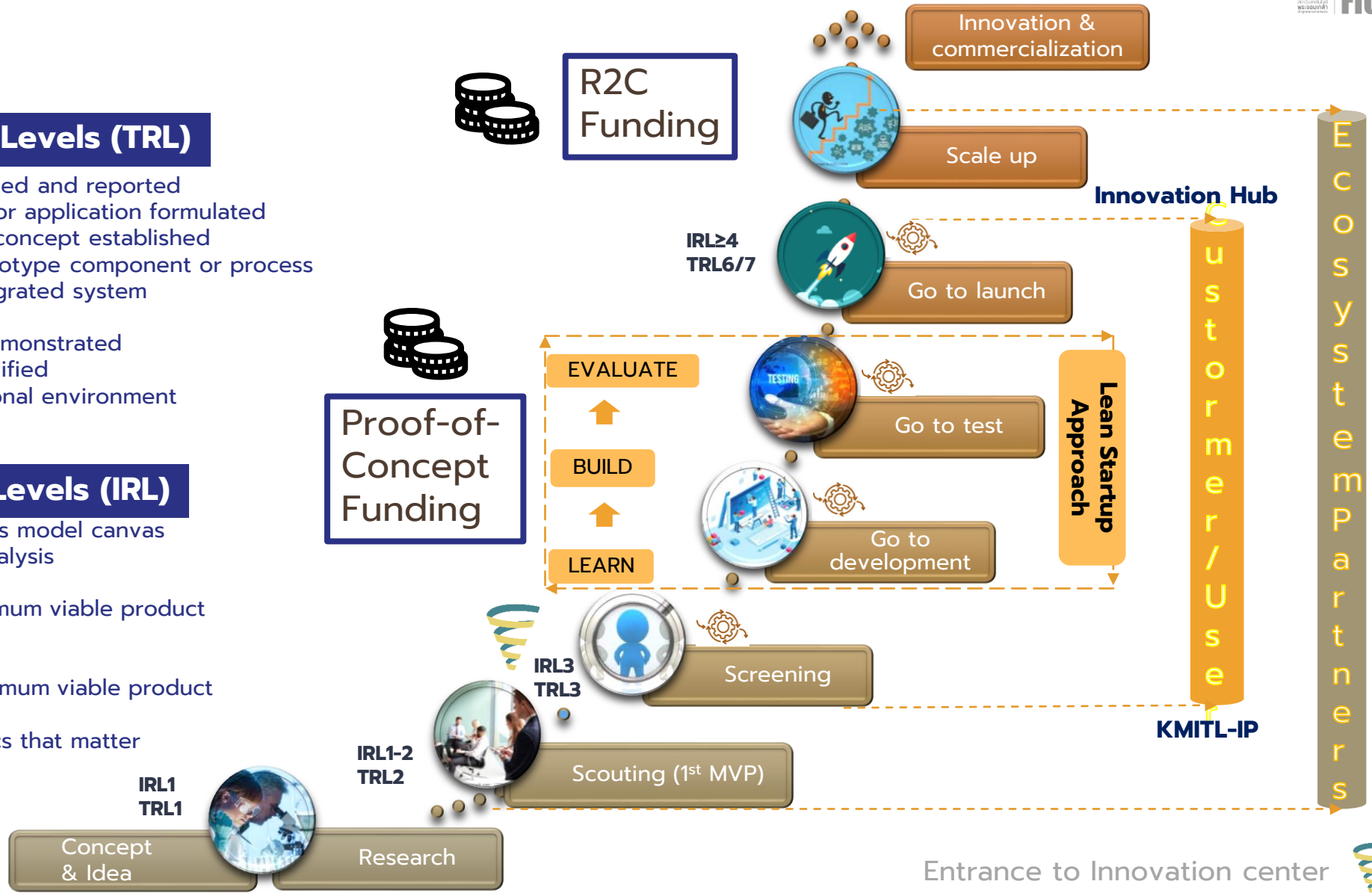
Graduate School of Management UCDAVIS

Technology Readiness Levels (TRL)

TRL 1 - Basic principles are observed and reported
TRL 2 - Technology concept and/or application formulated
TRL 3 - Critical function, proof of concept established
TRL 4 - Laboratory testing of prototype component or process
TRL 5 - Laboratory testing of integrated system
TRL 6 - Prototype system verified
TRL 7 - Integrated pilot system demonstrated
TRL 8 - System complete and qualified
TRL 9 - System proven in operational environment

Investment Readiness Levels (IRL)

IRL 1 - Complete first-pass business model canvas
IRL 2 - Market size/competitive analysis
IRL 3 - Problem/solution validation
IRL 4 - Prototype low-fidelity minimum viable product
IRL 5 - Validate product/market fit
IRL 6 - Validate revenue model
IRL 7 - Prototype high-fidelity minimum viable product
IRL 8 - Validate value delivery
IRL 9 - Identify and validate metrics that matter



M0 Checklist
A technology is identified, a purpose and timeline for key decisions is defined. Ready to spend money on building parts. Sufficient demonstration to consider capital spend.

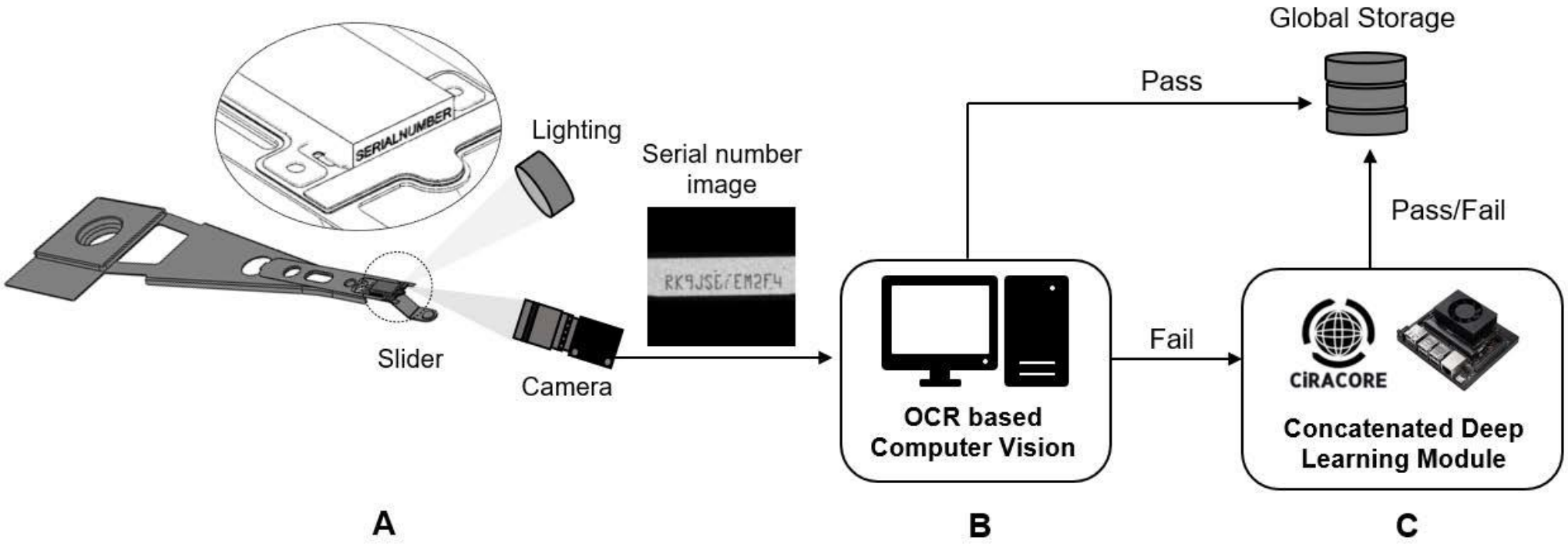
M1 Checklist
Small volume empirical results demonstrate desired performance in identified CTQs. The direction has been set for the technology that will be pursued (Feasible for product consideration). Capable of building samples at the volume site on volume tooling.

M2 Checklist
The process, equipment or design can be used routinely in pre-production volumes, at one site, to demonstrate the anticipated level of performance, validate models and exhibit compatibility with other processes and CTQs in the process flow. Technology is ready for Product Qualification.

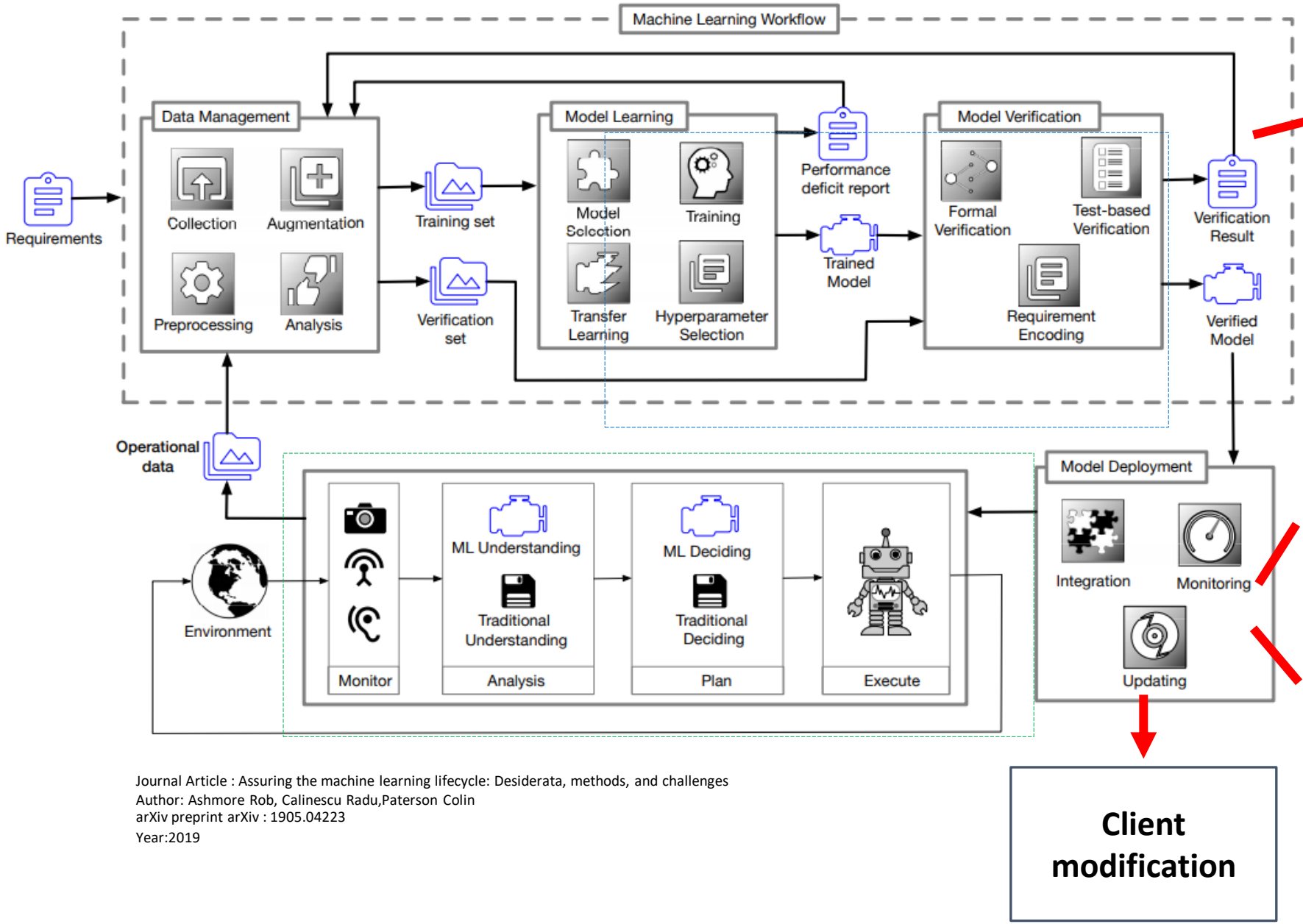
M3 Checklist
Process optimization to meet performance specifications completed. Equipment, Training, Documentation and System integration activities are complete and have been qualified for use in volume production. Qualified on at least 1 Product. Second volume site is qualified if required for volume.

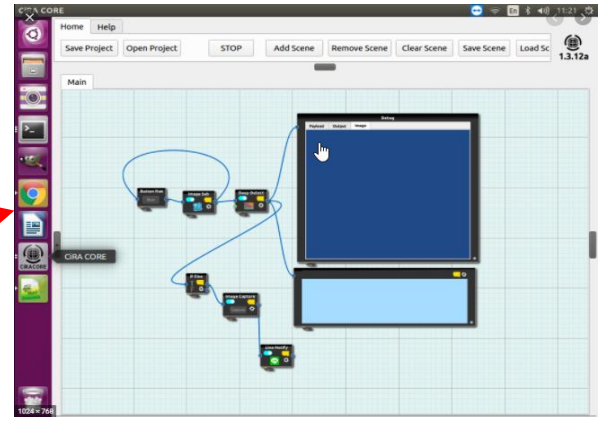
SEAGATE TECHNOLOGY LEVEL CHECKLIST

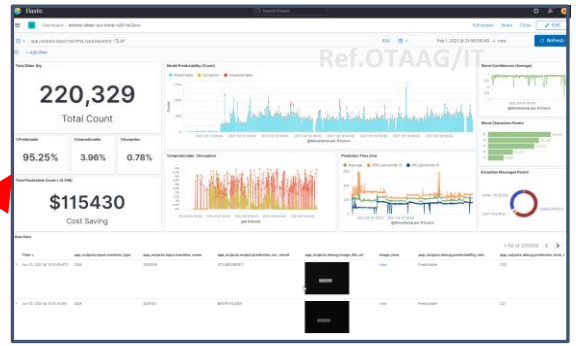
EXAMPLE TRL 9 ACTUAL SYSTEM PROVEN IN OPERATIONAL ENVIRONMENT

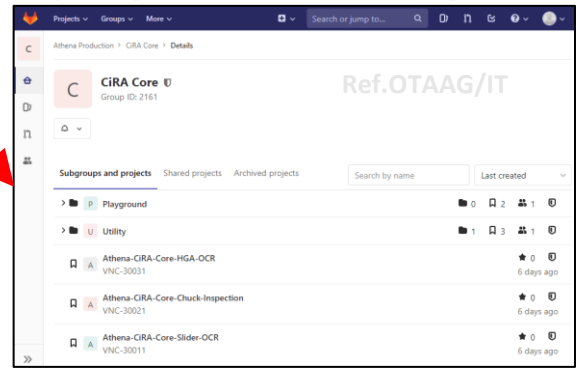


CiRA CORE implementation at Seagate









Journal Article : Assuring the machine learning lifecycle: Desiderata, methods, and challenges
Author: Ashmore Rob, Calinescu Radu,Paterson Colin
arXiv preprint arXiv : 1905.04223
Year:2019

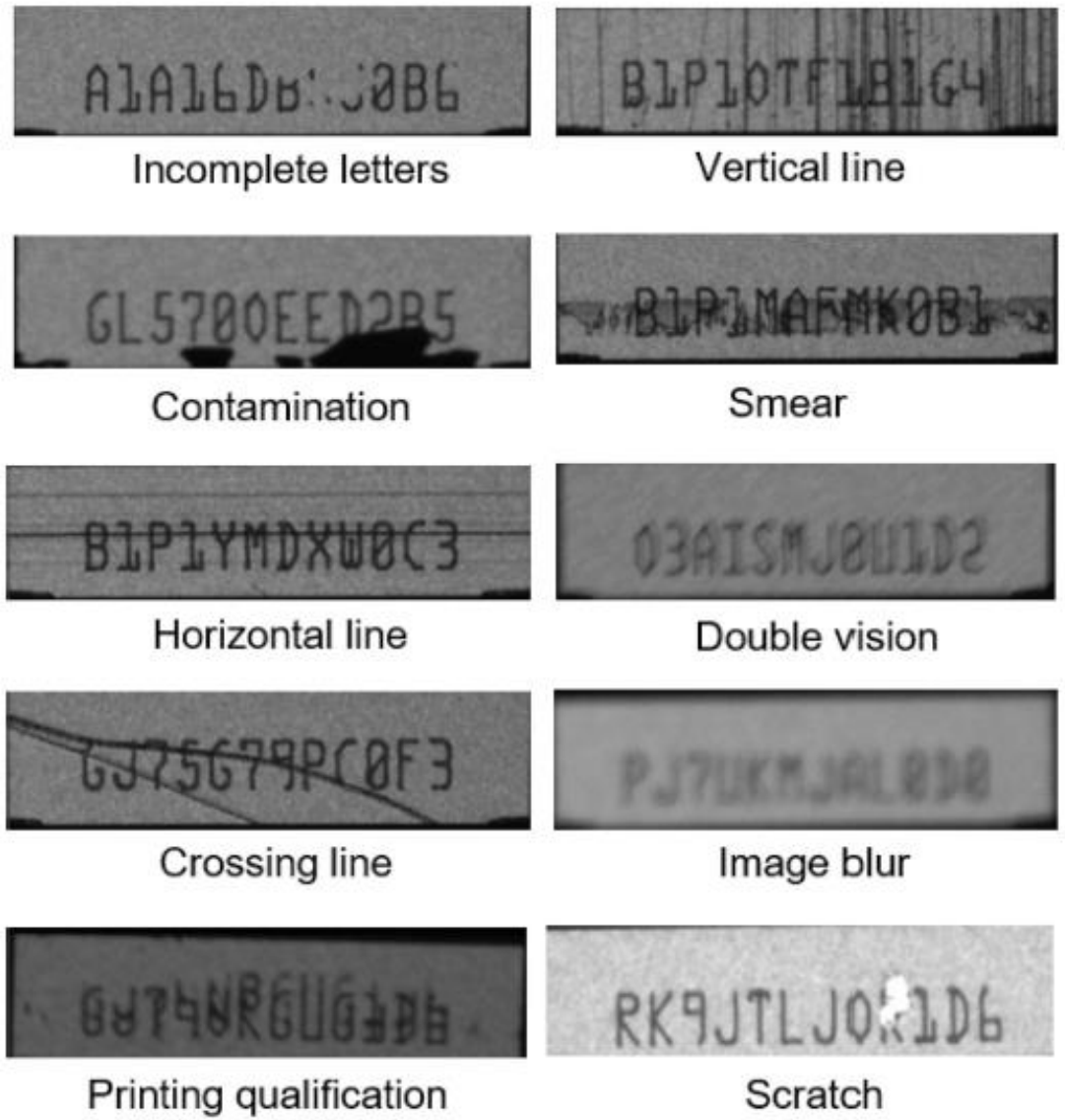


Figure 5. Types of defects on serial number images occurring in a production line.

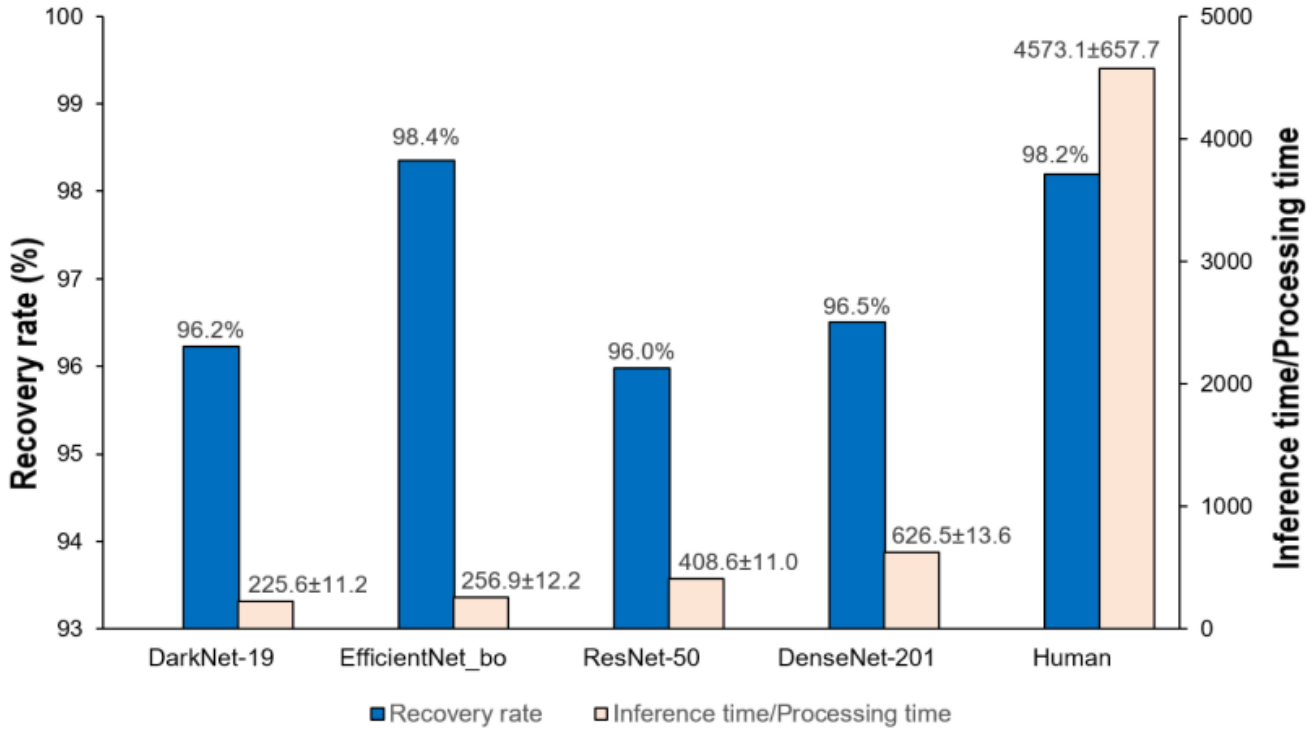


Figure 10. Recovery rates (%) and inference time (second) of four CNN networks and human reading.

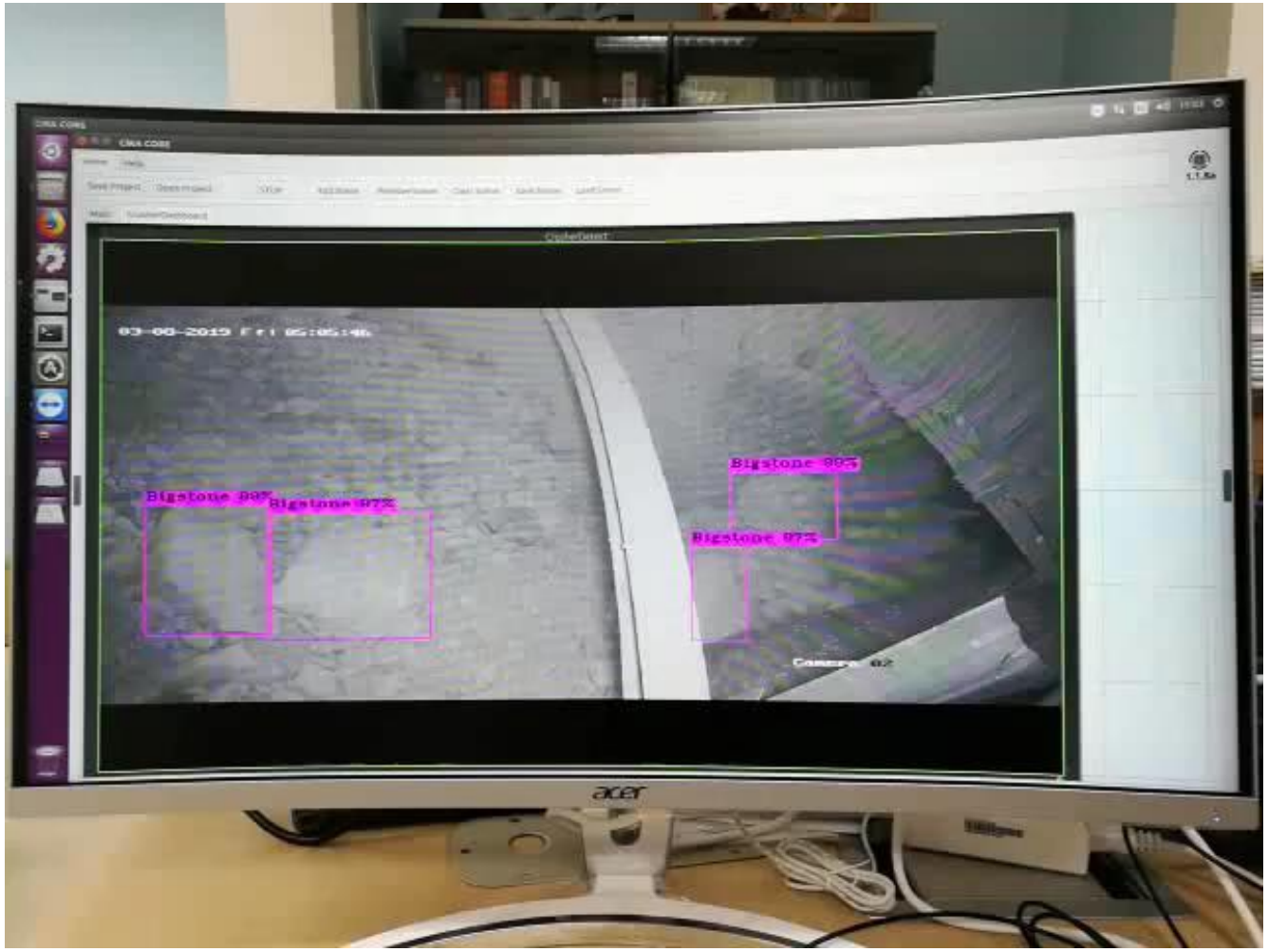
Database	B1P1LTKSP0H1	06GI9MDQB0A4	PL5KC3BMD1H0	BV91K086F2G5
Captured images				
OCR-based CDL (EfficientNet_B0)	B1P1LTKSP0H1	O6GI9MDQB0A4	PL5KC3BMD1H0	BV91K086F2G5
Human reading	B1P1LT?SP0H1	06GI9M?QB0A4	PL5KC3BMD1??	BV91??86F2G5

Figure 11. Examples of better classification performances of EfficientNet-B0 superior to human reading.

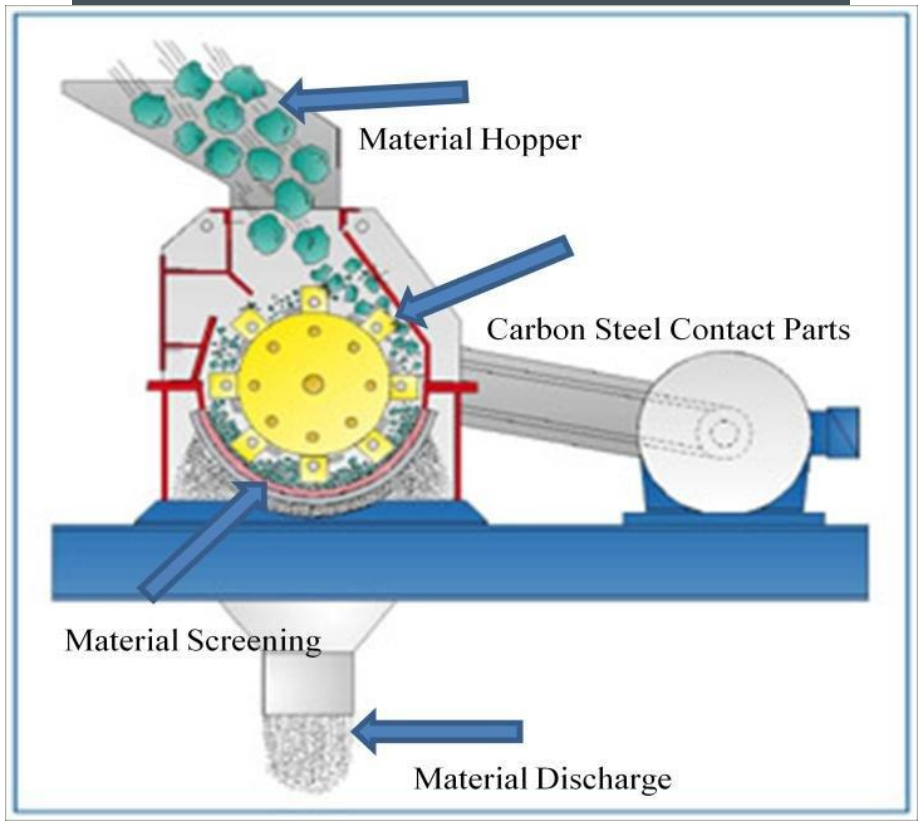
FOR SIGNALING THE TRUCK DRIVER

EXAMPLE TRL 9 ACTUAL SYSTEM PROVEN IN OPERATIONAL ENVIRONMENT

EXAMPLE TRL 9 ACTUAL SYSTEM PROVEN IN OPERATIONAL ENVIRONMENT

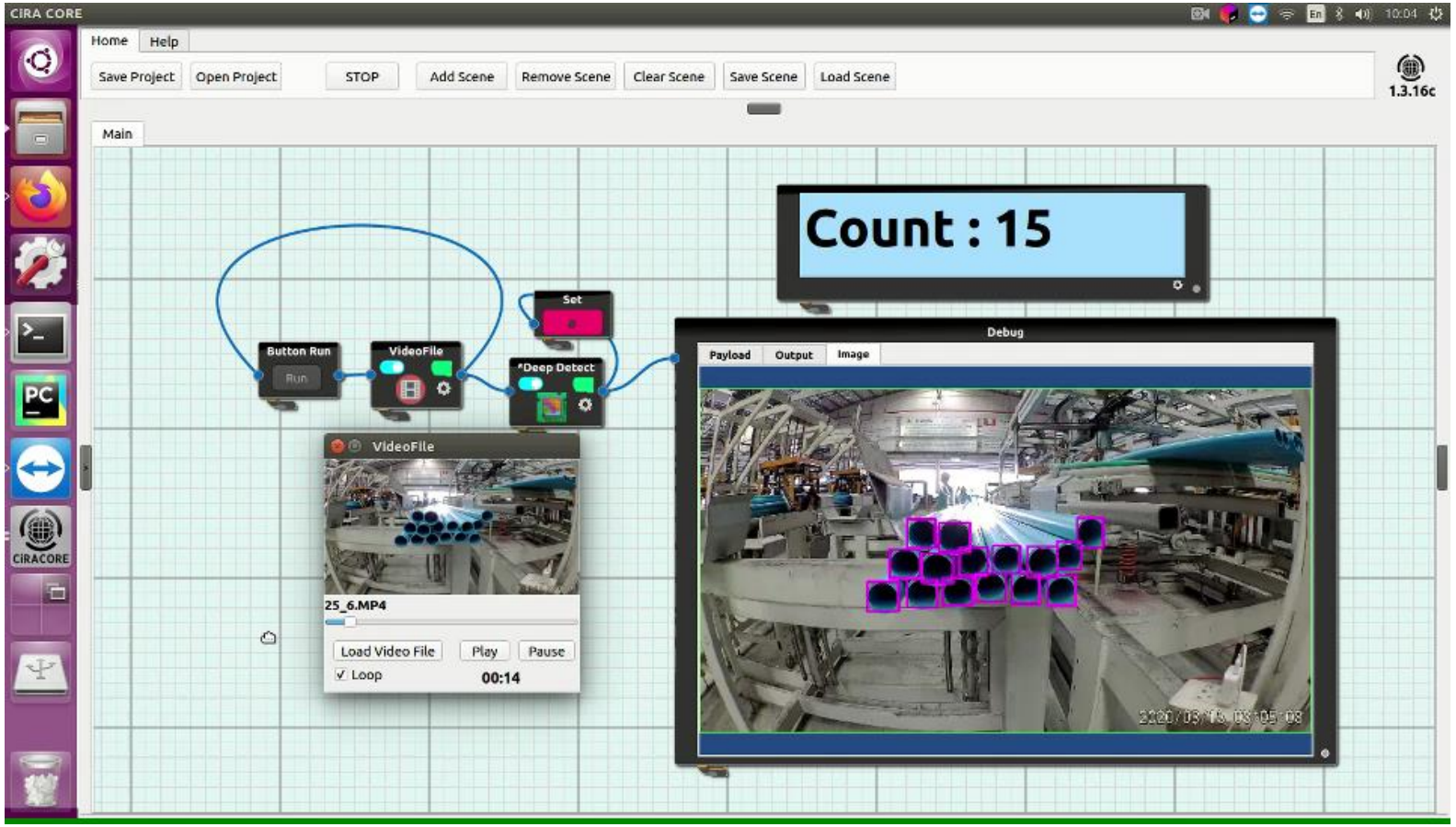


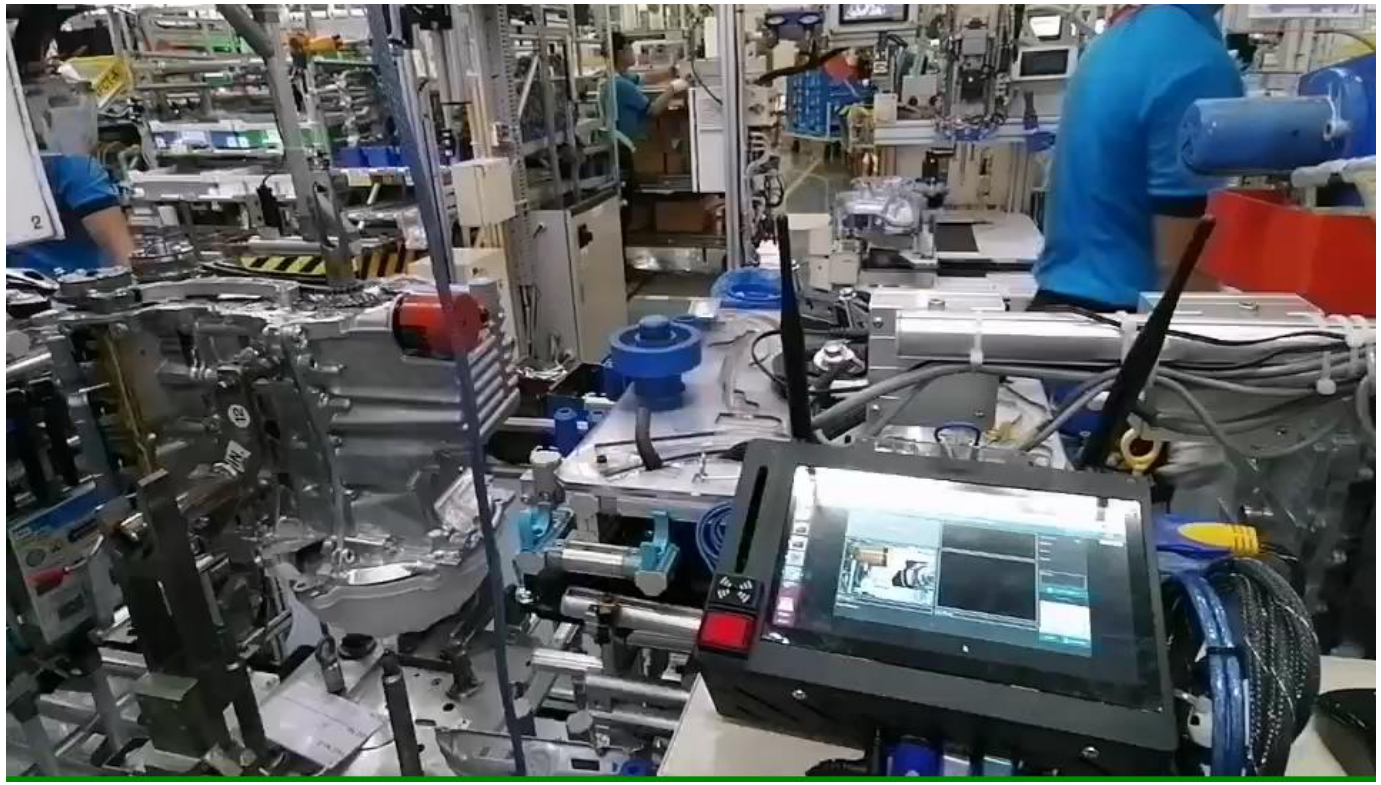
FOR DETECTING THE OVERSIZE STONE BEFORE CRUSHING.



FOR COUNTING FINISH PRODUCT

EXAMPLE TRL 9 ACTUAL SYSTEM PROVEN IN OPERATIONAL ENVIRONMENT





EXAMPLE TRL 9 ACTUAL SYSTEM PROVEN IN OPERATIONAL ENVIRONMENT

Thank you

the Dunning-Kruger Effect has been used in machine learning and artificial intelligence for basics of learning.

Pradeep Patel

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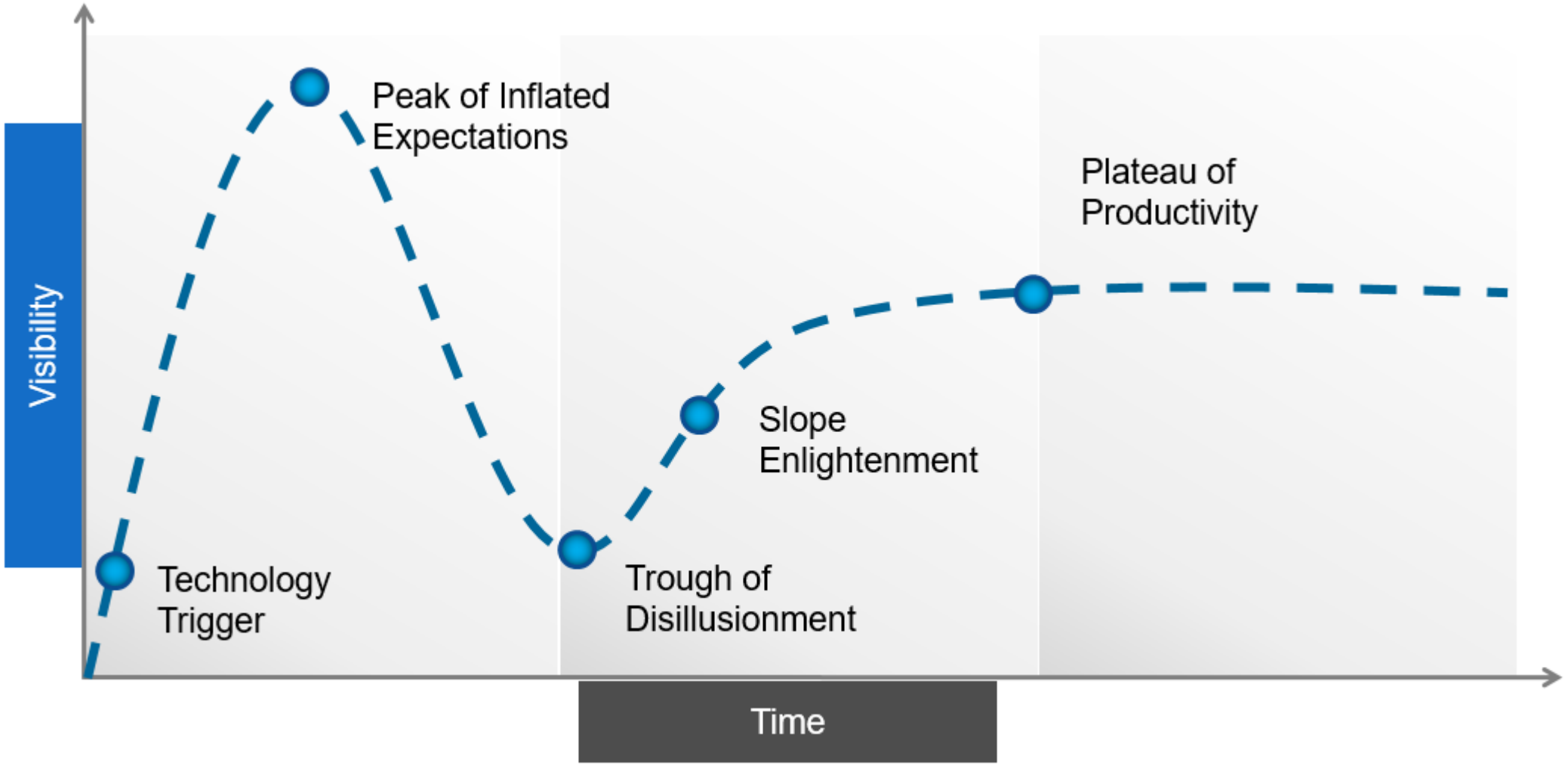
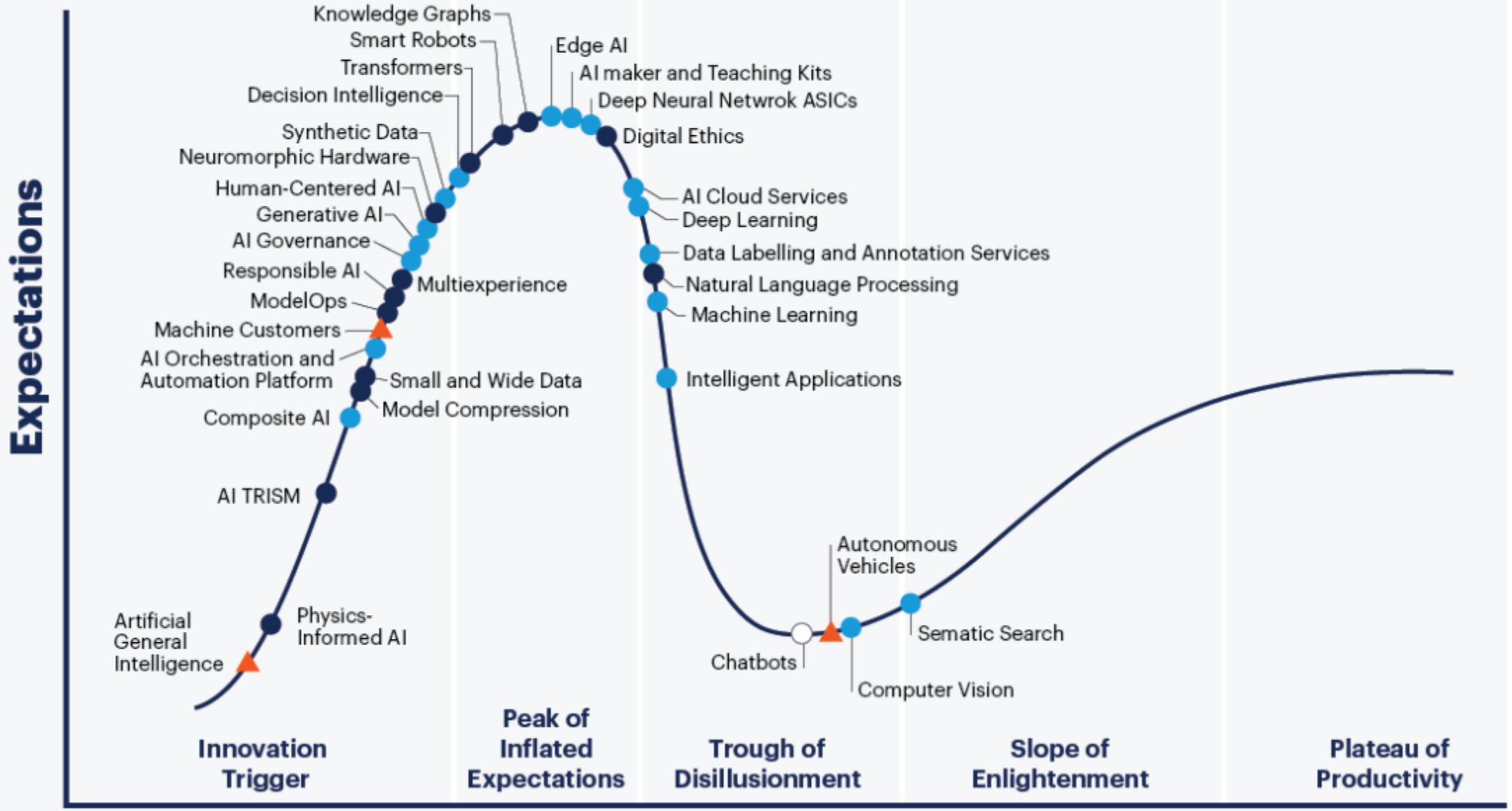


Hype Cycle for Artificial Intelligence, 2021



- Typically, TRLs 1-3 fall within the domain of research organizations such as Universities, and TRLs 7-9 fall within the domain of industry. TRLs 7-9 take promising technologies and take them through to the journey to maturity through production, ready for deployment. This ‘middle space’ is sometimes referred to as the ‘valley of death’ as it is often neglected.