

State of Play for the Future of Manufacturing



**New Business Models for the
Manufacturing of the Future**

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State of play for the future of manufacturing

Macro-factors

- Post-pandemic crises continue to disrupt
 - Major shift towards regional/national manufacturing
 - National subsidies are back and in a big way!
 - Talent in short supply, everywhere
 - Clean-tech driver for sustainable growth
 - Digital Lighthouses – continued roll-out
 - Significant investments in new technology fields – AI, Metaverse,
- => Manufacturing Supply Chain transformations



Manufacturing Supply Chain Transformations

1. **Managing Disruption:** *response to pandemic, trade tensions and conflicts, new production technologies*

=> Changing manufacturing supply chain footprints, revisiting reshoring drivers, creating dynamic supply chain configurations, modularity and micro-factories

2. **Digitalisation of Manufacturing Supply Chains and New Business Models**

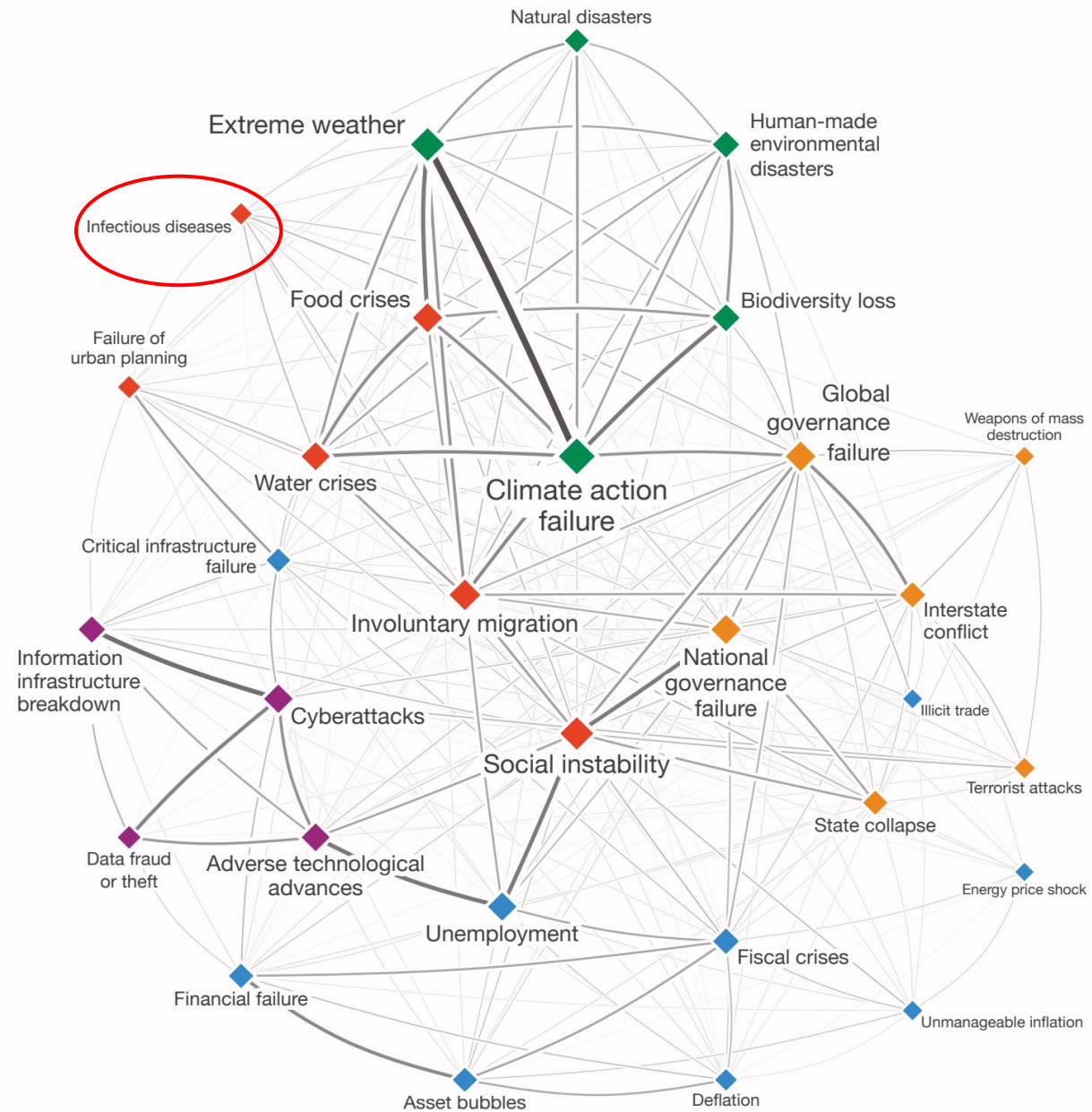
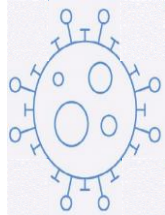
=> Industrial digital technologies driving productivity, transformation frameworks, developing new operating and business models, leveraging data throughout the supply chain

3. **Sustainable Supply Chains:**

=> Aligning with Environmental, Social, Governance (ESG) objectives, Scope 3 Net Zero targets

Supply Chain Disruptions

- Jan 2020 – risk chart
- Followed by COVID
- And post-COVID



But are all disruptions the same?

Are there compound effects?

The IMF World Uncertainty Index



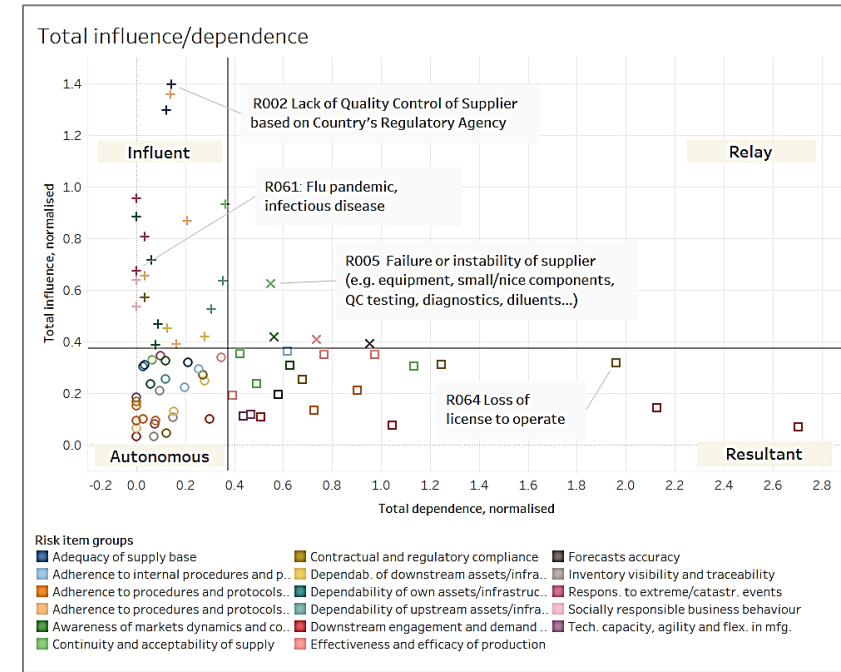
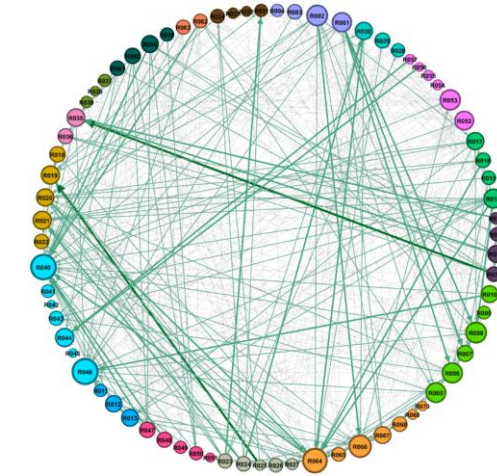
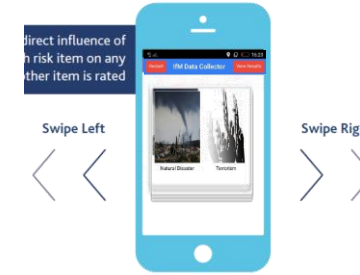
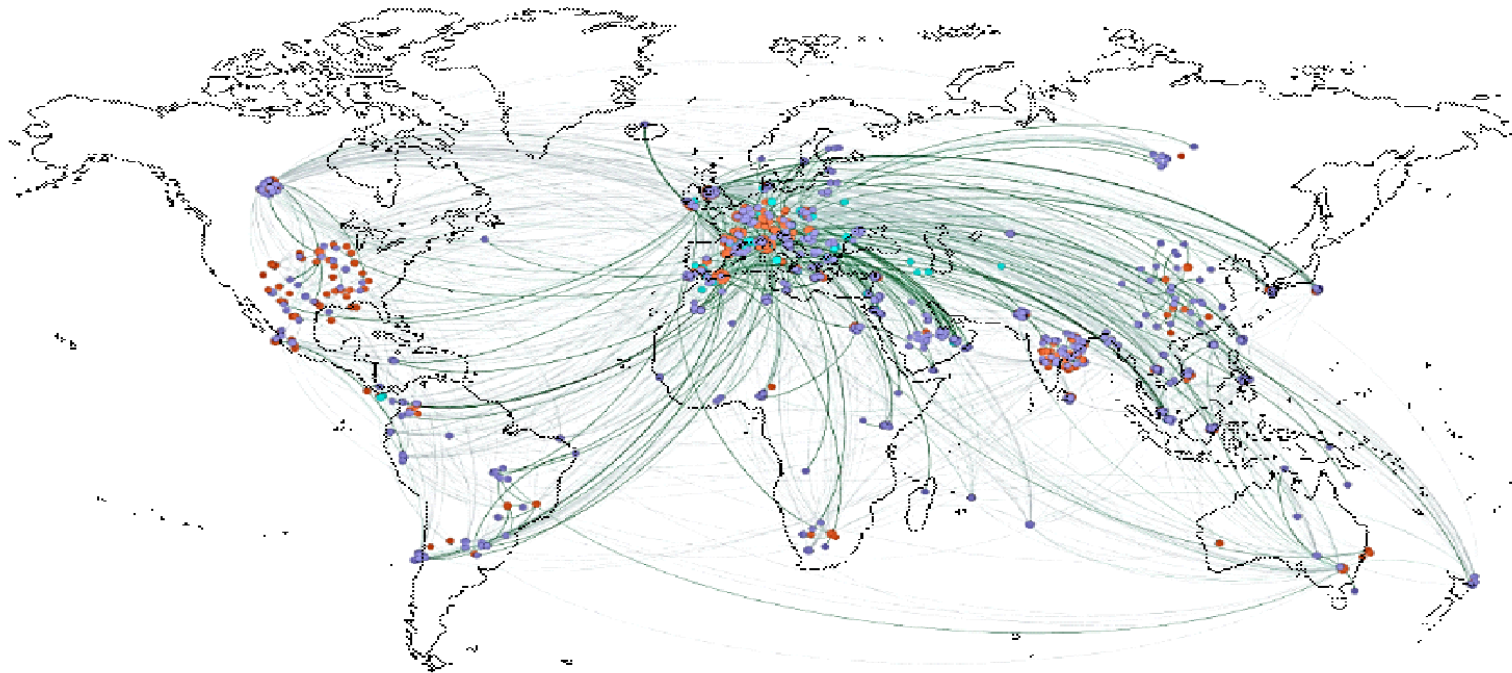
Sources: <https://worlduncertaintyindex.com/data/>; Ahir, Bloom & Furceri (2020, 2021)

Brexit	2Q16: Brexit vote	1Q17: Article 50 + Negotiations	1-4Q20: Brexit, with transition period	2021-2028: post-Brexit adjustments and phase-ins
China-US trade war	3-4Q18: 10-25% tariffs		2-3Q19: Further tariffs	2020: Exemptions and bans
COVID-19	2Q20: US 1st wave		1Q21: US 2nd wave	3Q21: US 3rd wave
War in Ukraine	1Q22: Russia invades Ukraine			

Risk interdependencies: Medicines

UK Pharma SC (2018 study)

One company: 836 global locations: Manufacturing & Distribution network
Involves 2,744 point-to-point network connections



For more details: Geyman, C., Settanni, E., Srai, J. S. (2020). Understanding risk in pharmaceutical supply chains. (White Paper). DOI: 10.17863/CAM.52597; Settanni, E., Kumar, M., & Srai, J. S. (2018). Identifying risk interdependencies in pharmaceutical supply chains through gamification-enabled structural modelling. In 49th Annual Meeting of the Decision Sciences Institute. 17-19 November, Chicago (IL), USA (pp731-745).

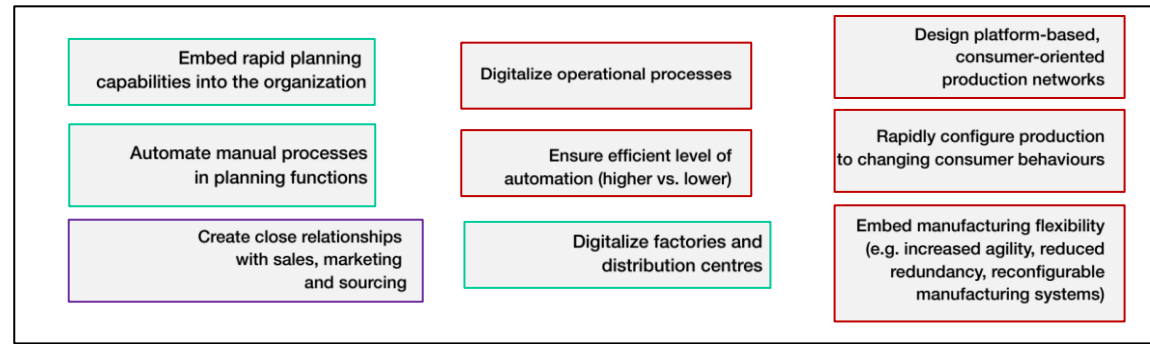
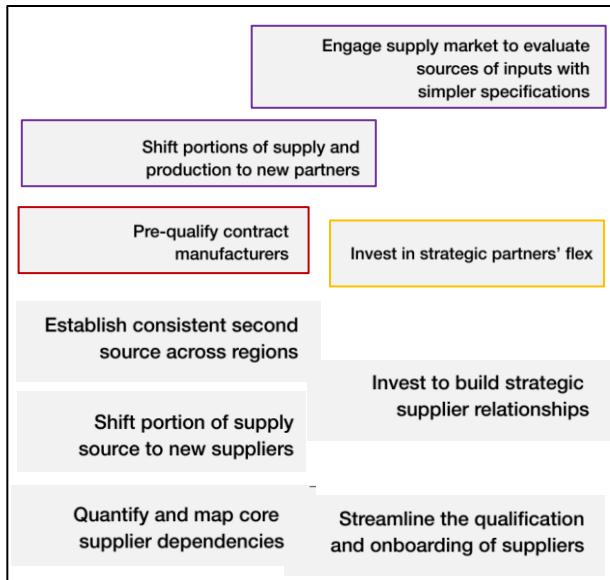
Leadership responses to disruptions

Intra-firm factory/operations

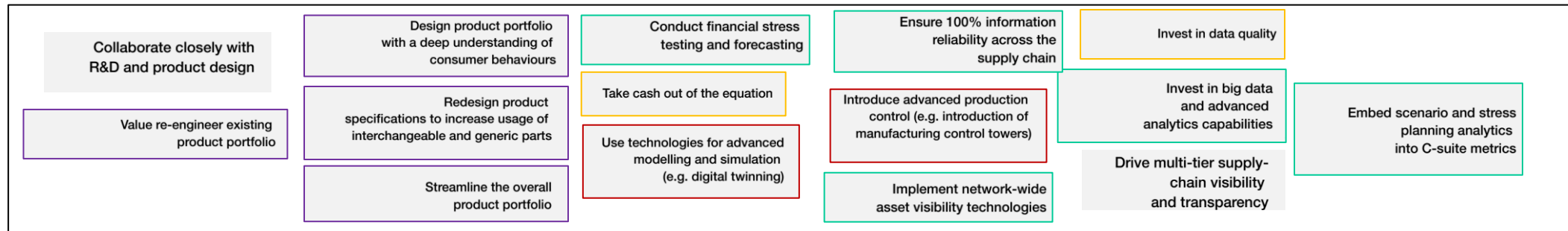
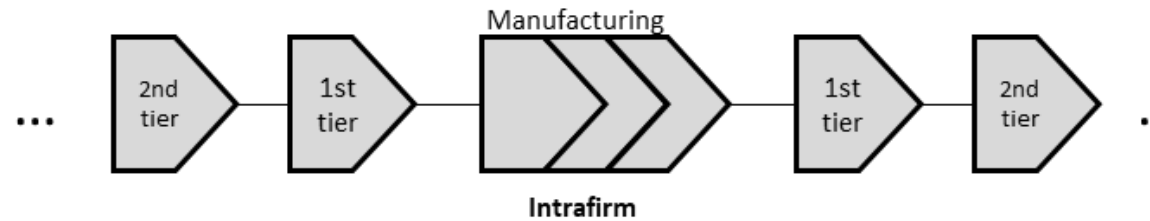
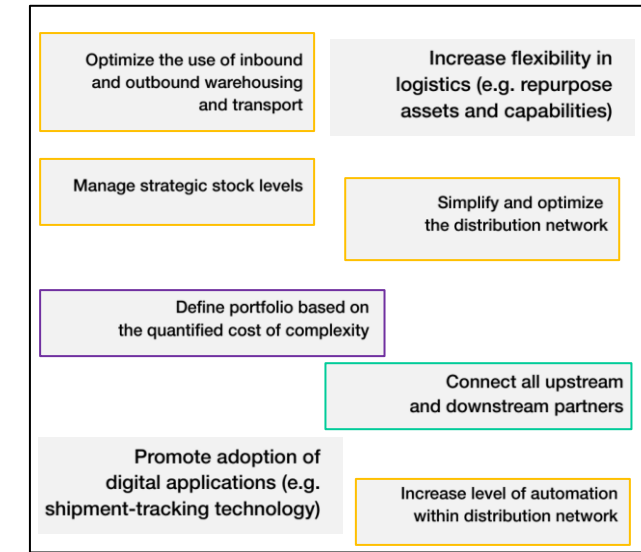
WEF Charting the Course for Global Value Chain Resilience 2022.pdf (weforum.org)



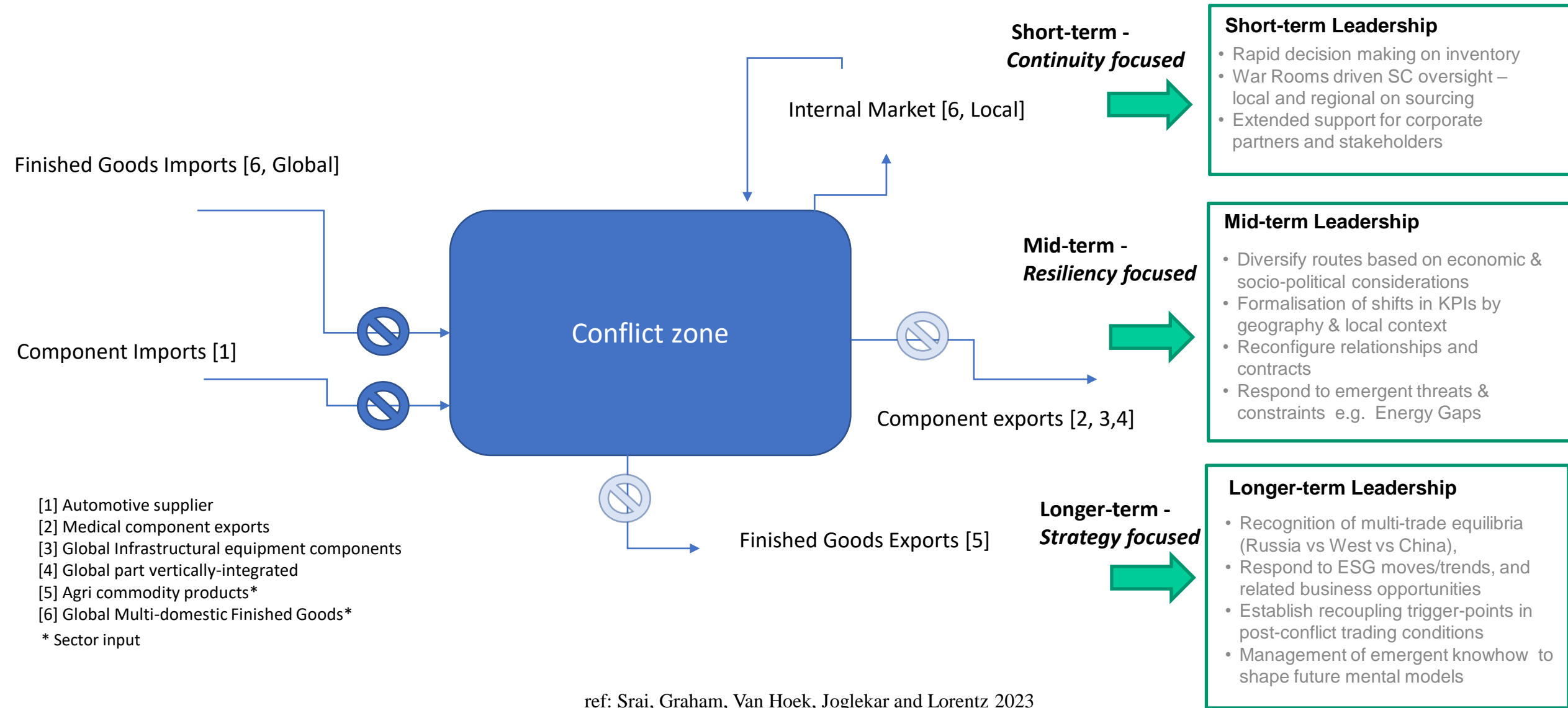
Inbound supply



Outbound delivery

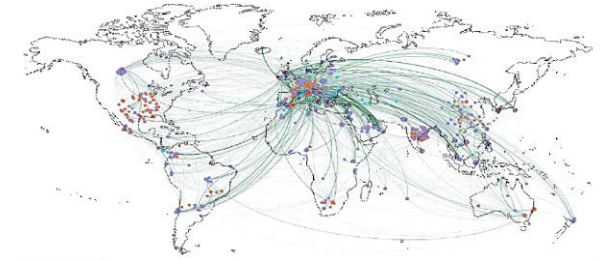
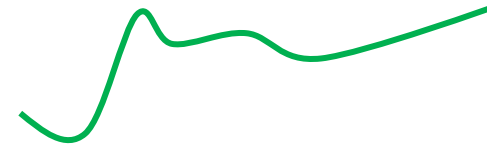


“Unhooking” from conflict zones – lessons from Ukraine-Russia



Disruption mitigation strategies driving supply chain transformation

- Demand Management through data!
- Manufacturing footprint and factory location decision
- Production process – modularity, scale-up/scale-out
- Sourcing strategies – paradox re supplier complexity
- Constraints and debottlenecking – capacity utilisation (incl. labour)
- Inventory optimisation, stockpiles and rapid replenishment models
- Industrial Policy matters – intended/unintended consequences....



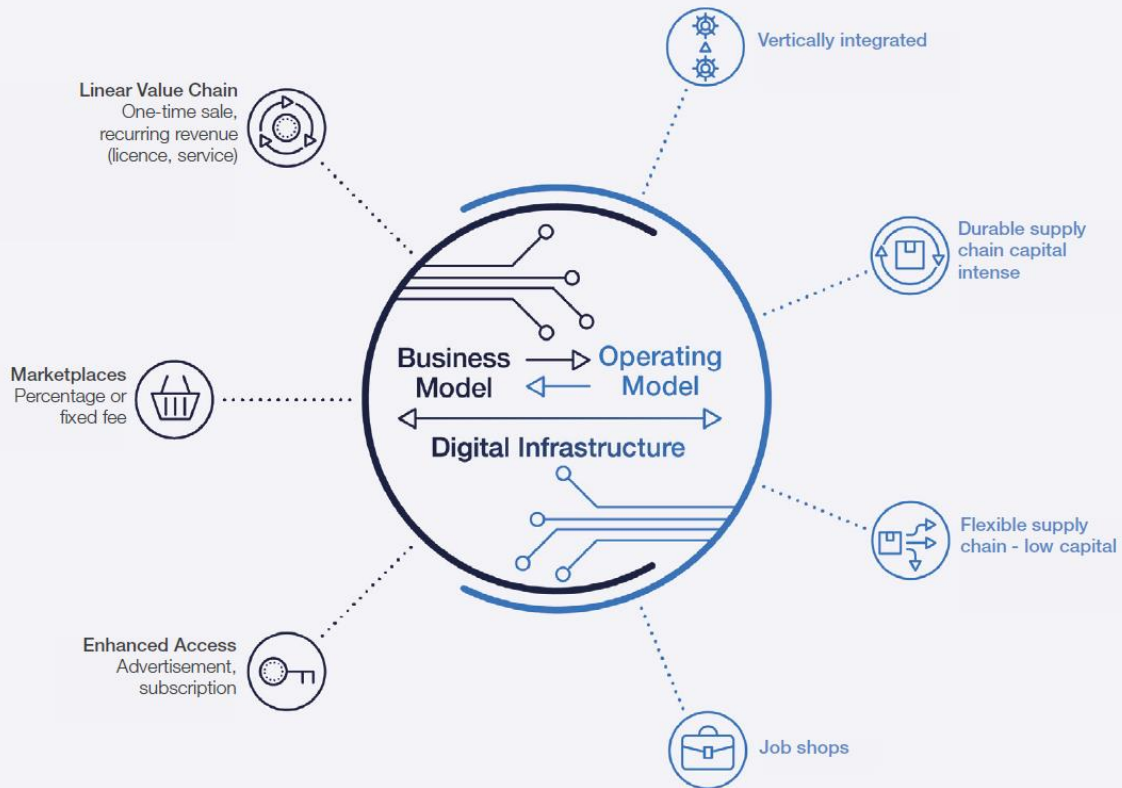
2. Business Model Innovation

through advanced manufacturing and digital technologies



<https://www.weforum.org/whitepapers/unlocking-business-model-innovation-through-advanced-manufacturing>
#DavosAgenda #Industry4.0

Time to think beyond manufacturing operations



1

New customer needs and a constantly changing demand environment:

The pandemic has deeply changed how consumers select, buy and interact with products, and how they expect to be engaged by the companies producing them. Customers are now looking for frictionless purchases, transparency of product information, and personalized products, which require new levels of agility and flexibility across manufacturing and supply chains for companies to meet new needs.



2

Climate change and the imperative of a net-zero-emissions world:

Current planetary challenges have elevated the importance of manufacturing companies cutting CO2 emissions and creating circular business models where supply chains can recover or recycle the resources used to create their products.



3

Digital transformation is here to stay, and disruption will further accelerate:

To remain competitive in markets increasingly threatened by digital players and new entrants, manufacturing companies must go beyond digitalizing their operations and leveraging their investments in advanced manufacturing to transform and innovate their operating and business models.

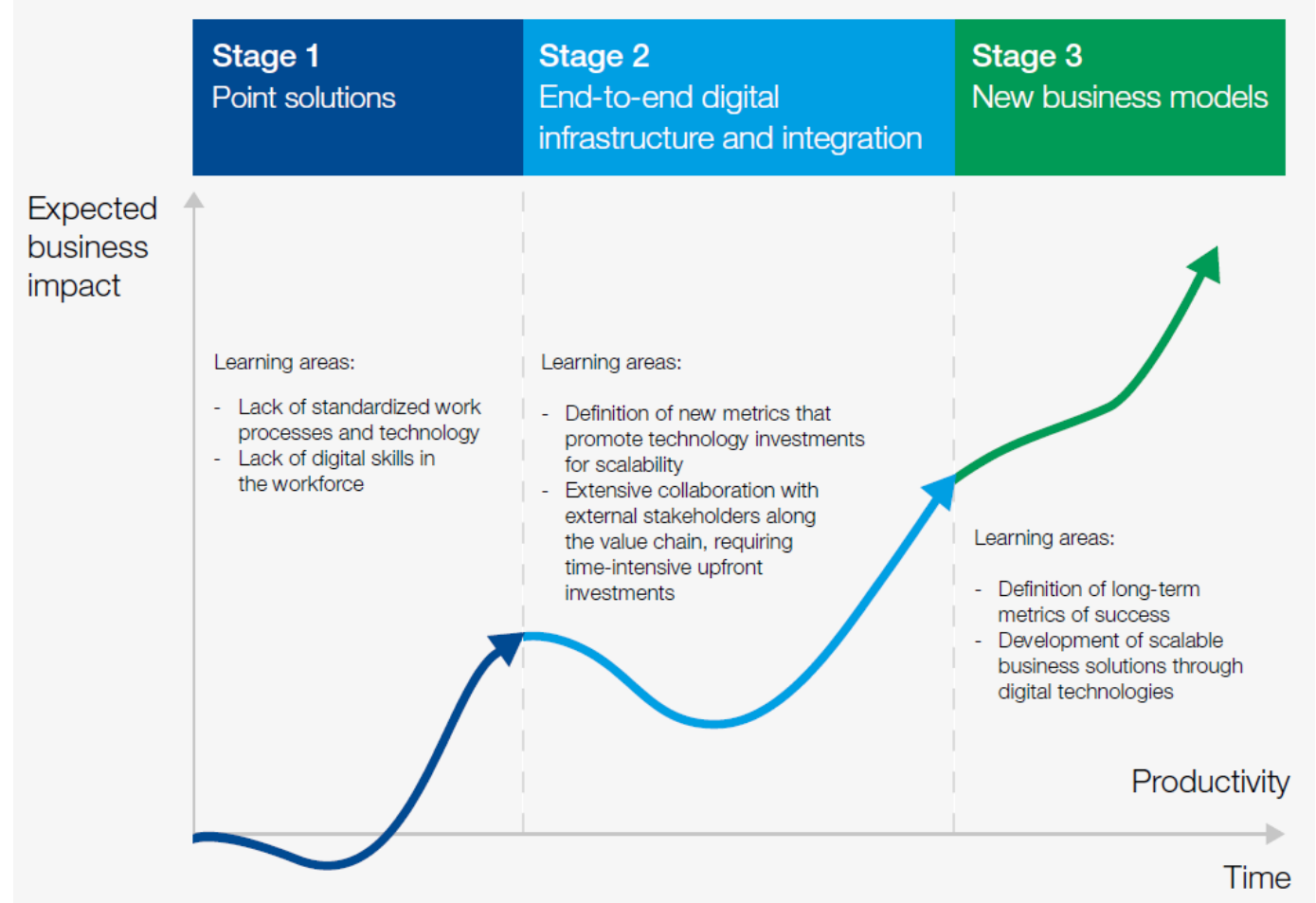


Three main trends are pushing companies to go beyond the transformation of manufacturing operations and to leverage investments in technology to reinvent their business models and drive #ResponsibleGrowth.

Three stages of Digital Transformation



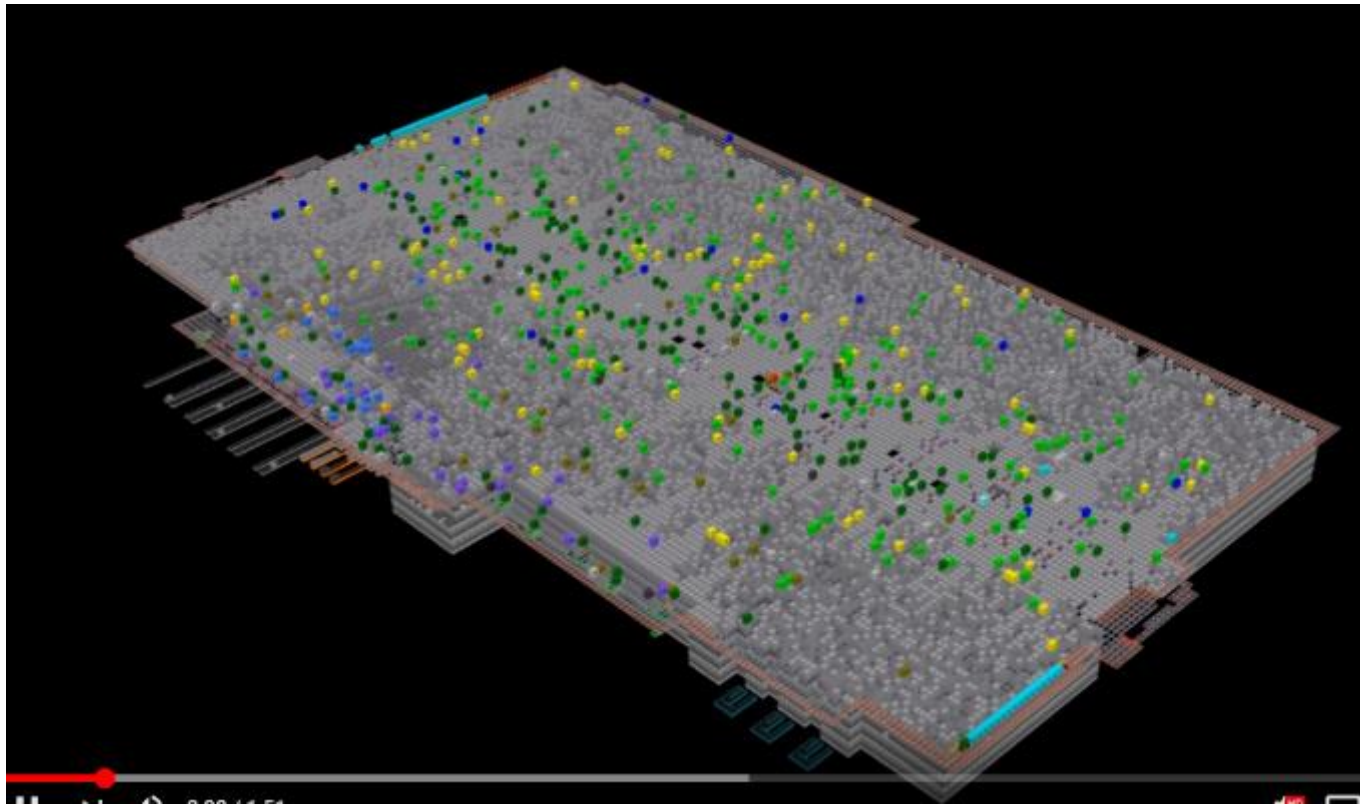
<https://www.weforum.org/whitepapers/unlocking-business-model-innovation-through-advanced-manufacturing>
#DavosAgenda #Industry4.0



Three stages are key to drive #BusinessModelInnovation through #AdvancedManufacturing – each with their own challenges and opportunities. The good news is that the learning curves can be accelerated by leveraging the key strategies learned from leading companies and summarized in this White Paper

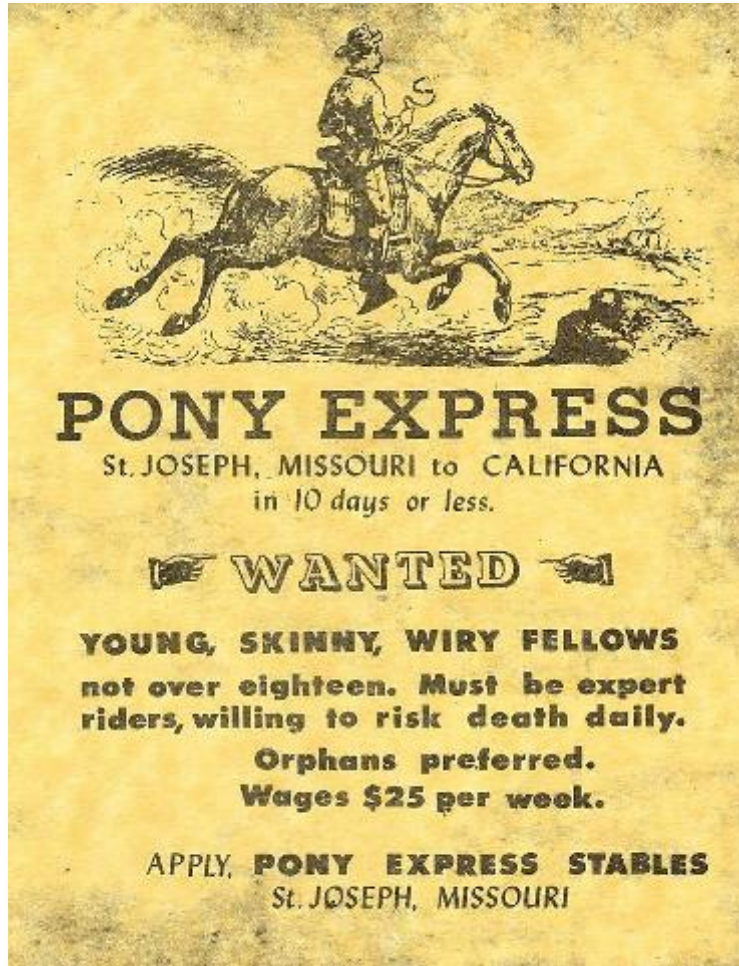
E-Commerce: consumer benefits of convenience and speed

- 2 hour delivery from order placement as is being offered by the pioneers of e-commerce such as Amazon Fresh grocery, Deliveroo and Ocado
 - <https://www.youtube.com/watch?v=iogFXDWqDak> 3000 units 4m/s; 5mm clearance



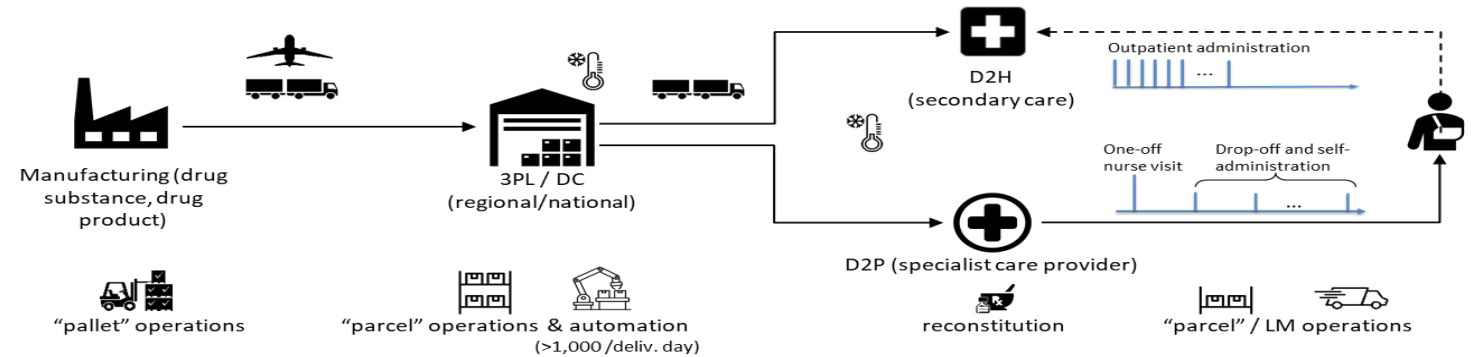
Last Mile Configurations

c.a. 1860 Last Mile Configuration



Source: commons.wikimedia.org/wiki/File:Pony_ExpressAdvert.jpg

21C e-Commerce Last Mile Configurations



Digitalisation of Service Supply – leveraging data

- Airbnb model – new developments
 - Building trust – for *hosts* and *guests*
 - Using economics/data to assess quality – return visits propensity
 - Market opportunity evaluated by needs of hosts as well as guests; disposal incomes and local rent
- Uber model – an evolving digital platform of platforms?
 - Balancing supply and demand; 5m forecasts per minute! Optimised at city block level in real-time
 - Building a family of *digital platforms*; drive cross-platform synergies
 - e.g. Uber Eats ‘turning riders into eaters’ and ‘eaters into riders’



Digital Transformation - Measuring the right things

- The 3 stages / project types have very different dynamics
- Stakeholder profiles are different – internal and external; Progressed over different timeframes; Need to measure the right things – and not just ROI!
- Require different leadership modalities

Further information available at - (q1 2024)



Joglekar, Parker, and Srai

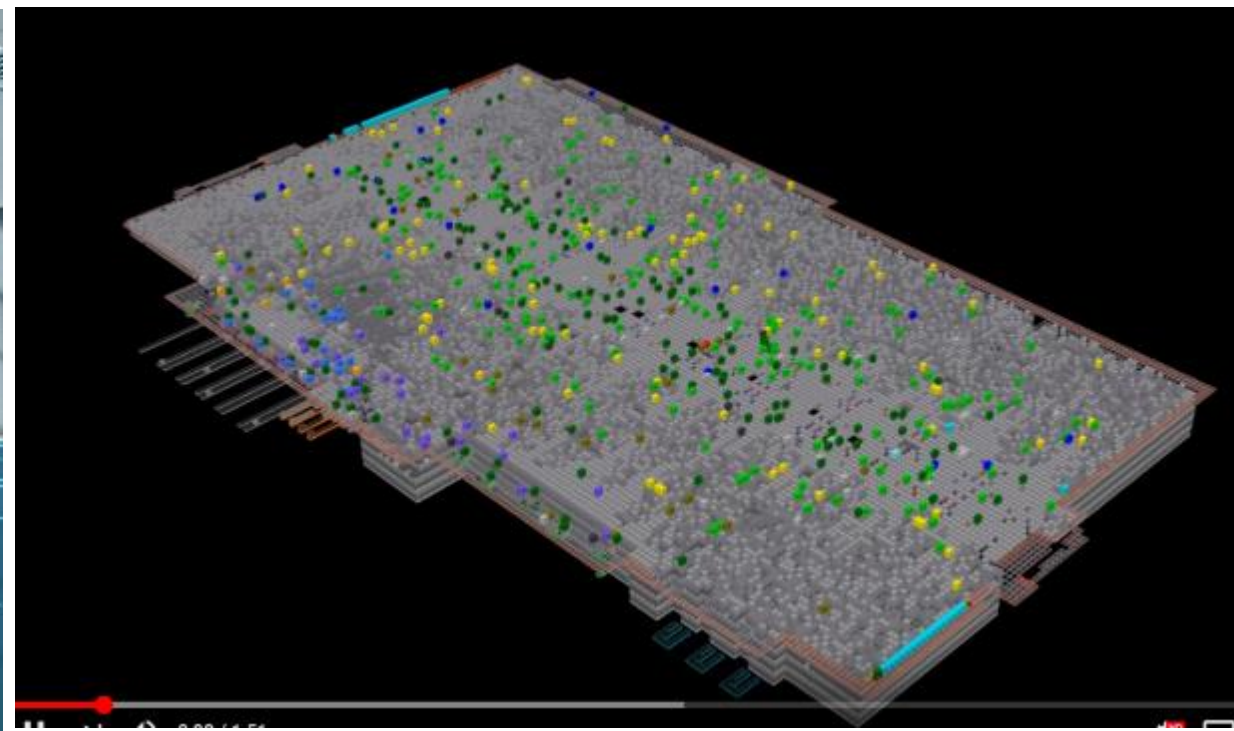
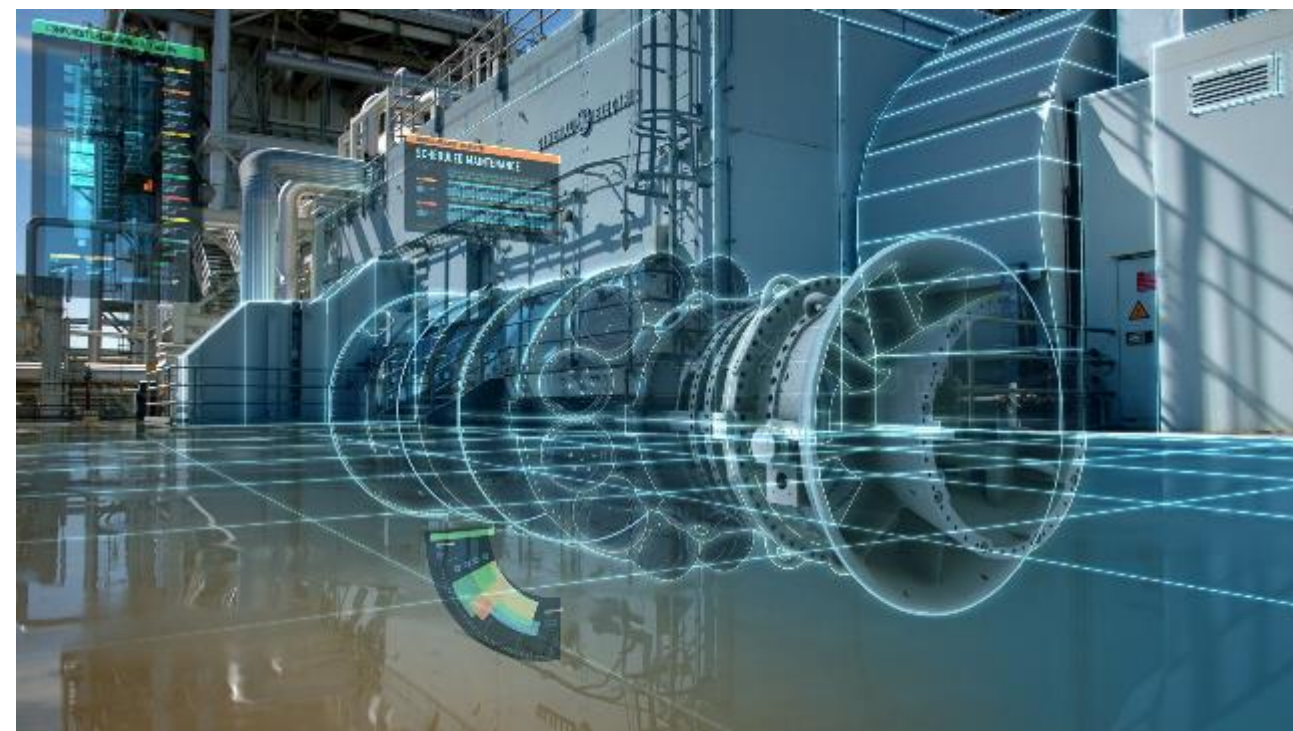
‘Why Manufacturers Need a Phased Approach to Digital Transformation‘(in print, 2024)

Nurturing 'digital attitudes'

- Understanding opportunities and challenges of digital adoption
 - Importance of experimentation and dangers of 'pilot' purgatory
 - Incremental (exploitation) vs. Transformative (exploration); most firms in catch-up mode only?
 - Dealing with ambiguity and uncertainty
- Leadership
 - What does this mean for leaders charged with driving digital transformation?
 - Reverse mentoring?
 - Different metrics depending on project type?

People with digital skills/attitudes –

‘digital twins’ exemplify the new mental models required in manufacturing supply chains



Top: Digital twins are virtual models of factories and other assets, like gas turbines, that provide GE's businesses with data insights they can use to improve performance.

Images credit: GE, GE Reports

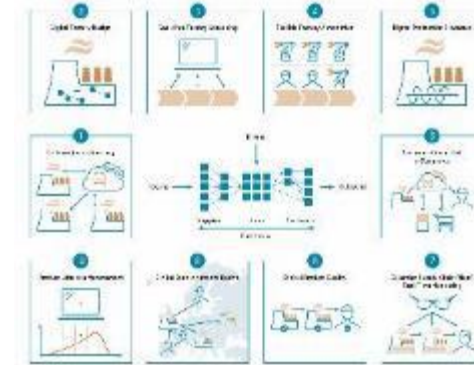
Top: Ocado warehousing and distribution in an e-Commerce environment

Images credit: Ocado

<https://www.youtube.com/watch?v=iogFXDWqDak>

Insights on digitalisation of manufacturing supply chains

- **Sector opportunities can be very different** – upstream, intra-factory, downstream supply chain; value-add combinations need teasing out *and project execution not easy*
- **Digital innovations can be transformative** – novel products and services, new industry players, alternative business models *but also ‘traps’ if investments misaligned*
- **Technology is a crucial enabler** – product, production process, infrastructure and change often not incremental, requiring inter-firm collaborations
- **Societal impacts** – jobs, consumer behaviour, governance regimes *(not all positive!)*
- **Skills gaps outstrip Technology gaps** contributing to significant adoption challenges; Need to *nurture ‘digital attitudes’ within individuals and organisations*



From ‘experimentation’ and ‘pilot purgatory’ to new collaborative operating and business models

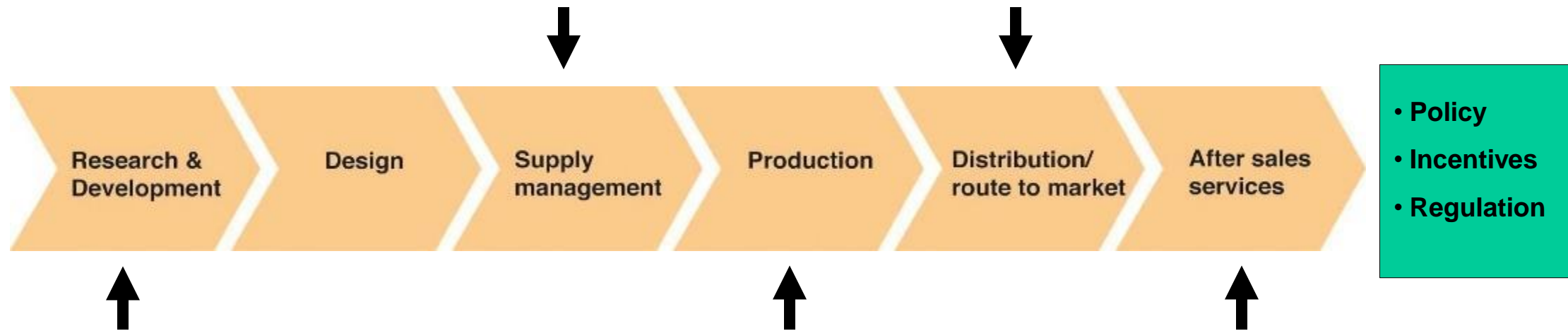
3. Sustainable Manufacturing Supply Chains



Possible Engineering solutions

- Use of renewables
- Reducing lead-time, optimising inventory management
- Feasibility of local 'Just in Sequence' supply

- Distribution channels that minimise storage and transport
- Exploiting regional logistics and infrastructure, e.g. road, rail, sea, air
- Improving last mile logistics, including reverse logistics



- Eliminating use of hazardous /toxic and non-functional materials
- Shorter Innovation cycles; managing product transition
- Design for Manufacture to support efficient production and use

- Optimum Energy source and location
- Energy consumption - alternative production processes
- Eliminate use of pollutants, waste, emissions
- Integration of Product-Process Technologies

- Through-life product-service solutions
- Eliminate landfill
- Managing end-of-life

Circular Transformation of Industries

Developed in collaboration with WEF, Bain, University of Cambridge

AMBITION

Transform our global systems to create growth in a world of limited resources

IMPACT

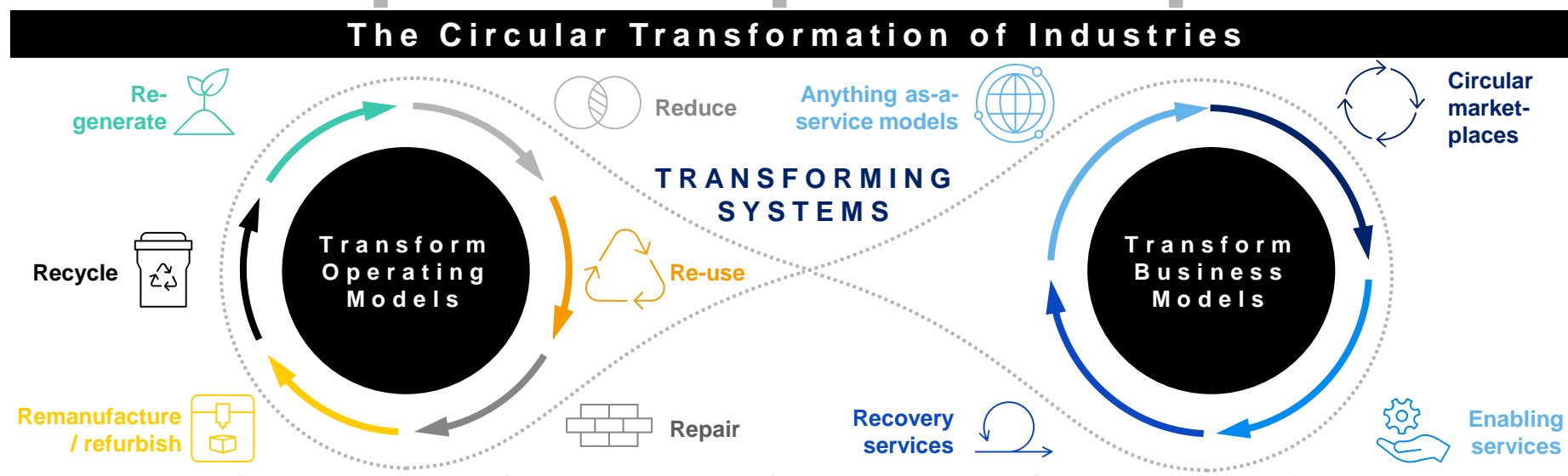
Next Generation Resiliency
Build flexibility along the supply chain and be reactive to external shocks by circulating materials

Revenue Growth
Generate new models of revenue through circular business models

Resource Efficiency
Optimize costs by increasing recovery, recycling and reuse of materials

Environmental Sustainability
Enable net-zero emissions goals by reducing wasteful consumption and production

VISION



ENABLERS

System-wide partnerships
At scale coalitions within and beyond current value chains

Infrastructure & Technology
Innovative and state-of-the-art tools to build circular solutions upon

Data sharing
Robust schemes and incentives to enable data-flows along the value chains

Financing
Attractive opportunities for investors and public institutions to finance the transformation

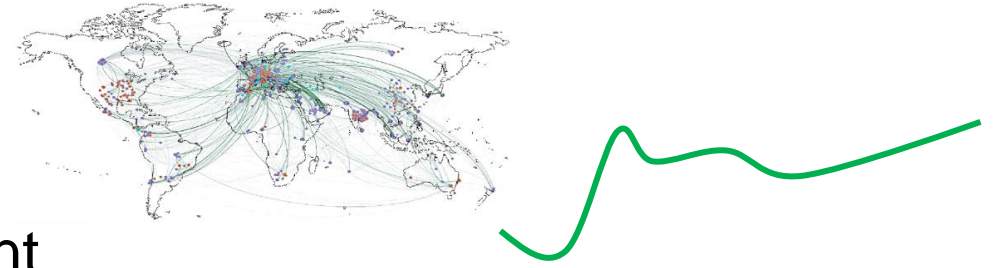
Regulation & Policy
Broad and interconnected policies, that are aligned among industries & regions

People & Culture
Upgraded skillsets and capabilities aligned with circular mindsets

See: https://www3.weforum.org/docs/WEF_Circular_Transformation_of_Industries_2022.pdf

Summary takeaways

- Supply network design and demand management
- External & geopolitical factors e.g. Policy*, Infrastructure**, conflict ***
- Business and operating model innovation through digital technologies
- Skills, labour flexibility and supply (pay & conditions, demographics)
- New drivers for Supply Chain Transformation; Supply Security, Digital and Sustainability



* Srail, J. S., Joglekar, N., Tsolakis, N., & Kapur, S. (2021). Interplay between competing and coexisting policy regimens within supply chain configurations. *Production and Operations Management*, 31, 457–477.

** Joglekar, N., Anderson, E. G., Lee, K., Parker, G., Settanni, E., & Srail, J. S. (2022). Configuration of digital and physical infrastructure platforms: Private and public perspectives. *Production and Operations Management*, 1–14.
<https://doi.org/10.1111/poms.13865>

*** Srail, J.S, Graham, G., Van Hoek, R., Joglekar, N., Lorentz, H. (2023). Impact Pathways: Unhooking Supply Chains from Conflict Zones – Reconfiguration and Fragmentation Lessons from Ukraine-Russia.

White papers



https://www.ifm.eng.cam.ac.uk/uploads/Resources/Reports/21.9.2017_IFM_GTR_DIGITAL_SUPPLY_CHAINS_AA_FINAL_WEB.pdf



<https://www.weforum.org/whitepapers/supply-chain-collaboration-through-advanced-manufacturing-technologies>



https://www.ifm.eng.cam.ac.uk/uploads/Resources/Reports/Remedies_risk_March20.pdf



http://www3.weforum.org/docs/WEF_Winning_The_Race_For_Survival_2020.pdf



<https://www.weforum.org/whitepapers/global-lighthouse-network-reimagining-operations-for-growth>



<https://www.weforum.org/whitepapers/charting-the-course-for-global-value-chain-resilience-2022.pdf>



<https://www.weforum.org/whitepapers/unlocking-business-model-innovation-through-advanced-manufacturing-2022.pdf>

Q&A



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<https://www.ifm.eng.cam.ac.uk/research/cim/>

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