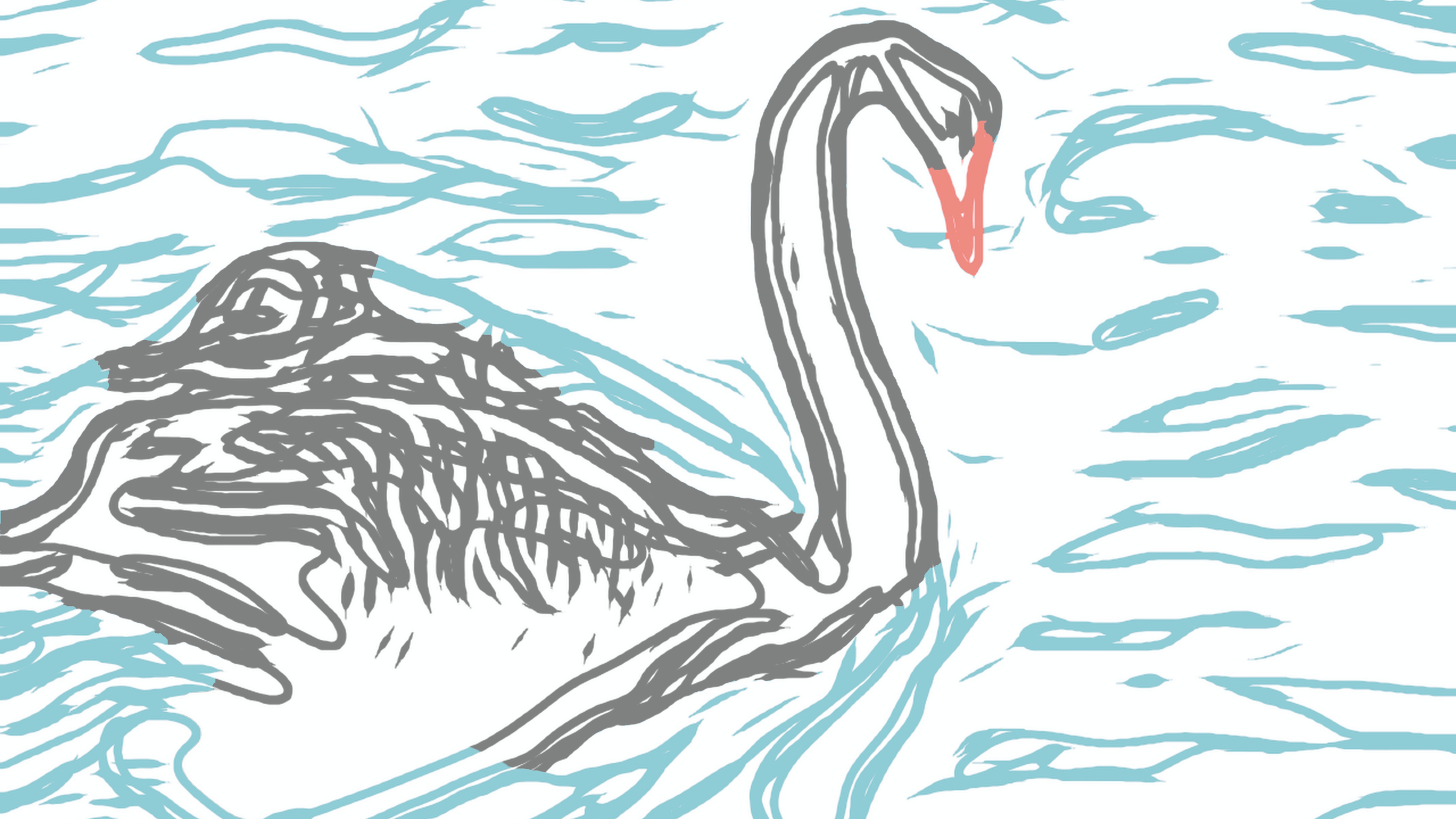
Building Antifragile Schools

Ruben R. Puentedura, Ph.D.

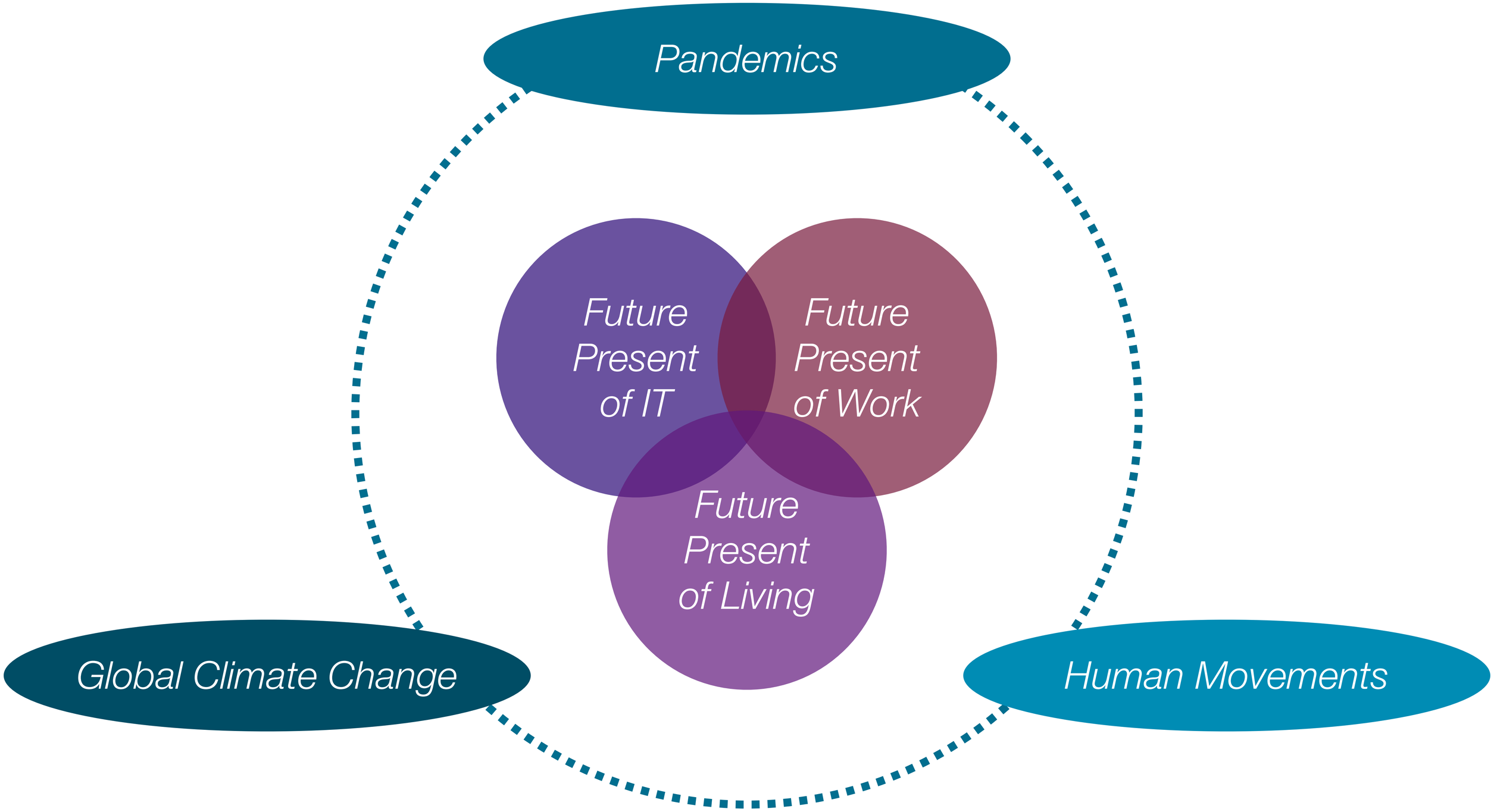
1. Black Swans and Antifragility

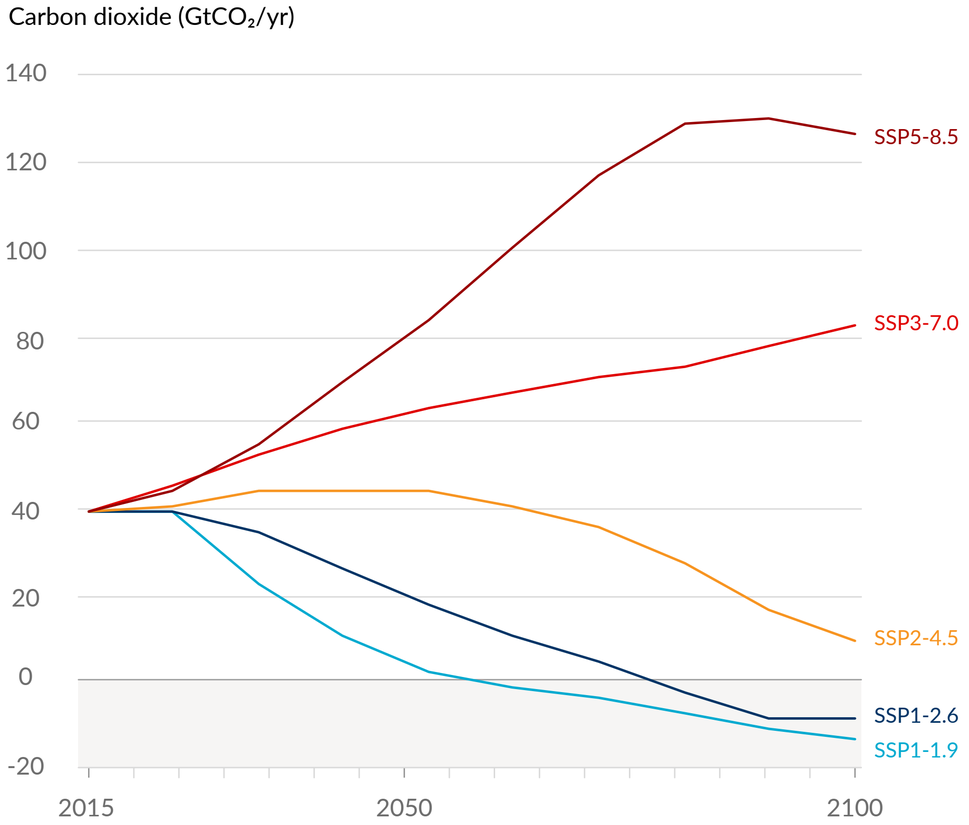


Black Swan Events

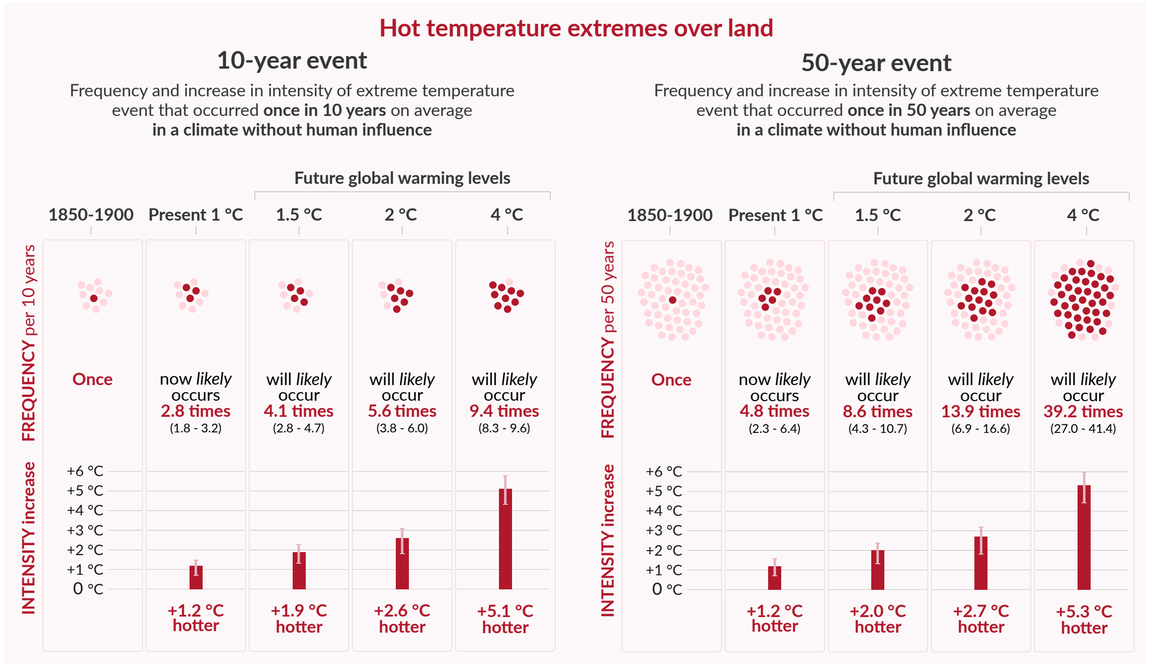
- Cannot be predicted ahead of time
- Have a major effect
- Can be rationalized retrospectively

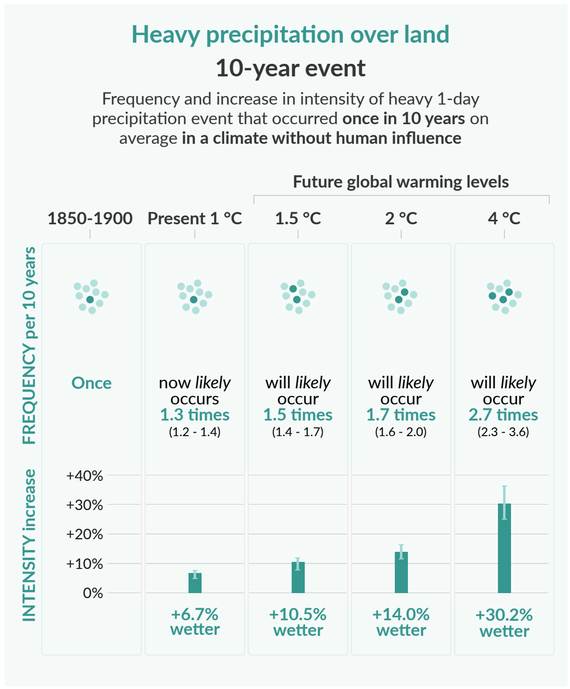
Taleb, Nassim Nicholas, *The Black Swan: The Impact of the Highly Improbable* (2007)

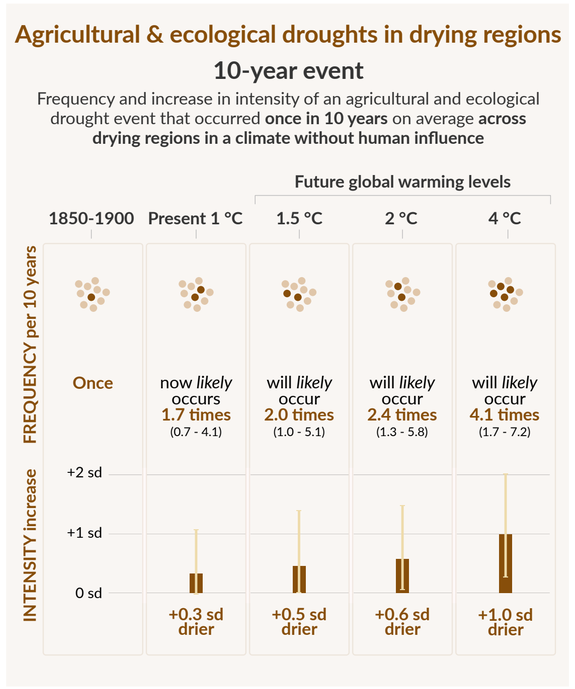

Pandemics
Future Present of IT
Future Present of Work
Future Present of Living
Global Climate Change
Human Movements



	Near term, 2021–2040		Mid-term, 2041–2060		Long term, 2081–2100	
Scenario	Best estimate (°C)	*Very likely* range (°C)	Best estimate (°C)	*Very likely* range (°C)	Best estimate (°C)	*Very likely* range (°C)
SSP1-1.9	1.5	1.2 to 1.7	1.6	1.2 to 2.0	1.4	1.0 to 1.8
SSP1-2.6	1.5	1.2 to 1.8	1.7	1.3 to 2.2	1.8	1.3 to 2.4
SSP2-4.5	1.5	1.2 to 1.8	2.0	1.6 to 2.5	2.7	2.1 to 3.5
SSP3-7.0	1.5	1.2 to 1.8	2.1	1.7 to 2.6	3.6	2.8 to 4.6
SSP5-8.5	1.6	1.3 to 1.9	2.4	1.9 to 3.0	4.4	3.3 to 5.7







Masson-Delmotte et al. (eds.) IPCC, 2021: Summary for Policymakers. In: *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press (2021).

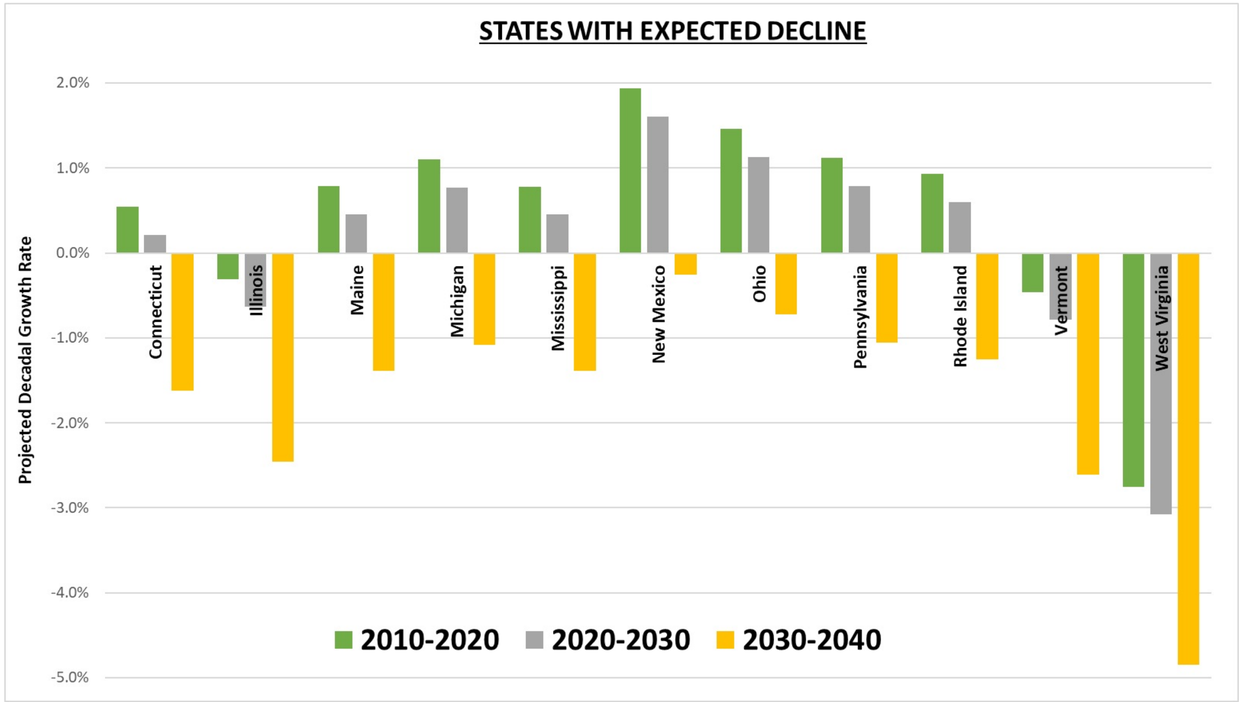
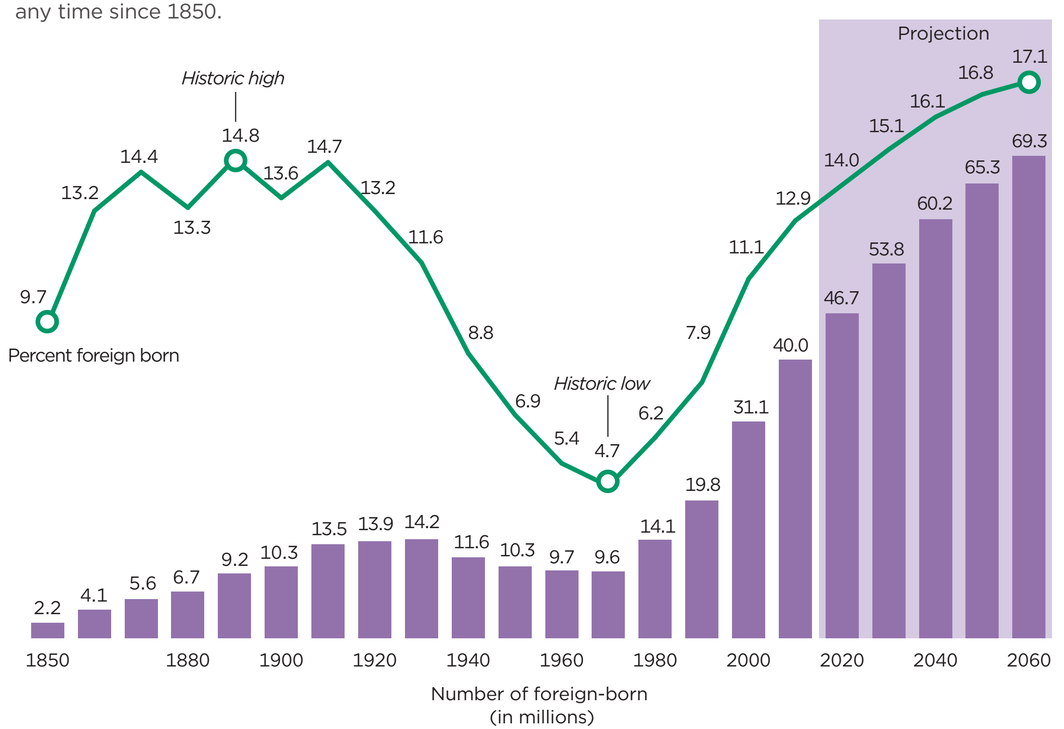


Figure 4.

Foreign-Born People Living in the United States: 1850 to 2010, Projected 2020 to 2060

By 2028, the foreign-born share of the U.S. population is projected to be higher than at any time since 1850.

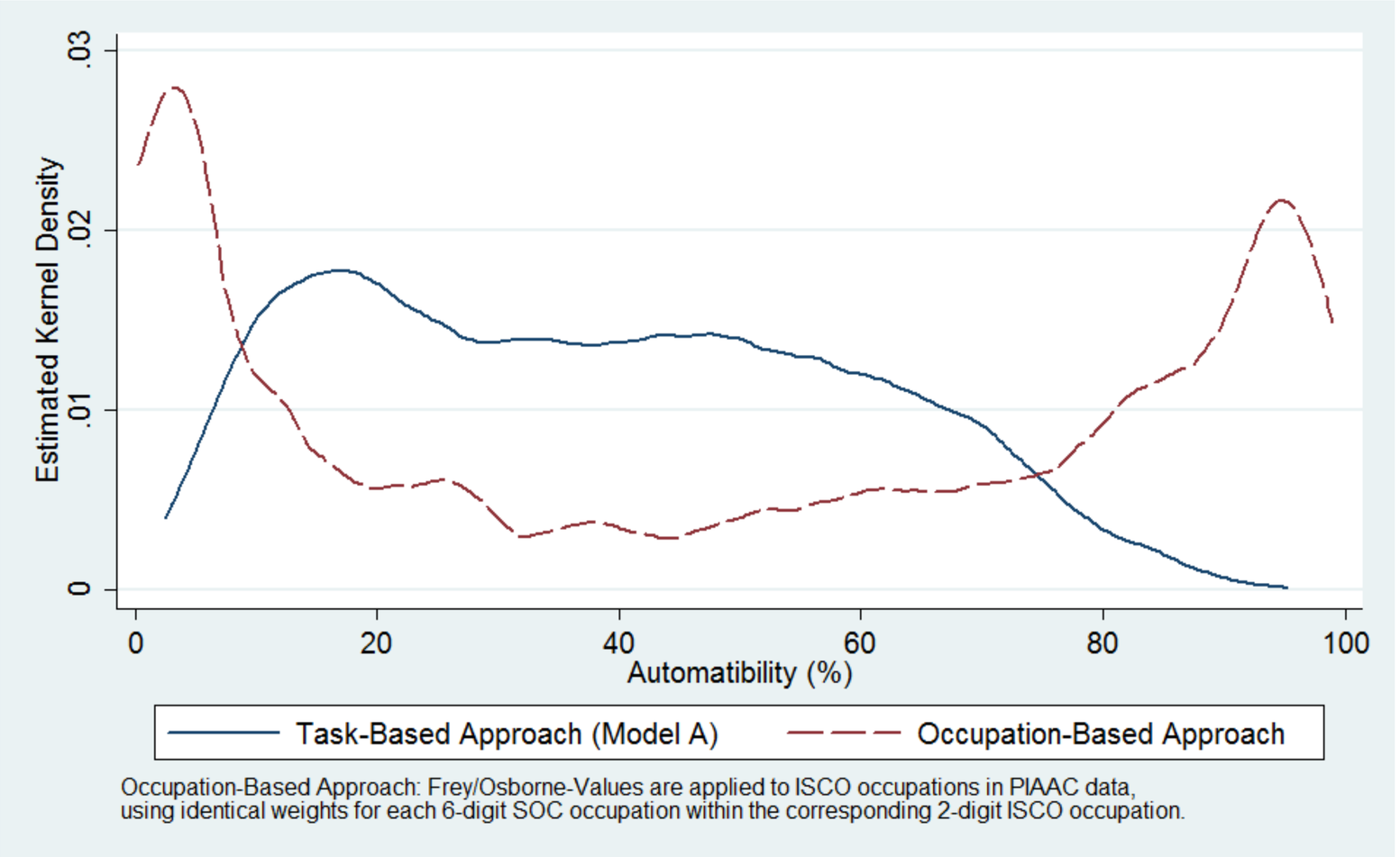


Source: U.S. Census Bureau, 1850–2000 Decennial Censuses, American Community Survey 2010, 2017 National Population Projections for 2020–2060.

Shonel Sen. *National Population Projections: 2020, 2030, 2040.* University of Virginia Weldon Cooper Center for Public Service. (2019)

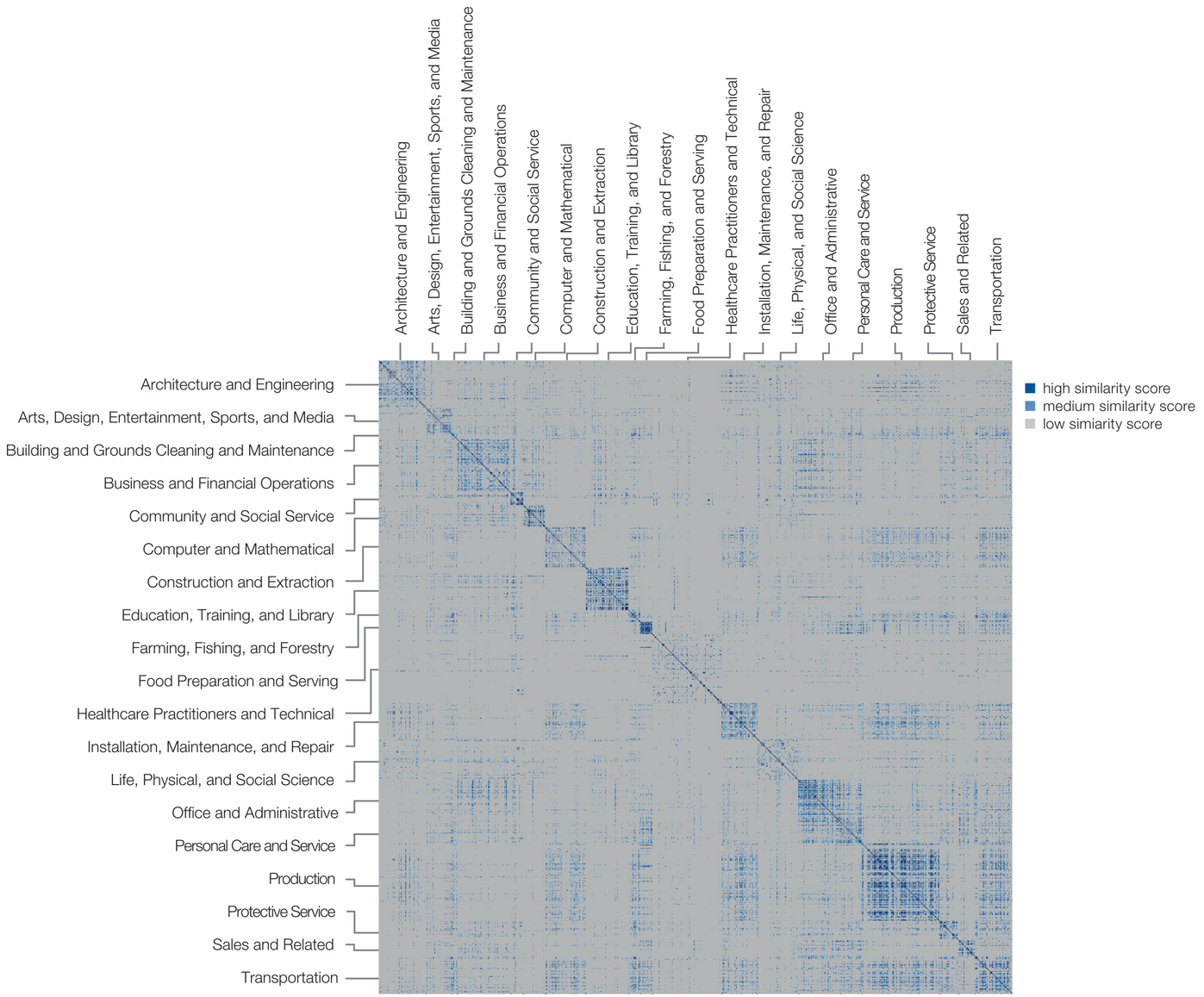
Vespa, Jonathan, Lauren Medina, and David M. Armstrong, “Demographic Turning Points for the United States: Population Projections for 2020 to 2060,” Current Population Reports, P25-1144, U.S. Census Bureau, Washington, DC (2020).

Distribution of Automatibility in the US (Task-Based vs. Occupation-Based Approach)



Arntz, M., T. Gregory and U. Zierahn (2016), "The Risk of Automation for Jobs in OECD Countries: A Comparative Analysis", *OECD Social, Employment and Migration Working Papers*, No. 189, OECD Publishing, Paris.

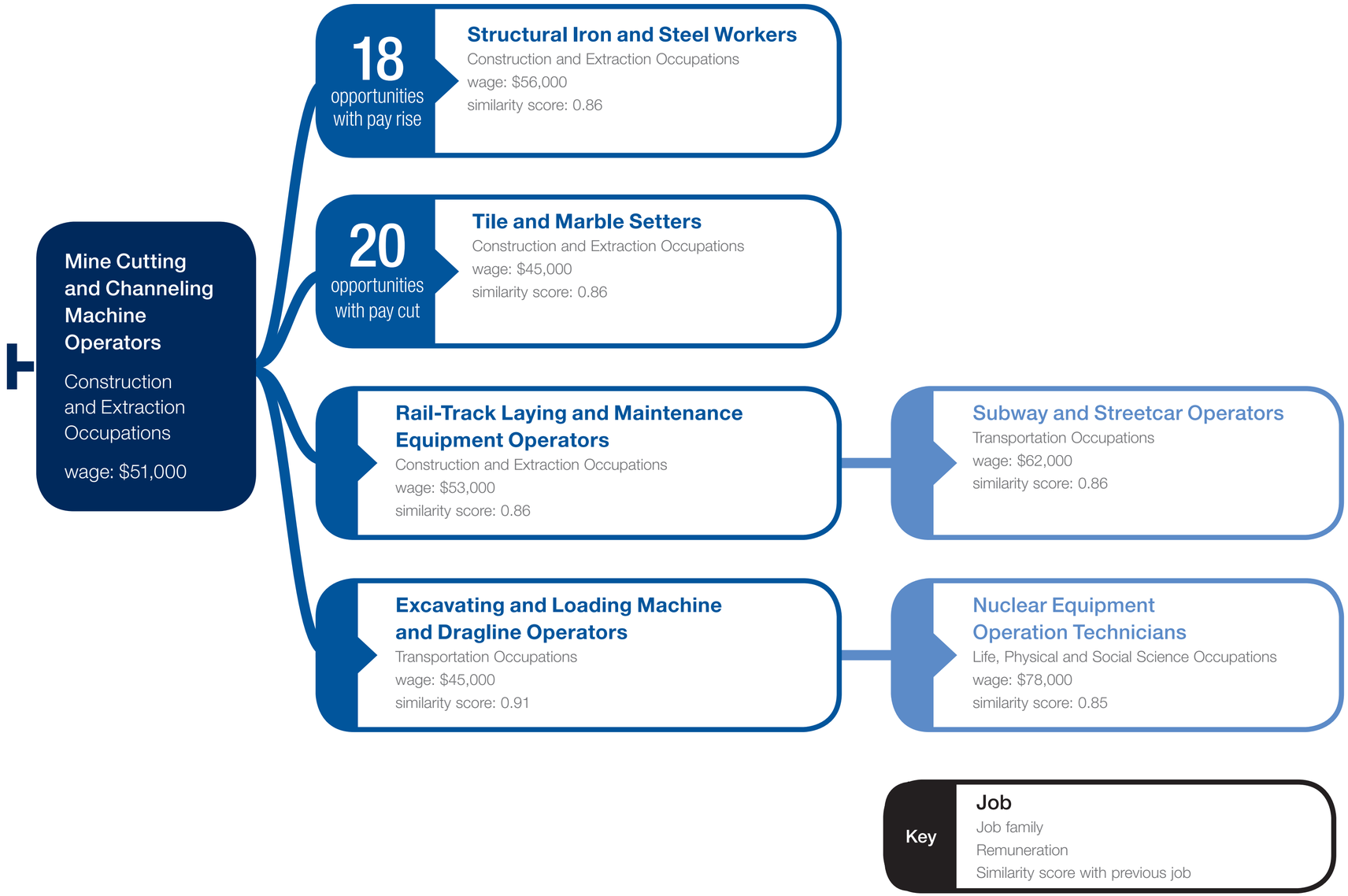
Figure 1: Job transition matrix between 958 jobs in the United States



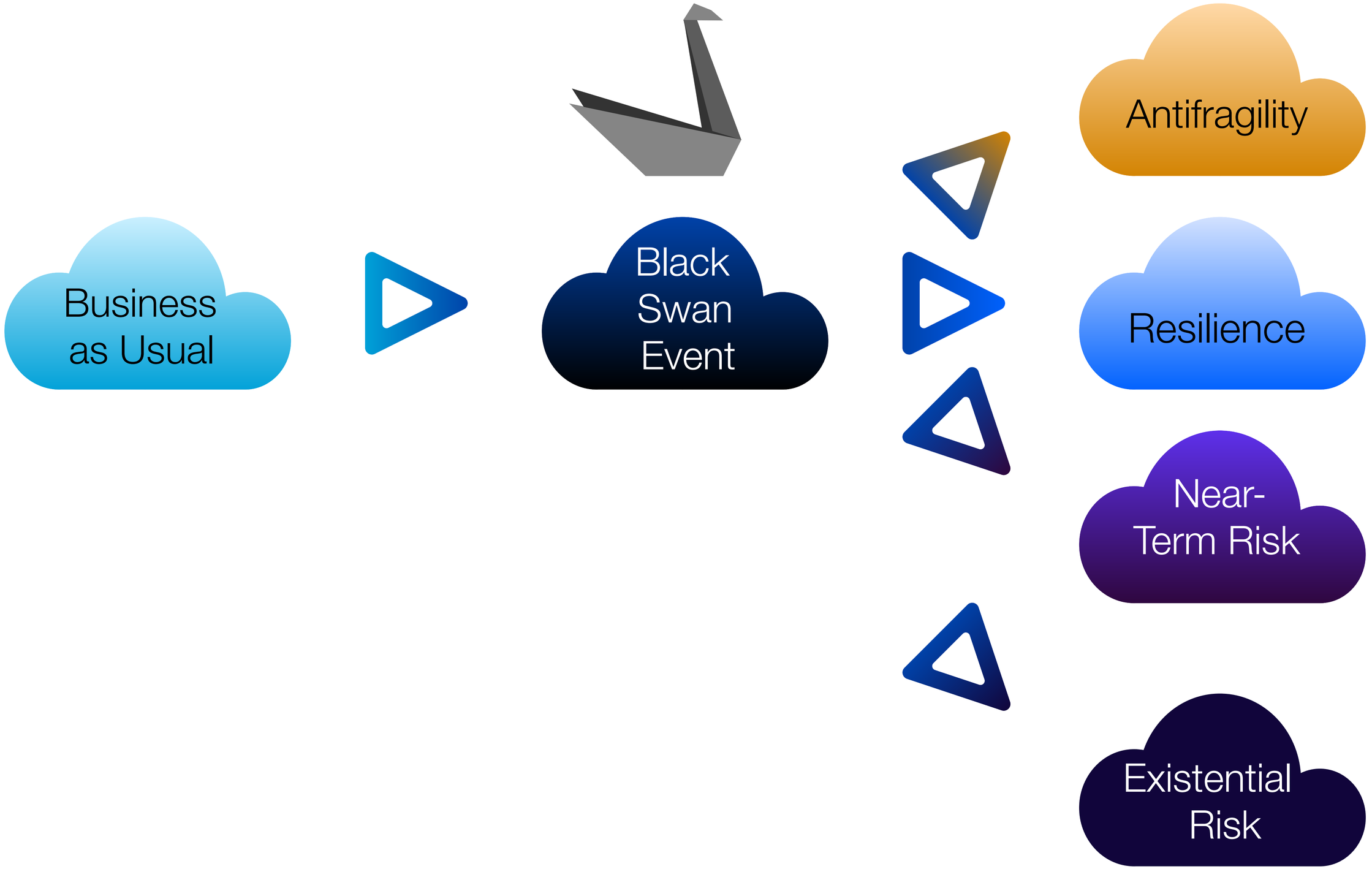
Source data: Burning Glass Technologies and US Bureau of Labor Statistics.

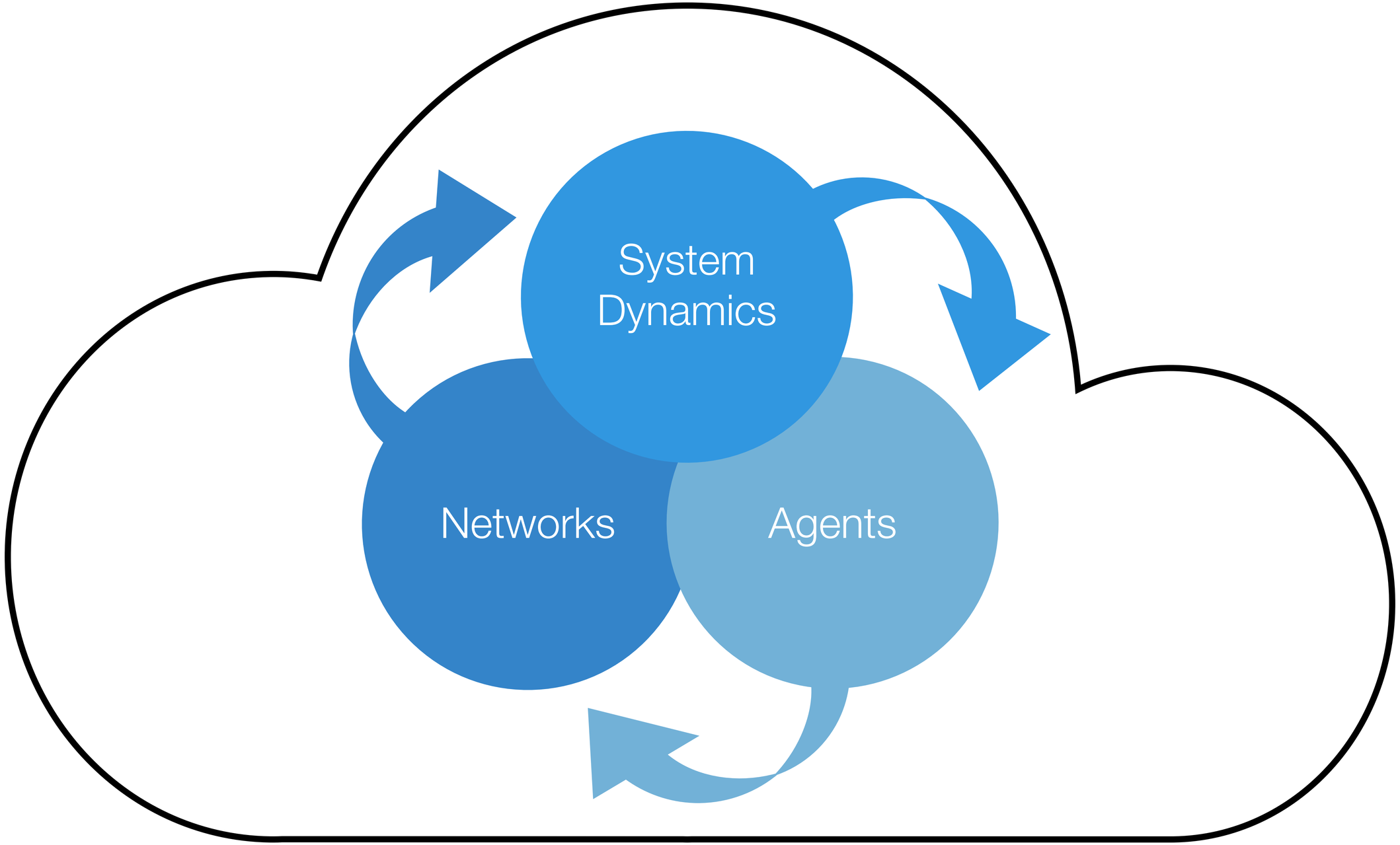
World Economic Forum, *Towards a Reskilling Revolution: A Future of Jobs for All*, 2018.

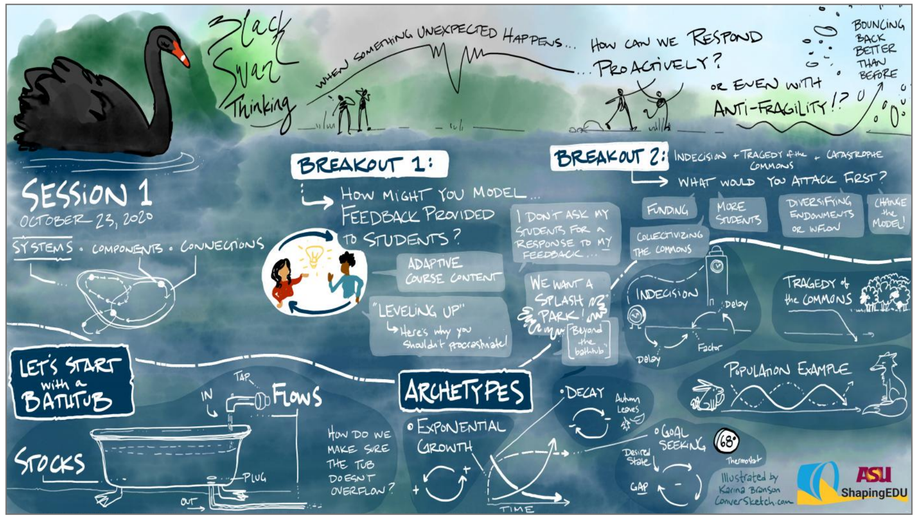
Figure B15: Examples of Pathways for Mine Cutting and Channeling Machine Operators

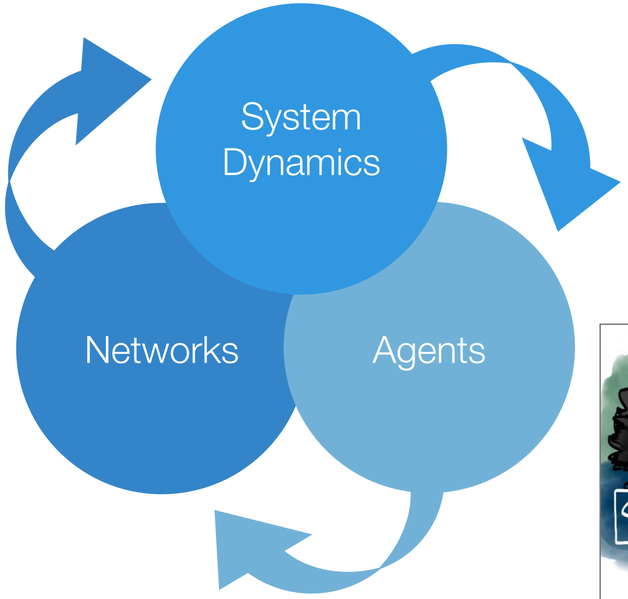


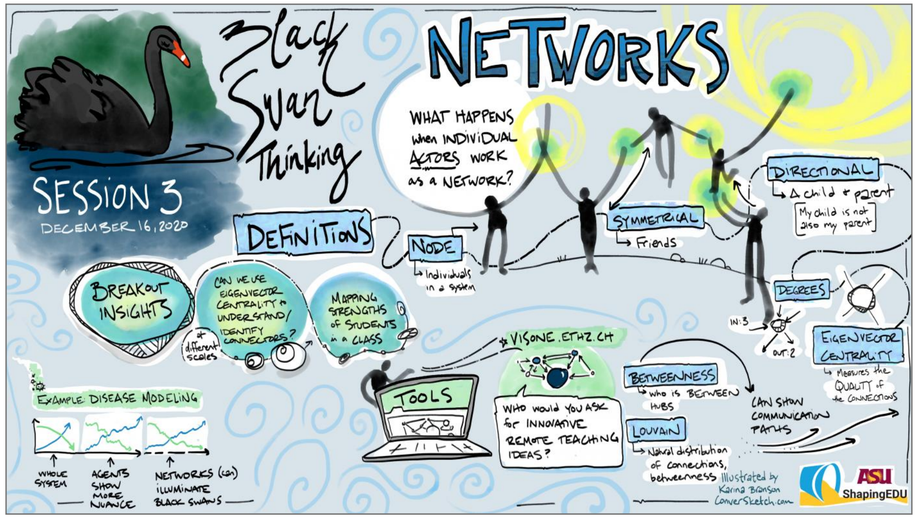
Source data: Burning Glass Technologies and US Bureau of Labor Statistics.

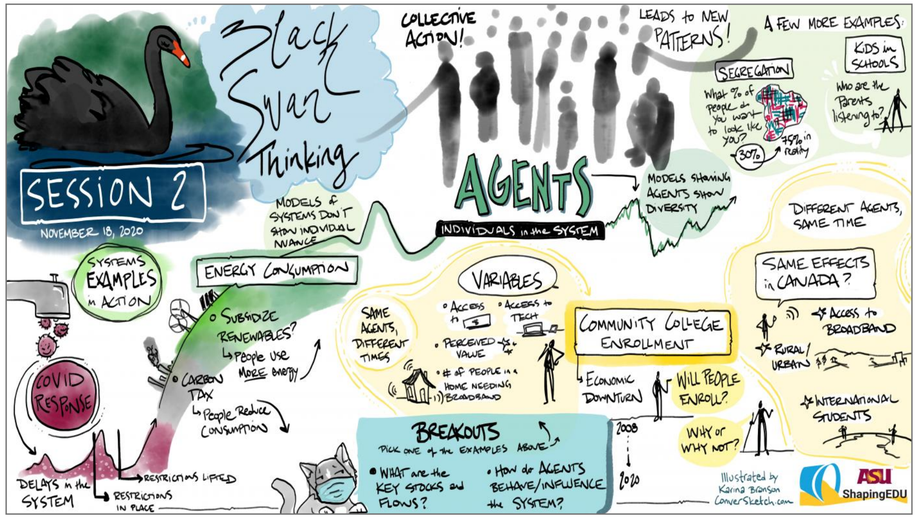

Business as Usual
Black Swan Event
Antifragility
Resilience
Near-Term Risk
Existential Risk


System
Dynamics
Networks
Agents


Black Swan Thinking
SESSION 1
OCTOBER 23, 2020
SYSTEMS • COMPONENTS • CONNECTIONS
WHEN SOMETHING UNEXPECTED HAPPENS... HOW CAN WE RESPOND PROACTIVELY?
OR EVEN WITH ANTI-FRAGILITY!?
BOUNCING BACK BETTER THAN BEFORE
BREAKOUT 1:
HOW MIGHT YOU MODEL... FEEDBACK PROVIDED TO STUDENTS?
ADAPTIVE COURSE CONTENT
"LEVELING UP"
Here's why you shouldn't procrastinate!
I DON'T ASK MY STUDENTS FOR A RESPONSE TO MY FEEDBACK...
WE WANT A SPLASH PARK!
Beyond the bathtub
BREAKOUT 2: INDECISION + TRAGEDY of the COMMONS + CATASTROPHE
WHAT WOULD YOU ATTACK FIRST?
FUNDING
MORE STUDENTS
DIVERSIFYING ENDOWMENTS OR INCOME
CHANGE THE MODEL
COLLECTIVE ACTION
INDECISION
Delay
Faster
TRAGEDY of the COMMONS
LET'S START with a BATHTUB
STOCKS
IN
TAP
FLOWS
PLUG
OUT
HOW DO WE MAKE SURE THE TUB DOESN'T OVERFLOW?
ARCHETYPES
EXPONENTIAL GROWTH
TIME
DECAY
Autumn Leaves
GOAL SEEKING
Desired State
GAP
68°
Thermostat
POPULATION EXAMPLE
Illustrated by Karina Branson
CanverSketch.com
ASU ShapingEDU


System Dynamics
Networks
Agents


Black Swan Thinking
SESSION 3
DECEMBER 16, 2020
NETWORKS
WHAT HAPPENS when INDIVIDUAL ACTORS WORK as a NETWORK?
DEFINITIONS
NODE
Individuals in a system
SYMMETRICAL
Friends
DIRECTIONAL
A child + parent
My child is not also my parent
DEGREES
IN: 3
OUT: 2
EIGENVECTOR CENTRALITY
Measures the QUALITY of the CONNECTIONS
BETWEENNESS
Who is BETWEEN HUBS
LOUVAIN
Natural distribution of connections, betweenness
CAN SHOW COMMUNICATION PATHS
BREAKOUT INSIGHTS
CAN WE USE EIGENVECTOR CENTRALITY to UNDERSTAND/ IDENTIFY CONNECTORS?
of different scales
MAPPING STRENGTHS of STUDENTS in a CLASS
VISONE.ETHZ.CH
TOOLS
WHO would you ASK for INNOVATIVE REMOTE TEACHING IDEAS?
EXAMPLE DISEASE MODELING
WHOLE SYSTEM
AGENTS SHOW MORE NUANCE
NETWORKS (&) ILLUMINATE BLACK SWANS
Illustrated by Karina Branson
CanverSketch.com
ASU ShapingEDU

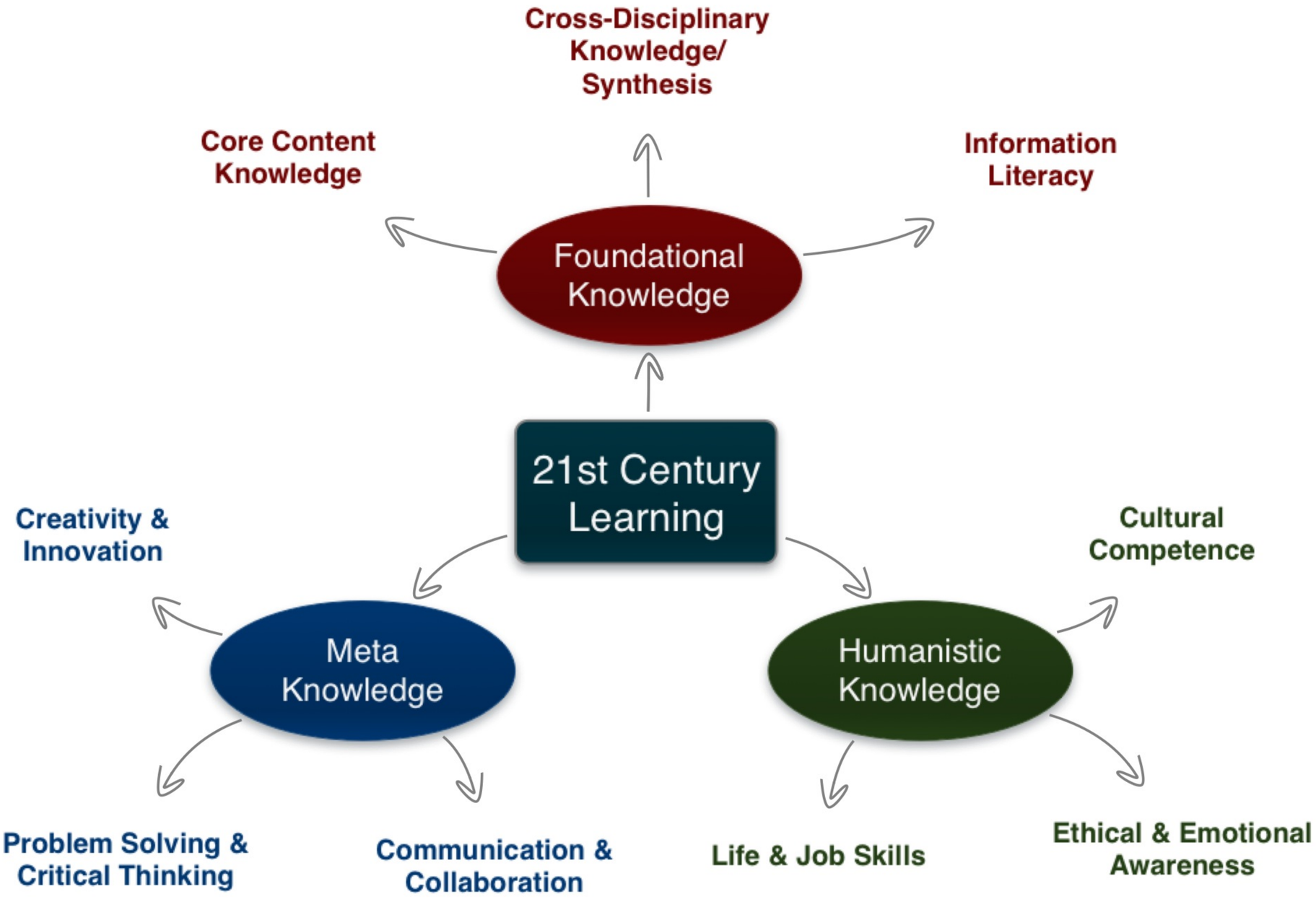

Black Swan Thinking
SESSION 2
NOVEMBER 18, 2020
COLLECTIVE ACTION!
LEADS to NEW PATTERNS!
A FEW MORE EXAMPLES:
AGENTS
INDIVIDUALS in the SYSTEM
MODELS SHOWING AGENTS SHOW DIVERSITY
MODELS of SYSTEMS DON'T SHOW INDIVIDUAL NUANCE
SEGREGATION
What % of people do you want to look like you?
30%
45% in reality
KIDS in SCHOOLS
Who are the Parents listening to?
DIFFERENT AGENTS, SAME TIME
SAME EFFECTS in CANADA?
Access to BROADBAND
RURAL/ URBAN
INTERNATIONAL STUDENTS
SYSTEMS EXAMPLES in ACTION
ENERGY CONSUMPTION
Subsidize RENEWABLES? People use MORE ENERGY
CARBON TAX People reduce CONSUMPTION
VARIABLES
Access to
Access to TECH
SAME AGENTS, DIFFERENT TIMES
Perceived $ VALUE
# of PEOPLE in a HOME NEEDING BROADBAND
COMMUNITY COLLEGE ENROLLMENT
ECONOMIC DOWNTURN
WILL PEOPLE ENROLL?
WHY or WHY NOT?
COVID RESPONSE
DELAYS in the SYSTEM
RESTRICTIONS LIFTED
RESTRICTIONS IN PLACE
BREAKOUTS
PICK ONE of the EXAMPLES ABOVE
WHAT are the KEY STOCKS and FLOWS?
HOW do AGENTS BEHAVE/INFLUENCE the SYSTEM?
2008
2020
Illustrated by Karina Branson
CanverSketch.com
ASU ShapingEDU


EAKINS 189

- How do I make this unit of instruction antifragile?
- How do I make this course antifragile?
- How do I make this degree antifragile?
- How do I make this institution antifragile?

- **How do I make this student learning antifragile?**

2. SAMR, the EdTech Quintet, and Antifragility



Kristen Kereluik, Punya Mishra, Chris Fahnoe, and Laura Terry, "What Knowledge Is of Most Worth: Teacher Knowledge for 21st Century Learning". *Journal of Digital Learning in Teacher Education (29)* 4 (2013)

Redefinition
Tech allows for the creation of new tasks, previously inconceivable

Modification
Tech allows for significant task redesign

Transformation

Augmentation
Tech acts as a direct tool substitute, with functional improvement

Substitution
Tech acts as a direct tool substitute, with no functional change

Enhancement

Ruben R. Puentedura, *As We May Teach: Educational Technology, From Theory Into Practice*. (2009)

Social	Mobility	Visualization	Storytelling	Gaming
200,000 years	70,000 years	40,000 years	17,000 years	8,000 years

Ruben R. Puentedura, “Technology In Education: The First 200,000 Years” *The NMC Perspective Series: Ideas that Matter*. NMC Summer Conference, 2012.

The EdTech Quintet – Associated Practices	
Social	Communication, Collaboration, Sharing
Mobility	Anytime, Anyplace Learning and Creation
Visualization	Making Abstract Concepts Tangible
Storytelling	Knowledge Integration and Transmission
Gaming	Feedback Loops and Formative Assessment

Redefinition
Tech allows for the creation of new tasks, previously inconceivable

Modification
Tech allows for significant task redesign

Augmentation
Tech acts as a direct tool substitute, with functional improvement

Substitution
Tech acts as a direct tool substitute, with no functional change

Differentiation
Primary Focus: Agents
Develop learner/community agency

Integration
Primary Focus: Networks
Create people/practice networks

Amplification
Primary Focus: System Dynamics
Enhance selected leverage points

Infrastructure
Primary Focus: EdTech Baseline
Implement shared tools and practices

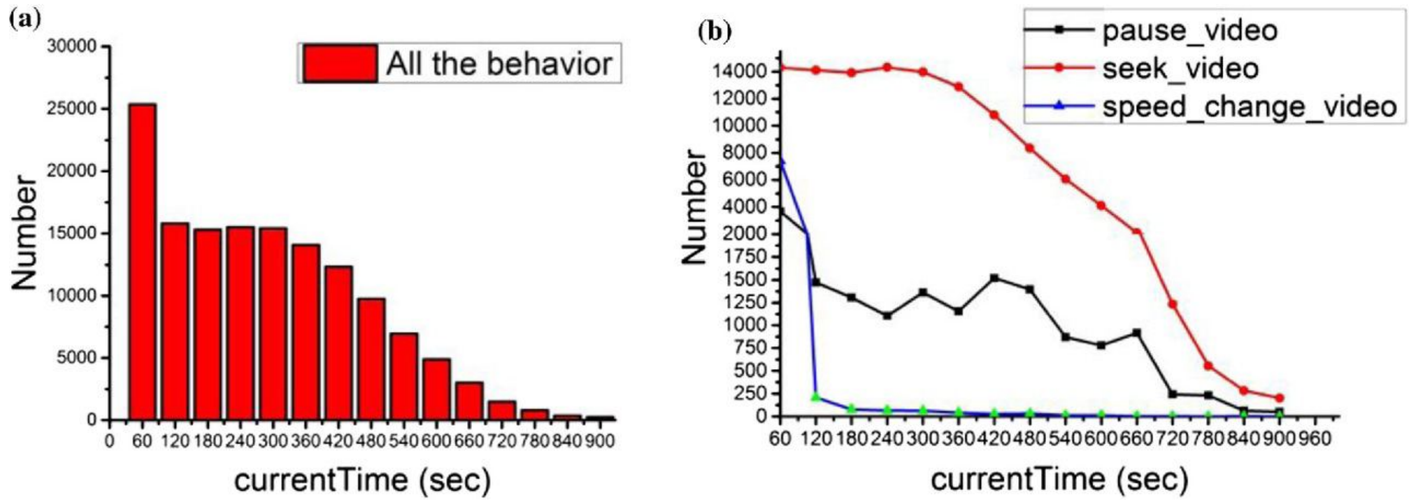
Hybrid Modes and Telepresence

	S	A	M	R
Design Focus	Appropriate Substitutive Use of Zoom	Stocks & Flows	Networks	Agents

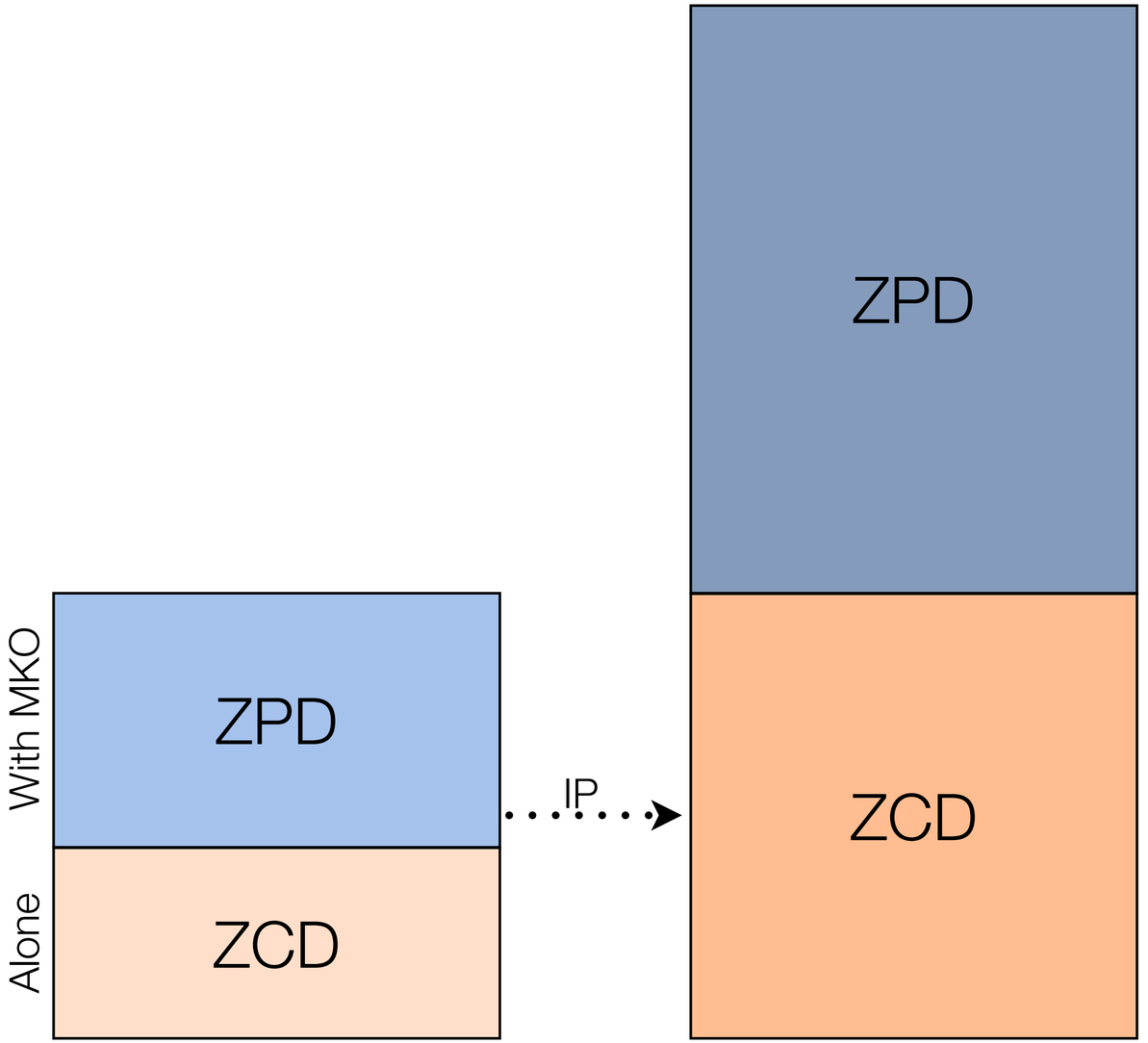
Practices	• **Personal space**
	  ‣ *On/off choice*
	• **Total “on” time**
	  ‣ *Limited duration*
	• **Environmental space**
	  ‣ *Backdrops*
	• **Group differentiation**
	  ‣ *Breakout rooms*
	• **Asynchronous presence**
	  ‣ *Libraries of created resources*
		• **Spaces**
		  ‣ *physical*
		  ‣ *conceptual*
		• **Uses**
		  ‣ *learning*
		  ‣ *social*
		  ‣ *recreational*
		• **Presence**
		  ‣ *remote*
		  ‣ *local*
			• **Individual groupings**
			  ‣ *optimize via network analysis*
			• **Collective function**
			  ‣ *create asymmetries*
			• **Local/Remote**
			  ‣ *keep in reciprocal picture*
				• **Creation of own *spaces***
				• **Driver of own *projects***
				• **Bring *world* into picture**

Video, Duration, and Attention

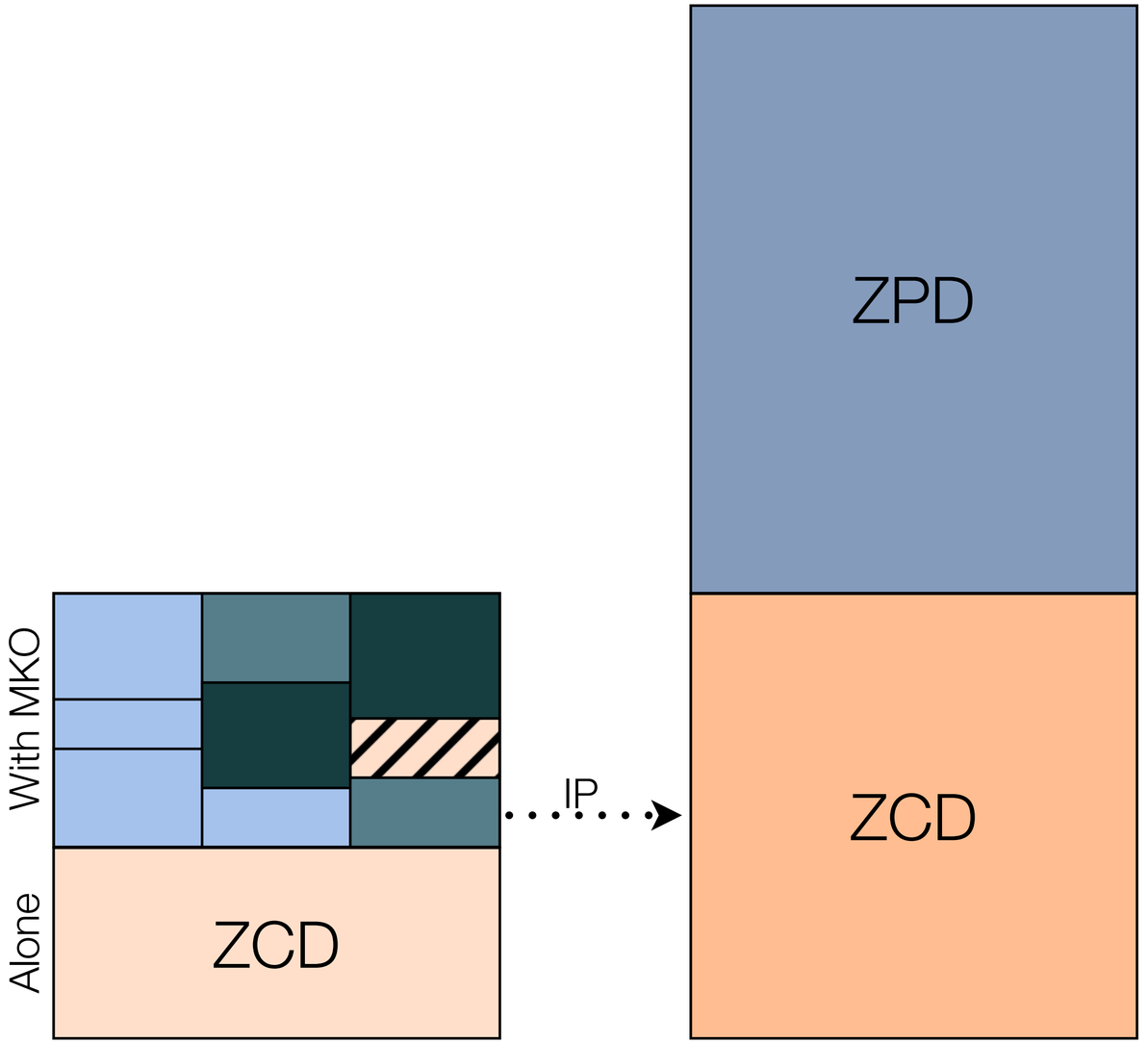
- Total Maximum Time: 11 minutes
- Ratio of Segments: 1:2:3 (approx.)
- One Possible Breakdown:
  - 2 minutes for background
  - 4 minutes for development
  - 5 minutes for application



Hu, H., Zhang, G., Gao, W. et al. Big data analytics for MOOC video watching behavior based on Spark. *Neural Comput. & Applic.* 32, 6481–6489 (2020).



Lev Vygotsky, *Mind in Society: The Development of Higher Psychological Processes*. Harvard University Press. (1978)



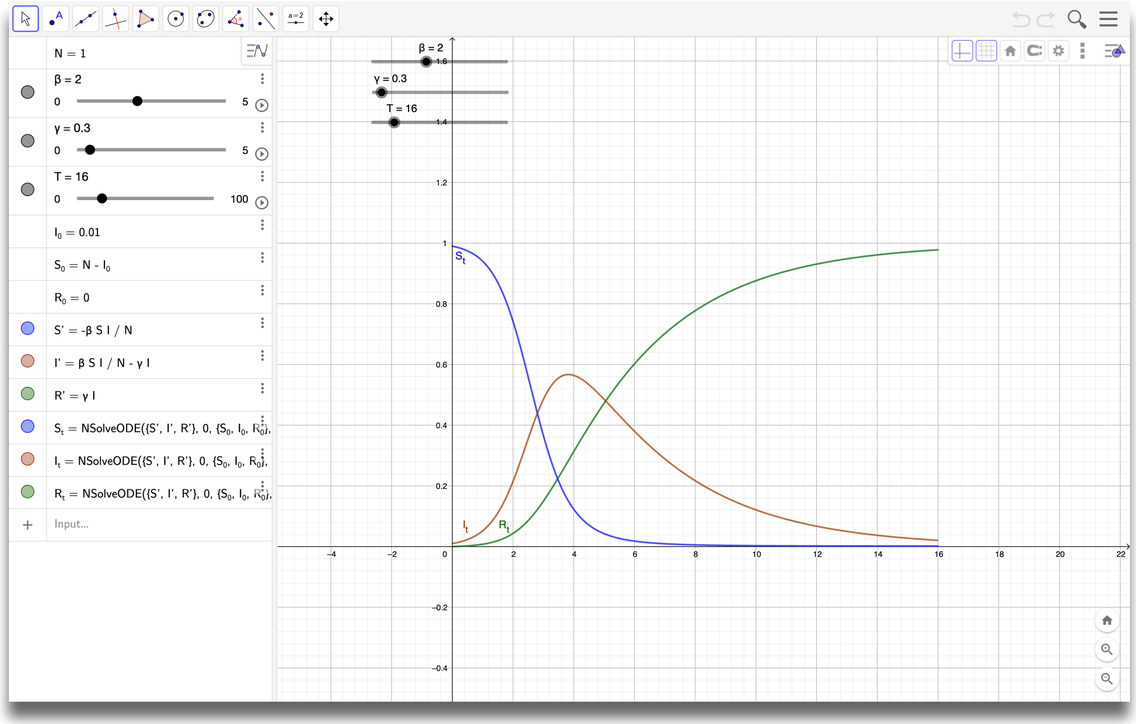
Galperin, P.Ia. “Stage by Stage formation as a method of psychological investigation”. *Journal of Russian and East European Psychology, 30*(4), 61-80 (1992)
Van Geert, Paul. "Vygotsky’s dynamic systems." *Lev Vygotsky: Critical assessments* 4 (1997): 3-21.

The EdTech Quintet – Associated Practices	
Social	Provides diversity to the ZPD
Mobility	Creates the context for the process
Visualization	Aids in segmenting ZPD, bridging gaps
Storytelling	Aids in the integration of the ZPD
Gaming	Provides frameworks for independent practice

Redefinition
Tech allows for the creation of new tasks, previously inconceivable

Modification
Tech allows for significant task redesign

Augmentation
Tech acts as a direct tool substitute, with functional improvement

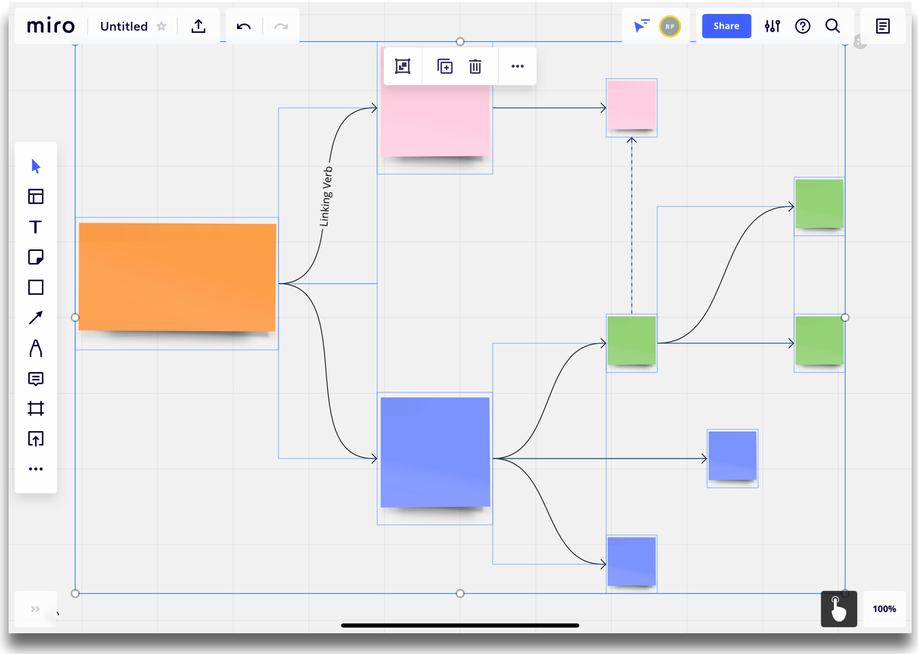


Substitution
Tech acts as a direct tool substitute, with no functional change

Infrastructure
Primary Focus: EdTech Baseline
Implement shared tools and practices

Redefinition
Tech allows for the creation of new tasks, previously inconceivable

Modification
Tech allows for significant task redesign



Augmentation
Tech acts as a direct tool substitute, with functional improvement

Amplification
Primary Focus: System Dynamics
Enhance selected leverage points

Substitution
Tech acts as a direct tool substitute, with no functional change

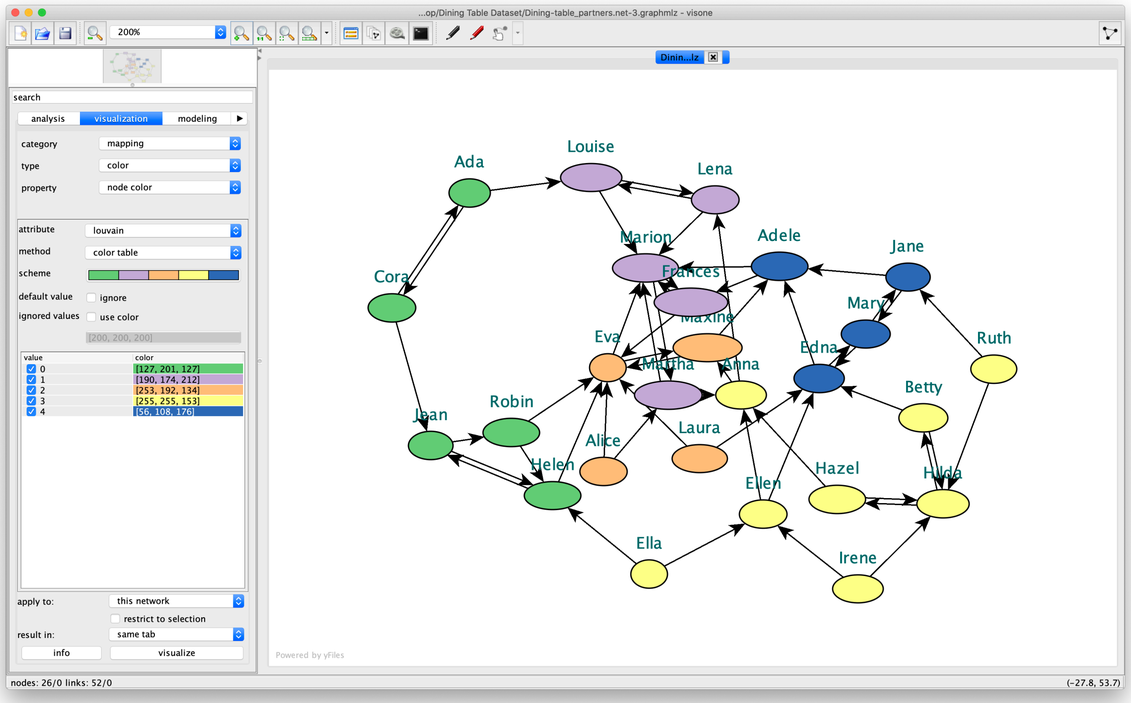
Redefinition
Tech allows for the creation of new tasks, previously inconceivable

Modification
Tech allows for significant task redesign

Integration
Primary Focus: Networks
Create people/practice networks

Augmentation
Tech acts as a direct tool substitute, with functional improvement

Substitution
Tech acts as a direct tool substitute, with no functional change



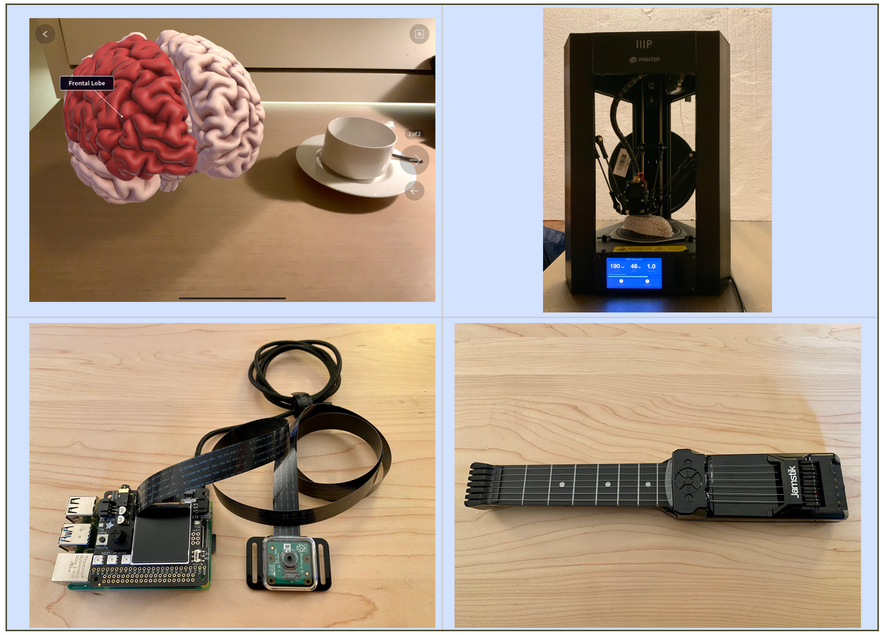
Redefinition
Tech allows for the creation of new tasks, previously inconceivable

Differentiation
Primary Focus: Agents
Develop learner/community agency

Modification
Tech allows for significant task redesign

Augmentation
Tech acts as a direct tool substitute, with functional improvement

Substitution
Tech acts as a direct tool substitute, with no functional change

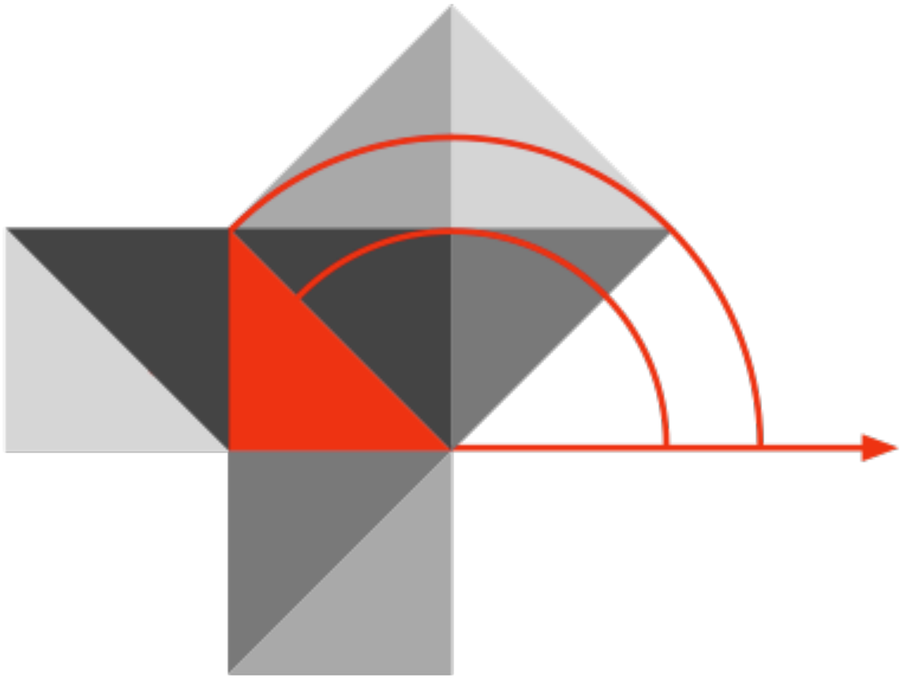


Additional Resources

- **SAMR and the EdTech Quintet:**
  - For an overview of both models in one location, this video covering the basics is probably the best place to start:
    - *Technology in Education: A Brief Introduction* – https://youtu.be/rMazGEAiZ9c
  - One particularly accessible and concise introduction focusing exclusively on the SAMR model was codeveloped with Common Sense Education:
    - *What is the SAMR Model?* – https://youtu.be/9b5yvgKQdqE
    - *How to Apply the SAMR Model* – https://youtu.be/ZQTx2UQQvbU
    - *The Impact of the SAMR Model* – https://youtu.be/SWU0Dzz6gs0
  - The EdTech Quintet has a rather interesting set of connections to older - much older - technologies, as discussed in this presentation:
    - *The NMC Perspective Series: Ideas that Matter* – https://youtu.be/NemBarqD6qA
  - Finally, for those wishing to dig a little deeper, a conversation between Dr. Bebell and Dr. Puentedura has more of the inside story on the research:
    - *Demystifying SAMR* – https://youtu.be/L9h9ePoXqS8

- **Black Swan Thinking:**
    - Dr. Puentedura's ongoing project, sponsored by ASU under its ShapingEDU umbrella:
      - *Of Swans, Dragons, and How to Tell Them Apart (Without Getting Singed)*
      - *Session 1: Why The Little Dutch Boy Was The Little Doomed Boy*
      - *Session 2: How The Leopard Didn't Get Its Spots*
      - *Session 3: Who Framed The Narrative Of Cock Robin?*
      - *Black Swan Thinking Foundations*

Hippasus



Blog: http://hippasus.com/blog/
Email: rubenrp@hippasus.com
Twitter: @rubenrp